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

HOW MATTEL'S 2006 LEAD PAINT INCIDENT AFFECTED THE COMPANY

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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

In 2024, when you think of children's toys, what kind comes to mind? Is it an advanced technological device that is capable of 100+ games, or is it a simple toy car? Mattel, one of the largest toy companies in the United States, is known for creating some of the most iconic toys, such as Barbie dolls, Hot Wheels cars, and Uno card games. Mattel takes pride in its main goals as stated on its homepage, "Quality, Safety, Value (Mattel, 2024)." Given Mattel's goals, one could assume they would never allow any of their toys to pose a risk to children. However, in 2007 Mattel had a large recall of their popular toys: Thomas the Tank Engine, Elmo, and Dora the Explorer. The reason for the recall stemmed from the use of lead-based paint and small, potentially dangerous magnets (Teagarden, 2009).

More recently, students have faced challenges from the shift to online learning during the COVID-19 pandemic. Many missed out on essential social interactions–specifically 3rd graders who started their education with online school in 2020–that played a large role in personal growth and academic success. To address these challenges, my technical project proposes the development of an educational game console designed to increase social interaction and improve reading comprehension. Through collaborative, narrative-based gameplay, the console encourages students to work together and solve reading questions, helping them develop skills while making learning more engaging and enjoyable. Because the challenge of manufacturing toys at a cheaper and more efficient rate 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 educational game console and

a Science and Technology Studies (STS) project proposal for examining global supply chain dynamics, regulatory oversight, consumer trust, and corporate responsibility in the 2007 Mattel Lead Paint Incident.

Technical Project Proposal

The COVID-19 pandemic significantly disrupted traditional education, particularly for children who began their academic journey in online school. These students missed critical opportunities to develop social skills through in-person interactions with peers and teachers. For example, research by Yunus Gunidi (2022) compared the social adaptation of preschool children in face-to-face versus online learning settings. The study found that children in face-to-face environments showed greater improvements in social adaptation and a more significant reduction in social incompatibility over three months compared to those in online classes. This highlights the gap in social skill development caused by online learning. Technology has played a role in education for a while, from online learning platforms to educational games, which have gained popularity in recent years. However, while these tools often succeed in delivering content, they rarely address the collaborative and social aspects of learning. This creates a need for tools that not only engage students academically but also encourage interaction and teamwork.

Without addressing the lack of collaboration in current educational tools, children who began school online may continue to struggle with social adaptation. These students risk falling behind in critical areas like teamwork, communication, and problem-solving—skills essential for both academic success and future endeavors. If this issue is left unresolved, it could widen the gap between students who started school online during the pandemic and their peers who had more traditional, in-person experiences. This gap could affect both academic performance and social development, limiting these students' ability to thrive in collaborative settings.

To bridge this gap, I propose the Educational Multiplayer Outlet (EMO), a two-person game console designed to promote collaboration through an educational, story-based game. The

console targets 3rd graders, who are among the students most impacted by COVID-19, and provides an interactive way to improve both social and academic skills. EMO is built around three key components: hardware, software, and aesthetics & safety. The hardware focuses on the power system and the microcontroller-based system with two USB plug-in joy-con controllers. At the core of the system is the Raspberry Pi 4, our chosen microcontroller, which was selected for its powerful processing capabilities, sufficient storage, and internet connectivity for remote updates in Github. The power system includes a wall plug-in adapter connected to a printed circuit board (PCB), ensuring stable and safe power distribution. Together, these components create a desirable and efficient foundation tailored to meet the needs of students and their educators. The software will focus on the game, coded in Lua using the Pico-8 platform, which will feature an engaging, story-driven 8-bit adventure based on the Virginia Standards of Learning (SOL). The story is a creative spin-off of *The Three Little Pigs*, with questions aligned to reading comprehension standards to ensure educational value. For example, questions in the game will mirror those found in SOL reading passages, such as "At the beginning of the story, Pip and Pete run to Percy's house because they—A… B… C… D…." This ensures alignment with state education standards while keeping the experience fun and interactive. For aesthetics & safety, the game console will be made out of wood that is smoothed out with no sharp corners. With 3D-printed plastic arms and legs, the console will have a child-friendly design. Being a visually appealing design that prioritizes safety, the console will ensure it is suitable for use in a classroom setting.

EMO's system directly addresses the challenges faced by 3rd graders, the group of students that began school online in 2020. By combining academic content with opportunities for collaboration, EMO is tailored to meet the specific needs of this group. Using publicly available Virginia SOL questions ensures the game is both educationally relevant and aligned with state standards. EMO will provide an engaging, collaborative learning experience that fosters social interaction and teamwork while reinforcing academic skills. By addressing the unique challenges faced by students who began school online, EMO offers a solution that supports both their academic and social development.

STS Project Proposal

In 2007, Mattel faced a public relations and manufacturing crisis when it recalled approximately 967,000 toys due to excessive lead paint levels exceeding U.S. Food and Drug Administration (FDA) standards (Story, 2007). This was followed by two additional recalls, all tied to its Chinese manufacturing partners. The issue raised significant concerns about safety in offshore manufacturing, a practice Mattel relied on for over 15 years to reduce costs. As Teagarden (2009) stated, "offshore manufacturing is an important option for companies trying to contain cost… however, companies using this strategy must trust but verify." This balance between trust and verification was a critical failure point in Mattel's supply chain. While gaps in regulations and design flaws are often cited as the primary causes of the recalls, these explanations overlook the broader sociotechnical dynamics at play. Mattel's reliance on trust in long-term partners without sufficient testing, along with the pressures of reducing costs, created an environment where such failures could occur. The regulatory disconnect between the U.S. and China further exacerbated the issue, leaving safety responsibilities poorly defined (Merle & Mui, 2007).

The lack of rigorous testing after production, combined with the reliance on trust, significantly weakened Mattel's ability to ensure safety. This was by the public and the political scrutiny. U.S. policymakers suggested stopping Chinese imports altogether, and Mattel's apology to China caused backlash from politicians who argued that China, not Mattel, should have apologized (Merle & Mui, 2007). The controversy highlighted the complexities of global supply chains, where trust, cost reduction, and safety oversight often conflict.

The immediate effects on Mattel were severe. Within weeks, its stock price dropped from $25 to $21 and continued to fall, reaching as low as $16 by the end of 2007 (Yahoo Finance). Rebuilding trust required significant effort, as seen in Mattel CEO Robert Eckert's public apology and the company's interactive website launch to address consumer concerns (Curtin, 2010). While Mattel eventually regained its reputation, the incident serves as a warning of the long-term consequences of failing to balance trust with oversight in global manufacturing. I argue that the Mattel lead paint incident was not caused by a single factor but by the breakdown of its sociotechnical network. Specifically, the overreliance on trust in its partners without sufficient post-production testing was a key failure. Companies must adopt a more holistic approach, integrating rigorous verification processes into their supply chains to ensure safety and maintain consumer trust.

To analyze this incident, I use Actor-Network Theory (ANT), a framework developed by Michel Callon, Bruno Latour, and John Law. ANT views technology as a network of interconnected actors—both human and non-human. In this case, Mattel acts as the network builder, with actors such as manufacturing processes, regulations, testing protocols, shareholders, and Chinese manufacturing partners forming the network (Callon, 1987; Cressman, 2009). Mattel as an enterprise is a 'punctualized' actor which defines an entire network of human and non-human actors within the network of Mattel (Cressman, 2009). ANT introduces a heterogenous network where different elements collaborate to solve a problem or achieve a goal, using translation as a process to align the values of the various actors involved. Callon highlights an importance of heterogeneous networks where "although sociologists are unable to account for all changes, it is their responsibility to meet the success of those developments in their networks (Callon, 1987).

ANT reveals how these actors interact and where the network broke down, providing a holistic perspective on the incident. Mattel's apology to both consumers and the Chinese government highlights the consequences of these network failures. The company admitted responsibility for the recalls, with executives stating, "Mattel takes full responsibility for these recalls and apologizes… to the Chinese people and all of our customers" (Merle & Mui, 2007). However, many argued that regulatory misalignment and the lack of rigorous testing were significant contributing factors. This analysis demonstrates that the failure was not solely a technical or economic issue but a sociotechnical one rooted in the network's reliance on trust and cost-cutting measures.

Conclusion

In summary, I developed a technical process for creating the Educational Multiplayer Outlet (EMO), a two-person educational game console designed to enhance student engagement, foster problem-solving skills, and meet the needs of students, parents, and educators. To ensure the sustainability and safety of EMO, I conducted an STS project proposal analyzing the Mattel Lead Paint Incident of 2007. Using the STS framework, particularly actor-network theory, I identified materials that are sustainable, safe, and cost-effective while emphasizing the importance of trust and rigorous testing to ensure user safety. These insights informed the technical development of EMO, resulting in a console that is not only functional and safe but also prioritizes the needs of its users.

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