THE DESIGN AND ANALYSIS OF THE EDUCATIONAL MULTIPLAYER OUTLET (EMO)

INFLUENCE OF GAME-BASED-LEARNING AND EDUCATIONAL SOCIAL DYNAMICS

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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

Gamification is the application of game-like elements to non-game environments (Kuntas et al. 2019, 1) and game-based learning (GBL) refers to the usage of games to facilitate learning and educational processes (Grand View Research, n.d.). Gamification in the classroom has increased in recent years and is projected to grow significantly in the next decade. In 2023, the global GBL market was valued at $18.4 billion dollars (Grand View Research, n.d.), compared to $8.7 billion in 2017 (Knowledge Based Value Research, n.d.). IMARC group experts expect the market to reach $71.7 billion dollars by 2032, with growth accelerated by COVID-19 (Grand View Research, n.d.). Due to the pandemic and guidance from UNESCO, 1.6 billion students were affected by school closures and the transition to a distance learning environment (Salta et al., 2021, 94). During the change to online classrooms, teachers used technology to mitigate learning loss. According to the United States Government Accountability Office (2022), "Teachers used many strategies to mitigate learning loss. They reported that two strategies in particular helped at least half their students make academic progress: live instruction and technology apps or platforms."

Given the rapid growth of GBL, our technical team will develop an educational gaming console to support reading comprehension skills for third-grade Virginia students. The gaming system, called the Educational Multiplayer Outlet (EMO), will feature a two-player game centered on a storyline that teaches plot diagrams. EMO will be a console intended to be used in classrooms and will not be handheld. It is not only important to consider the technical aspects but also the social, economic, and varying factors that contribute to the technology's impact. To do so I will draw on the STS framework of Actor Network Theory (ANT) to investigate how

changes in technical and parental values influenced the game-based learning market. Which ultimately contributed to the failure of the LeapPad developed by LeapFrog Enterprises Inc.

Ignoring the social and technical factors faced by actors in the educational game network removes the technology's ability to meet societal needs. If the system fails at being either an effective educational console or game, the system will be rendered useless and a failure. Thus, because the challenges of creating both an educational console and game 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 a new educational gaming system and an STS project proposal for examining the relationship between technical factors and parental values that led to the collapse of the LeapPad.

Technical Project Proposal

Currently within the education sector of the global game-based learning market, 74% of teachers use game-based learning within their lessons (Bouchrika, 2024). Educational games and consoles are user-centered designs that focus on the engagement of the student and their experience. Additionally, for the system to be an effective learning tool it must also address the needs of other stakeholder groups: parents, teachers, and school district administrators. Thus, gaming consoles have a functional need to be multipurpose. Gaming consoles need to: provide teachers creative freedom for lessons, games that keep students engaged, and game variety; however, educational gaming systems fail to meet this cross sectional need.

One study that highlights the limitations of educational games and its cognitive engagement was the investigation of "Skills Arena". An arithmetic based game titled "Skills Arena" by GameBoy, was developed to investigate the effects of game technology on elementary students (Shin et al., 2012, pp. 543, 544). Students could create their own characters and identities and choose among three difficulty options on their handheld GameBoy Color (Shin et al., 2012, 543). Students had learned basic arithmetic, but researchers could not gauge the cognitive engagement nor could teachers increase the difficulties besides the default options (Shin et al., 2012, 558). Furthermore, students had reported that the game was boring due to the repetition of easy challenges (Shin et al., 2012, 557). Ultimately, researchers stated that more qualitative research was necessary to understand the engagement, motivation, interest, and learning outcomes and that such research is critical to provide guidelines for game design (Shin et al., 2012, pp. 557, 558).

Skills Arena helps acknowledge engineering design flaws and identify overlapping themes within these issues. However, currently there is no coherent gamification guideline to

enable student engagement (Bayo, 2024, 2). The proposed technical solution will identify the cross-sectional needs between stakeholders by surveying and interviewing local educators in the Charlottesville, Virginia area. The solution will have defined its learning objectives, have a structured experience, and a defined target audience as guided by Tida Bayo (Bayo, 2024, 35) . The games will focus on reading and writing comprehension and will be formatted using Virginia SOL questions to follow a standard metric teachers can use to measure student performance. Lastly, a version control system will be implemented to allow for updates and changes to the system to adjust for student engagement, teacher creativity, and game variety.

The project will be broken into software and hardware to divide work and allow for asynchronous development. Software will focus on version control, game design, game mechanics, and user experience. Version control will allow the software team to change or modify the stored code in a “repository”, the system will use the version control system GitHub. The code stored in the repository will be written in PICO-8 syntax; PICO-8 is a game engine designed for games, sprites, maps, and sound effects. PICO-8 is designed to compile and execute the files written in its language and display final games; therefore, the code written for the game engine can easily implement game design, mechanics, the user interface, and user experience. Hardware will focus on the console case, microcontroller, game controllers, and power system. The console will be made out of wood that is smoothed out with no sharp corners and will have a child-friendly design. A Raspberry Pi 4 Model B+ microcontroller will be used, the microcontroller will act as the processing power for the system providing: computational capabilities, physical storage space for the code, USB ports, and internet access for remote access and GitHub. The controllers will be Nintendo NES controllers given their low power

requirements, compatibility with the microcontroller, and affordability. Lastly, a wall plug in will be interfaced with a printed circuit board (PCB) to provide power to the overall system.

The success of the design will be measured by its demo at local elementary schools within Charlottesville, Virginia. Teachers and students will interact with the project and provide feedback whether the design meets their needs and gives a fun educational experience. Surveys will be used to measure engagement, motivation, learning, and game features. The overall system should satisfy 75% of the users we survey.

STS Project Proposal

LeapFrog Enterprises introduced its LeapPad in 1995, the device was a series of electronic books based on children's stories designed to help students read. When a student would touch an unfamiliar word with their finger or the provided stylus the device would sound it out (Raugust, 2004). As the market for electronic books grew LeapFrog Enterprises faced competition with Fisher-Price and Publications International. They had gained licenses for original titles and more recognizable characters at the time like Clifford or Toy Story 2. (Raugust, 2004). The LeapPad was struggling to keep up with the dynamic changes found in other electronic book competitors.

During the fiscal year of 2006, the company was at its worst with sales declining and a record profit loss of $145.1 million dollars (Feigner, 2007). Nearly a decade prior to 2006 the company led in electronic learning; but, due to change in leadership and a lack of creativity LeapFrog became vulnerable (Feigner, 2007). The company salvaged itself by making massive cuts to its inventory, releasing new competitive models of the LeapPad, and a transition to online marketing in 2007 (Feigner, 2007). Much of the failures in LeapPad point to a static competitive model that underperformed with its market counterparts. I argue that the failure of the technology lies more within its failure to consider the actors it interfaced within its network.

To focus on this analysis I will draw on the science, technology, and society (STS) concept of actor-network theory (ANT). This framework developed by STS scholars: Michel Callon, Bruno Latour, and John Law, claims that any technology can be viewed through the perspective of actors and networks. Actors can be either human or non human and when combined form the network of the technology (Callon, 1987, 87). ANT will be used to

demonstrate the human actors: parents, children, educators, LeapFrog. As well as the non-human actors: LeapPad and its market. The primary actors in this analysis are the network builders who combine both human and non-human actors (Cressman, 2009, 3). In our case, the network builders are LeapFrog Enterprise, parents, and educators. Furthermore, LeapFrog Enterprise also serves to be a 'punctualized' actor which defines the entire network of human and non-human actors within the network of the LeapPad (Cressman, 2009, 7). ANT proposes a heterogeneous network that works together to solve a problem or accomplish a goal utilizing translation which is a process that aligns actor values (Cressman, 2009, pp. 4, 5, 9).

Michel Callon highlights the importance of a heterogeneous network stating that although sociologists are unable to account for all changes it is their responsibility to meet the success of those developments in their network (Callon, 1987, 91). Therefore, LeapPad's failure to consider the dynamic needs of its stakeholders and users removed its ability to be a modern educational tool. With changes in competitive electronic book models, the LeapPad failed to adjust to the parental and literacy needs of its actors. The system had oversimplified its educational material and hindered its ability to adapt; LeapPad had delegated its roles of teaching literacy to the software but the software was unable to meet actor needs. Thus, for an educational system to be successful its components, software and hardware, must be dynamic like its network. LeapFrog Enterprises failed to build a heterogeneous network, integrate its actors, and translate the actor values to accomplish the goal of a successful gamified literacy tool.

Conclusion

In conclusion, the technical design follows well researched gamification guidelines to improve on motivation, engagement, and learning outcomes. EMO's hardware allows for easy remote access for software updates and improvements. EMO's design improves on creative freedom, student engagement, and focuses on being multipurpose to move with the dynamic needs of its actors: children, parents, educators, and schools. To ensure EMO will be sustainable within its network an STS project proposal was conducted to demonstrate the limitations and failures of the LeapPad. Examining the LeapPad provided insight on key factors for educational networks and the actors that must be considered. Both the technical and STS proposals provide a foundation for EMO to not only be functional but also be successful in supporting its users and network.

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