The Importance Of Actor Value Translation For Success In Game Based Learning

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Salvador Adrian

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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

Advisor

Joshua Earle, Department of Engineering and Society

Introduction

In the 1960s Mabel Addis, a New York elementary school teacher, partnered with IBM to design one of the first educational games in history (PAPER, n.d.). Her innovative project to teach sixth grade students basic economic principles led to the development of the "Sumerian Game." Students were immersed in Lagash, a Mesopotamia city, where they served the role of priest-ruler. Students had to allocate resources, manage surplus grain for the development of crafts, and promote trade. Using the objective and decision features, it allowed students to learn basic economic principles through gamification (Horn, 1977, p. 66).

Gamification is the application of game-like elements to non-game environments (Knutas et al. 2019, 1); however, Mabel Addis's project was the start of game based learning (GBL), the usage of games to facilitate learning and educational processes (Grand View Research, n.d.). Since the 1960s GBL has grown significantly and in 2023 the global GBL market was valued at $18.4 billion dollars; additionally, IMARC group experts expect the market to reach $71.7 billion dollars by 2032 (Grand View Research, n.d.). Furthermore, to gain an understanding of market trends and societal values in GBL, successful and failed products need to be analyzed.

Therefore, to gain an understanding of the GBL market I analyzed two products: the LeapPad developed by LeapFrog Enterprises and Minecraft Education Edition owned by Microsoft and developed by Mojang Studios and Xbox game studios. These two cases are important to analyze for two reasons, the first is that both of these cases can be argued as being in the top of their market during their respective time and showcase different approaches to meet shareholder and consumer needs. For this paper's analysis I drew 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). I used ANT to investigate the societal and technical factors of LeapFrog Enterprise's and Microsoft's respective educational products, as well as market challenges faced. In doing so I investigated the question; what pedagogical features and mediums are the most effective in GBL and how are market trends integrating and growing GBL technologies? I judged the technology's success based on its market performance and educational efficacy. This paper researched the question thoroughly in an effort to improve educational learning outcomes, support educators and developers, and help engagement in GBL.

The paper starts by learning about the rise of LeapPad, a strong educational tool in the 90s, and its failure. Next, an analysis of Minecraft Education Edition provides insight into successful modern day educational games. Following this section is an analysis into the modern day GBL market and the factors contributing to its massive growth. Lastly, the conclusion section provides a synopsis of the research conducted and states what pedagogical features and technological mediums are succeeding.

LeapPad

LeapFrog Enterprises was founded in 1995 and released the LeapPad in 1999, 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). LeapFrog Enterprises went on to sell 30 million LeapPads and related products worldwide and more than 70 million companion books; earning them $330 million, half of LeapFrog's revenue in 2003 (Helft, 2008). In 2004, LeapFrog Enterprises was ranked the third-largest toy manufacturer behind Mattel and Hasbro and had established the

LeapPad family including several extensions and their best partner product, the “My First LeapPad” (Raugust, 2004).

LeapFrog Enterprises was a successful leader in the world of GBL with the interactive storytelling and stylus based interaction. As the market for electronic books grew LeapFrog Enterprises faced competition with Fisher-Price and Publications International. Fisher-Price and Publications International had gained licenses for original titles and more recognizable characters at the time like Clifford or Toy Story 2 whereas LeapFrog’s titles were only adaptations of Arthur chapter books (Raugust, 2004, 2). Mattel’s subsidiary Fisher-Price introduced the “Power Touch Learning System” which would teach kids reading using their fingers as opposed to a stylus. Fisher-Price had conducted customer research, “One of preschool parents’ key concerns is finding products that help develop pre-reading skills,” which led to the design and launch of PowerTouch. As well in 2004, the PowerTouch book library doubled their collection having over 25 titles ranging from beginner readers to intermediate and even School Skills books (Raugust 2004, 1).

As for Publications International, which was an already established publishing company with over 300 childrens book titles per year and a successful business model around soundbooks (Raugust 2004, 1). In late 2003, Publications International announced the Story Reader which required no stylus and was priced lower than its competitors. The company sold one million Story Reader units and five million books in 2004. By the end of 2004 it had a book collection of 47 and by the end of 2005 the company planned to expand to 200 books. Furthermore, the company introduced a number of new interactive devices like the Active Point which was similar to the LeapPad and the Color-Along Sound Activity Book at $6.99 (Raugust 2004, 1). The

LeapPad was facing a number of competitors, new products, and dynamic changes to the electronic book market.

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. 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, 1). 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, 2). 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 social and technical values of its consumers.

ANT will be used to identify 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 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.

Compared to LeapFrog Enterprises competitors, such as Fisher-Price, they had already translated their actor needs through company feedback and allocated the responsibilities of the technology efficiently, through the 'PowerTouch.' As for Publications International, they had taken a network that was successful, the soundbooks, and translated it into the Story Reader which could be compatible with the established network of electronic books. The actions of both Fisher-Price and Publications are examples of maintaining a heterogeneous network. With the demand for electronic books, both companies were able to adjust their networks through translation and shift their resources to build strong educational tools. LeapFrog enterprises experienced little to no competition and thus failed to establish a heterogeneous network and thus when faced with contenders they were unable to translate their actor needs and faced massive market setbacks. LeapFrog Enterprise did not have products that could fulfill the needs of their customers and users. This failure was a major blockage point that prevented them from developing a heterogeneous network and releasing products that satisfied and stimulated their market. Whereas their competitors had to establish a heterogeneous network prior to releasing their products and showed a much more successful outcome in translating and aligning actor needs.

Minecraft Education Edition

Minecraft is a game made up entirely of blocks, creatures, and is referred to as a "sandbox game" which is a title given to games with no real set goal (Landin, 2023). In 2022 the game sold over 200 million copies with 125 million monthly active players and an expanding fanbase (Henningson, 2022). The first official version of Minecraft was released by Swedish programmer Markus Persson on May 17, 2009 on TIGSource forum (Henningson, 2022) . The first major update was released on June 30, 2010 named the Alpha version and was one of the first catalysts for the games popularity. It wasn't until November 18, 2011 that the full version of Minecraft was released (Henningson, 2022).

Four years following the games release a study done in 2015 by Steve Nebel, Sascha Schneider, and Günter Rey (2016), investigated the use of Minecraft in education and research. Minecraft had been unofficially introduced as an educational tool and was being used worldwide in classroom settings. Minecraft was being used to teach spatial geometry, language and literacy, digital storytelling, and social skills. Given the growing popularity in classrooms, educators wished to address other topics such as ecology, geology, biology, and other subjects. Mojang, the development studio at the time encouraged educators to implement Minecraft and responded with a teacher-friendly version 'MinecraftEdu'. The study found many benefits to Minecraft given its open world nature that encouraged active knowledge construction, cooperation, and engagement (Nebel, Schneider, & Rey, 2016, 3).

Following the release of MinecraftEdu, a new edition designed for cross-platform play was released on November 1, 2016; Minecraft Education Edition (Microsoft, n.d.). An early access version of the game was made available for free to select schools in June 2015. The early access received massive support with over 35,000 students and teachers signing up for access (Trotman, 2016). Minecraft's development studio received a common comment from educators,

“One of the most common requests from teachers was the ability for students to collaborate to build projects and solve problems within Minecraft” (Trotman, 2016). Thus the official releases of Minecraft Education focused on collaboration, educational content, accessibility, and compatibility with a number of devices: mobile or computer (Microsoft, n.d.). Minecraft Education allowed teachers to create a world consisting of up to 30 students and gather student progression without the need of an external server (Trotman, 2016). Currently, Minecraft Education provides features for assessment, coding, and over 600 pre-built lessons (Microsoft, n.d.). The curriculums provided spans from STEM, Coding, History, Language Arts, and more (Microsoft, n.d.). Much of the features provided in Minecraft Education provide a better designed version for teachers to manage the learning outcome of students without removing the open world aspect that gained the love of millions of fans.

A study published in 2024 by Eadaoin Slattery and coauthors (2024) investigated the effectiveness of Minecraft Education on spatial thinking in primary school children. In the study spatial thinking was defined as:

> "A number of separate but related spatial thinking factors have been identified such as spatial visualisation (i.e., the ability to perform complex, multistep manipulations of spatial information), spatial perception (i.e., the ability to determine spatial relations from one’s own point of view) and mental rotation (i.e., the ability to mentally rotate 2D or 3D objects; Linn & Petersen, 1985)." (as cited in Slattery et al., 2024, p.2).

Spatial thinking is important to a number of subjects especially STEM, “Spatial thinking is fundamental to various STEM fields, For example, civil engineers analyse spatial information on maps to make navigation decisions.”. Spatial thinking is important and can be improved through instruction and spatial play in classrooms (Slattery et al., 2024, p. 2). This presents

Minecraft Education Edition a unique opportunity to measure its educational success through spatial thinking from its GBL features, “Spatial thinking in ME can include spatial language (e.g., students use spatial language to communicate with other players including when giving directions and discussing the placement of blocks)...” (Slattery et al. 2024, p. 3).

Upon completion of the study researchers had eight hundred and eight students complete the baseline spatial assessment. Furthermore, a follow up with the 9 teachers found that:

> “All teachers agreed or strongly agreed that the programme effectively integrated creativity into the curriculum, while 92% agreed that the programme effectively integrated spatial thinking. All teachers reported that they were satisfied with the programme and 92% either agreed or strongly agreed that it was a valuable educational experience ” (Slattery et al. 2024, p. 7).

However, upon analysing the qualitative data there were no significant statistical differences between the control and intervention group. The only group that experienced any real significant difference was the 5th grade group which researchers argued was because of a difference in engagement and enjoyment (Slattery et al. 2024, p. 7). I’d argue that if the experiment went for longer, for example a semester I believe better results would have yielded. The experiment went for six weeks and the majority of teachers responded positively (Slattery et al. 2024, p. 10); therefore, I believe more research on the spatial awareness of Minecraft Education should be conducted. I believe that the study still proved that Minecraft Education was engaging and, “the study suggests that to maintain intervention effects students are required to continuously engage in spatial thinking practice.” (Slattery et al. 2024, p. 13).

Minecraft Education is still widely adopted in classrooms. In 2023 Minecraft Education was used in 40 countries and over 100,000 schools (Hirschhorn, 2023). I argue that the success

of Minecraft Education and the demand for research on its effects; are the result of a successful interpretation of technical and social values identified within its network. To further this argument I will use ANT to analyze the interactions, support, and outcomes of Minecraft Education Edition and its users. In the case of Minecraft Education the human actors consist of: parents, children, educators, Microsoft the current owners (Microsoft, n.d.). As for the non-human actors: Minecraft software, cloud services for data, and the devices such as computers or tablets. The network builders are: Microsoft, parents, educators, and the software engineers. Furthermore, the 'punctualized' actor of the network is Microsoft.

The network of Minecraft Education is one that is heterogeneous and successfully translates actor needs to software solutions. In the early stages of Minecraft Education, there were insights and comments provided by teachers as well as an early access event prior to the official launch. Minecraft was an already well established game and proved that it could produce successful software updates that improved the quality of the original game. But the 'punctualized' actor Microsoft understood that to create a successful educational tool they needed to translate the actor needs of educators and parents. Thus organizing the network and using network builders like software engineers to translate actor needs into functions in the game. I would argue that there were no massive differences between outputting software solutions like that of the normal game, but rather the real difference was interpreting the network of a GBL tool.

The case of Minecraft Education shows the importance of a heterogeneous network. Microsoft delegated the responsibility of education to the software as well as to the educators. Microsoft understood that the product was for classrooms and more specifically for educators and thus provided many tools for educators to teach. Granting teachers the ability to assess,

provide their own lecture material, and be given ways of measuring student performance. The way Microsoft translated actor needs was in a way that kept the product dynamic and removed a potential static decline. The educational features of the game aligned with actor values which in turn explains the success of its sales and market value as GBL tool.

Modern Day Market

With a market expected to reach $71.7 billion dollars by 2032 and a compound annual growth rate (CAGR) of 22.0%. The GBL market is considered an accelerating market with a high growth stage (Grand View Research, n.d.). The GBL market is divided into two components: solutions and services with the solution branch leading the market with 73.2% of the revenue share in 2023 (Grand View Research, n.d.). The solutions component focuses on educational content for learner needs, preferences and skill levels; where the service segment is focused on integration of technology into existing educational or training environments (Grand View Research, n.d.). Service also provides insights such as consulting, technical assistance teams, and training programs for the new technology (Grand View Research, n.d.).

Current market growth is being driven by a demand in interactive and immersive learning as well as new technology such as artificial intelligence (AI), augmented reality (AR), and virtual reality (VR). Furthermore, the COVID-19 pandemic has accelerated the growth of GBL across a number of sectors (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 this shift in online and remote learning solutions, the outcome has been a demand for digital learning and GBL solutions (Grand View Research, n.d.).

The GBL market has seen new technology in recent years to create more engaging educational content, these technologies are mainly: AI, AR, and VR (Grand View Research, n.d.). With the usage of these technologies more sophisticated and immersive learning environments are engendered. AI algorithms are able to curate learning paths for students based on data, and AR and VR can both create simulations for real-world situations and provide hands-on learning opportunities (Grand View Research, n.d.). There is a popularity for location-based with a revenue share of 39.6% in 2023 among game types. These solutions are in demand due to its ability to hold virtual content into real-world settings through a digital world. Futherenore, the learning experience from AR and VR supports collaborative learning, critical thinking, and is more engaging through immersive technology (Grand View Research, n.d.). However AI-based games have the fastest CAGR due to machine learning and predictive analytics. The self-learning nature of AI makes it appealing to the market for catering to individual learners and tailoring unique solutions for a number of different learning styles (Grand View Research, n.d.).

In 2023, North America was a leading contributor to the GBL market with a revenue share of 43.10% in 2023. Furthermore, the United States accounted for 30% of the revenue share in the North America contribution (Grand View Research, n.d.). With a massive demand for GBL and the United States being a massive contributor, the U.S then holds massive weight in the direction in which GBL goes. Within the U.S, " The U.S. education and corporate training

sectors are increasingly turning to game-based learning solutions to enhance learning outcomes, improve employee performance, and drive innovation in teaching practices." (Grand View Research, n.d.) Major GBL companies consist of: Google, Duolingo, Amazon Web Services, and Mojang Studios all of which are continuing to provide solutions to meet U.S education and retail demand (Grand View Research, n.d.).

Main concerns currently within the GBL market are about deployment and platform insights. Issues in deployment are about privacy and security; industries such as government agencies, healthcare organizations, and financial institutions need data security. Other segments need GBL solutions besides education; for example, in August 2022 Amazon Web Services (AWS) announced GBL solutions to teach employees cloud computing skills through AWS Cloud Quest and AWS Educate (Grand View Research, n.d.). Platform insights are focusing on eliminating the need for continuous internet connectivity and the over reliance on cloud storage. The current market is leaning towards offline GBL solutions so that organizations can save on data costs, server hosting, and subscription fees (Grand View Research, n.d.).

The GBL market comprises a number of segments all of which seek different technological solutions. Therefore, the need to understand the ethics and sustainability of these technologies is ever so important given their need in critical aspects of our society. The market shows an accelerated growth and a need for engineers and solutions. The shape these technologies take will affect the trajectory in which we teach students, employees, and other important members of society. With new technologies innovating pedagogical methods, it's important we monitor what and how these solutions are released.

Conclusion

In conclusion, I utilized ANT to analyze the network of both Minecraft Education and LeapPad and showed the need for heterogeneous networks and proper translation of actor values. Microsoft and LeapFrog Enterprises served as 'punctualized' actors in their respective networks but showed different outcomes when it came to how they translated actor needs into their technologies. Although both Microsoft and LeapFrog translated actor values into their software, the key difference between their translations was Microsoft's ability to dynamically change software tools to meet evolving needs where LeapPad was unable. Because of LeapFrog's miscalculation the LeapPad succumbed to market failure when met with competition. LeapFrog and Microsoft both had the same types of actors and goals in educating their users but the means in which they achieved their goals and identified themselves as 'punctualized' actors is the defining factor that separated them.

As GBL continues to grow, actor values are showing a growing need for dynamic and individualistic solutions. Market demand shows a need for AI, AR, and VR solutions all of which provide immersive and innovative ways to cater to individual student needs. With how rapid the market is, the need to maintain and translate actor values is critical to the success of GBL tools.

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