ESL AUDIO COMPREHENSION AID

ONE LAPTOP PER CHILD INITIATIVE

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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

English is a global language essential for international business, science, and diplomacy (Pariona, 2017). However, many children, especially in rural or remote areas, lack access to adequate English language resources. These regions often face challenges such as insufficient funding for education and a shortage of qualified teachers, making it difficult for students to develop their English skills. This disparity aligns with goal four of the United Nations Sustainable Development Goals (SDGs), which emphasizes the need for inclusive, equitable, and quality education for all (United Nations, n.d.). Improving access to English as a Second Language (ESL) resources is vital to achieving this goal.

To address this issue, I propose the development of an offline, interactive language-learning tool designed to enhance vocabulary and comprehension skills for ESL children. The tool will feature a custom keyboard, an LCD screen, and an external speaker powered by a USB flash drive, enabling students to learn English without requiring internet access. Success in this project will require careful consideration of both technical and social factors to ensure the tool meets the needs of under-resourced communities. Drawing from the STS framework of actor-network theory (ANT), I will analyze the failure of the One Laptop per Child (OLPC) initiative, which aimed to provide affordable laptops to children in underserved areas. The project's failure stemmed from issues such as design flaws, techno-utopian expectations, and a lack of alignment with local educational needs. This case study illustrates the importance of addressing both technical and socio technical factors in educational initiatives.

Overlooking the interactions between diverse factors in a project and treating the proposed aid as independent of its sociotechnical context can result in a tool that fails to address

other key elements essential for its success. Should this result take place, the tool's ability to effectively promote inclusive and equitable education would be severely compromised, inevitably leading to the project's failure. Because the challenge of providing inclusive and equitable education is sociotechnical in nature, it requires attending to both its technical and social aspects to accomplish successfully. In what follows, I set out two related research proposals: a technical project proposal for developing an offline, interactive language learning tool for ESL children and an STS project proposal for examining the technical, social, and conceptual factors in the OLPC initiative.

Technical Project Proposal

A major technical challenge in developing effective language-learning tools for children is designing an interface that is intuitive and engaging while minimizing cognitive overload. Achieving this balance requires careful application of user interface and user experience design principles. Features such as speech recognition and touchscreen inputs complicate development, as these systems must process input in real time with high accuracy, even in noisy environments or when handling non-native accents. Additionally, the learning experience must be tailored to different proficiency levels, which requires sophisticated algorithms capable of dynamically adjusting task difficulty, learning pace, and content based on user performance. Lastly, speech recognition must not only transcribe language, but also evaluate pronunciation, grammar, and fluency in real-time.

To address these challenges, a number of language-learning tools were developed. Examples of these systems include Duolingo, Rosetta Stone, and Babbel. Duolingo uses a gamified approach, offering free lessons with interactive exercises and rewards (Blanco, n.d.).

Rosetta Stone employs its Dynamic Immersion method, providing exposure to language through audio, written words, and real-world images ("How rosetta stone works," n.d.). Babbel allows learners to study at their own pace and reinforces vocabulary and grammar using a spaced repetition system ("How language learning with babbel works," n.d.). These language-learning tools play a vital role in addressing technical challenges related to cognitive overload, user engagement, and adaptability to different proficiency levels.

Nevertheless, a crucial problem exists. These language learning tools require an internet connection. This can be a significant barrier for children in rural or underprivileged areas where reliable internet access is either unavailable or too expensive. As a result, these learners are excluded from taking advantage of the mentioned features of digital language tools that could otherwise help them develop language proficiency. Moreover, the reliance on technology often assumes that families have access to devices such as smartphones, tablets, or computers, which might not be the case for low-income households. This digital divide further exacerbates educational inequality, leaving some children without the necessary tools to keep up with their peers in learning another language.

The objective of the technical project is to resolve this flaw by designing an offline, interactive language learning tool that enhances English vocabulary and comprehension skills for non-native English-speaking primary school children without internet access. Since listening is an effective way for children to learn languages, the tool will be equipped with a speaker that pronounces phrases in the user's native language and translates them into English (Jiang et al., 2024). A liquid crystal display (LCD) screen will show translated phrases, and a custom-made keyboard will allow children to type the English words after listening to the translation.

Designing this offline solution can bridge the digital divide, enhance language proficiency, and reduce educational inequality among underprivileged children.

This project will have three main deliverables. The first deliverable will be the custom designed keyboard. The keyboard will be created using a key-switch matrix printed circuit board (PCB) designed in KiCad software. It will include all 26 letters of the English alphabet, along with start, end, help, delete, and enter keys tailored specifically for the application. The second deliverable will be the audio system. The external speaker will connect to an STM32F407G microcontroller using the onboard auxiliary port. A USB flash drive connected to the microcontroller's On-The-Go port will store the selection of native languages and words for the user to choose from. The final deliverable will be the LCD screen. The LCD screen will be connected to the STM32F407G microcontroller via general purpose input output pins to display user input and output. All embedded code will be written using the C programming language in the STM32Cube IDE. Unit testing will be conducted on each deliverable to ensure functionality before assembling the overall system.

In order to develop the initial design, an observation from IEEE scholarly articles pertaining to Texas Instruments' Speak and Spell will be analyzed. Technical performance metrics such as how fast the speaker delivers feedback and the LCD screen displays input will be taken into account during the design process to ensure uninterrupted learning experiences. Finally, the viability of the tool will be tested on students at an elementary school who are in the process of learning the English language.

STS Project Proposal

In 2005, Nicholas Negroponte, founder of MIT Media Lab, introduced the One Laptop per Child (OLPC) initiative, a bold vision to transform education in the developing world. The program aimed to provide durable, low-cost XO laptops to children between the ages of six and twelve in underserved regions. These laptops were designed to be nearly indestructible and would serve as powerful educational tools. Children using these devices would teach themselves languages, mathematics, and coding, ultimately sharing their newfound knowledge with their families and communities (Reese, 2019). The initiative sought to bridge the global digital divide and foster self-guided learning on an unprecedented scale. However, despite its promising start, the project failed to meet its goals, and eventually, funding dried up (Reese, 2019).

Recent discussions about the OLPC initiative point to a range of factors contributing to the project's downfall. Many of the laptops broke down, and in areas with limited access to electricity, keeping them charged proved difficult. Additionally, the cost of maintaining the program, including the necessary training for teachers, turned out to be far higher than anticipated (Reese, 2019). Despite the project's intentions, many children showed little interest in using the machines, and the expected improvements in their skill levels did not materialize. Another issue was the lack of customization of the laptops to align with local traditions and customs, making them less suitable for the communities they were introduced to. The devices' failure to adapt to their new cultural contexts limited their relevance and usability, further hindering the program's success (Shah, n.d.).

Although these issues factored into the failure of the OLPC, it does not fully explain why the initiative failed. When a project fails, the responsibility does not just rest on the individual

components, but also on how those components interact with each other. Recent discussions ignore the reality that the factors contributing to OLPC's failure are interconnected. Instead, they are treated as separate issues, rather than as parts of a larger, unified problem that ultimately led to the collapse of the initiative. Consequently, these explanations for the OLPC's failure overlook the intricate interplay between various stakeholders, including the children and teachers, local governments and educational institutions, technology developers, and the devices themselves. These interconnected factors ultimately caused the initiative's downfall. If current views of the OLPC continue to be seen this way, efforts to design more effective educational technology programs for underserved communities may be hindered. For this reason, I argue that the techno-utopian vision, the lack of attention to local educational needs, the design of the laptop itself, and the over-reliance on technology without sufficient human support, taken together, led to the failure of the OLPC. More specifically, I argue that the interaction between these factors accelerated the project's failure, as inadequate infrastructure and poor program sustainability amplified the laptops' shortcomings and exacerbated the initiative's excessive dependence on technology.

I will base my analysis of the OLPC initiative on the science, technology, and society (STS) framework known as actor-network theory (ANT). Actor network theory (ANT), developed by STS scholars such as Michel Callon, Bruno Latour, and John Law, posits that technical projects can be understood as networks of both human and non-human actors brought together by a network builder to achieve a specific goal. A central idea in ANT is that the strength and success of the network depend on the interactions and relationships among these actors (Cressman, 2009). Furthermore, I will apply Michel Callon's concept of translation, which

outlines the process of forming a network, to identify the points at which the OLPC initiative faltered in its implementation, clarifying why certain actors were not effectively integrated (Callon, 1986). The evidence I will use to support my argument will mainly come from the MIT Press, specifically *The Charisma Machine: The Life, Death, and Legacy of One Laptop per Child* by Morgan G. Ames, to examine the critical factors that contributed to the initiative's failure, as well as various academic articles, case studies, and reports (Ames, 2019).

Conclusion

The technical and STS projects provide a comprehensive approach to addressing the challenge of equitable access to English language education for underserved children. The technical project will develop a functional prototype: an offline, interactive language learning tool for ESL children without internet access. Featuring a custom keyboard, LCD screen, and speaker powered by the STM32F407G microcontroller, this tool enhances vocabulary and comprehension skills, offering a cost-effective solution for remote, resource-limited environments. The STS project analyzes the failure of the One Laptop per Child (OLPC) initiative to uncover key lessons about the interaction of social, technical, and conceptual factors. Using actor-network theory (ANT) and the concept of translation, the analysis reveals how techno-utopian visions, neglect of local educational needs, and flawed design led to OLPC's failure. Applying these insights will help ensure the success of the offline language-learning tool by addressing both technical challenges and the sociotechnical challenges.

Word Count: 1849

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