University of California, Irvine

WHAT DESIGN FEATURES CAN MOTIVATE CHILDREN USE EDUCATIONAL TECHNOLOGIES AT A HIGHER RATE?

Undergraduate Honors Thesis

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To my two daughters, who are my two eyes, I see the world with those two eyes.

Abstract

Educational technologies can provide an optimum learning experience. Technologies or computers mediate almost every single interaction in these days. If it is possible to get a detailed understanding of how people are using computers day-to-day, it can inform technology design ("Gloria Mark"). In the future, we have to design systems for people the way they want, not the way we want them to be ("Design for How People Think (Don Norman)"). This study understood how younger people are using technology today and how they want the design of their technology to be. It obtained an understanding of what, how, and why younger people are using technologies in their daily life. We must support children in ways that are useful, effective, and meaningful for their needs (Druin 2). This research investigated qualities in existing technologies for children that meets their need and motivates them using it. Besides, it probed entertaining and educational technology use patterns in children and scrutinized features in them. Technology design features were analyzed in-depth by applying mix-methods with in-person surveys and observation. A mock-up of the design of future educational technology for children was created with the superior features largely adopting from entertaining technologies that children admired. The mock-up informs design for creating educational technology for children that children can be inspired to use at a higher level.

Keywords

Children, Motivation, Human-Computer Interaction (HCI), Child Computer Interaction (CCI), Entertaining Technology, Educational Technology, Technology Design, Lewin's Field Theory, Motivational Affordance Theory (MAT), The Self-Determination Theory, Expectancy-Value Theory, Gamification

1. Introduction

Today a variety of educational technology is being created for children with the objective that children will learn and will be advantaged from them. Nonetheless, evidence shows that the productive consumption of these educational technologies is not being brought out by children. For example, students are frequently using educational technology for off-task activity and multi-tasking, and this inefficient use of educational technology is leading to significant decrements in academic performance (Aagaard 1). Educationally relevant material is being displaced by fun technological tools such as games, funny images, videos, social networking sites, etc. As a result, instead of being a tool of learning, digital technologies are becoming sources of distraction for children (Aagaard 1).

Children are rapidly becoming tomorrow's advanced users of computers and technology (Druin 2). As being digital natives, children and young people are progressively using technology in every aspect of their life such as doing their homework, entertaining themselves, accessing information, using social media, etc. (Aziakou 2). How children are being affected by technologies that can support the provision of efficient learning and productive use is a crucial area for research. Educational technology design for children should be created in such a way so that these technologies give only optimistic effects from them. For example, educational technologies should motivate children to learn educational content instead of doing off-task and multi-tasking activities while using these technologies. This study intended to explore if the design of technology can be an aspect that makes children unmotivated and unfocused to use it. This study concentrated on exploring the features of technologies that can motivate children to use educational technology.

2. Background

2.1 Children Playing Different Roles in the Design Process of Technology

Giving importance to the educational technology design issue, researchers introduced a framework for understanding how children can play a significant role in the tech design process, particularly regarding designing technologies that support learning (Druin 2). This study suggested that as new technologies are becoming ever more critical to our children's lives, we need to be sure these technologies support children in ways that make sense for them as young learners, explorers, and avid technology users. For years the Human-Computer Interaction (HCI) community has pursued new ways to understand users of technology. Nevertheless, with children as users, it has been challenging to bring them into the design process. Children go to school for most of their days; there are existing power structures, biases, and assumptions between adults and children to get beyond; and children, especially young ones, have difficulty in verbalizing their thoughts. For all of these reasons, a child's role in the design of new technology has historically been minimized. Druin suggested that roles played by children can impact technologies that are fashioned. Each role (user, tester, informant, and design partner) played by children had been defined based upon a survey of the literature and the author's or researcher's own research experiences with children (Druin 1).

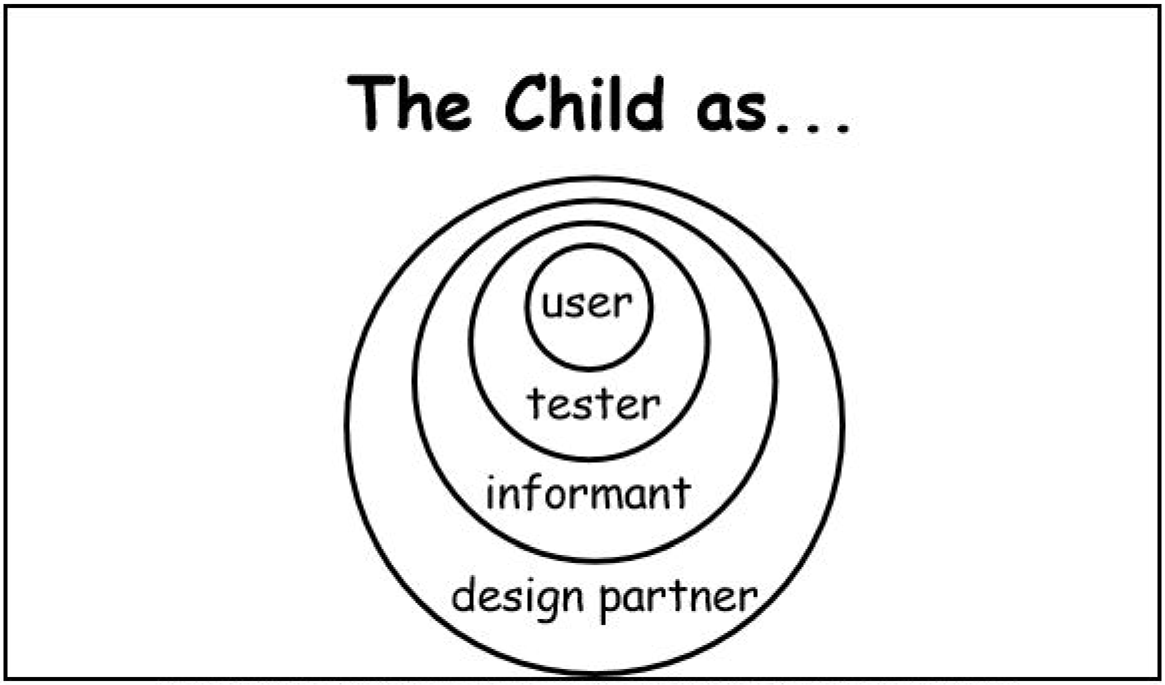


Figure 1: The four roles that children may have in the design of new technologies

More informed decisions about technology design processes with children in creating new technologies were advised through this framework (Druin 2).

2.2 Enhancing Instructional Outcomes with Gamification: An Empirical Test of the Technology-Enhanced Training Effectiveness Model

In recent years, gamification design has been used to engage or motivate users in many thoughtful contexts, such as education (Tang and Zhang 2). Gamification objects refer to visual or non-visual digital objects that form building blocks of gamification systems (Tang and Zhang 3). Examples of gamification objects include graphics, audio clips, avatars, virtual items, artificial characters, storylines, badges, and leaderboards (Tang and Zhang 3). Gamification mechanics is a higher level of design that is built with game artifacts with play patterns and dynamics, such as level system, point system, quests, competition, and collaboration, in-game economy, and social networking systems (Tang and Zhang 3).

Gamification, or the use of game elements in non-game contexts, has become a widespread practice to improve instructional outcomes in both organizational and educational contexts. In the corporate context, the Technology-Enhanced Training Effectiveness Model [TETEM] offers a framework to understand how technologies, like Gamification, can effect change in various instructional outcomes. Specifically, the application of TETEM suggests that Gamification may not effect change in instructional products when learner attitudes towards game-based learning and experience with video games are low. Landers and Armstrong verified this model in the gamification context by assigning potential learners to read scenarios describing gamified instruction or traditional, PowerPoint instruction in random order and assessing their training valence. Landers and Armstrong's study established that individuals with less game experience and lower attitudes towards games, in general, might benefit less from gamified instructions than others.

2.3 Applying Psychological Theories for Designing Technology for Children

Gelderblom and Kotzé emphasized how psychological theories of child development can be translated into guidelines of the design of technology for children. They intended to create a set of guidelines for the design of age-appropriate technology for five to eight-year-old children. The authors gave importance to the issue that recent guidelines for children's products do not distinguish sufficiently between different age groups, and they mostly suggest high-level advice that is important only during the initial planning stages of design.

To identify design factors that can be translated into design guidelines, theories of four prominent development psychologists were applied to their research.

Theory 1: The first theory that Gelderblom and Kotzé valued is Piaget, who viewed the development of general cognitive structures as a necessary prerequisite to learning and represented that learning happens from within the individual.

Resulting Design Guideline:

- Designers must be well informed of all the knowledge schemes that underlie every activity they present to the child.
- A product must make it possible for the child to
    - o fit the information presented into existing schemes (assimilation),
    - o adapt existing methods so that the new information can find a place (accommodation), or
    - o combine existing methods to form more complex tasks (organization).
- Technology aimed at five to eight-year-olds may use symbols and images to represent real-life situations.
- Include activities that require children to mentally reverse actions such as combining, ordering, separating, and recombining of elements.
- Software aimed at younger pre-operational children should allow users to physically move objects, e.g., by dragging them with the mouse.
- Children older than six should be allowed or even expected to perform operations that involve combining, ordering, or separating objects, mentally.
- Present children with three-dimensional images that they can manipulate with the mouse or with virtual physical spaces through which they can navigate using the mouse, keyboard, or other input devices.
- Employ narrative-based activities where children must help on-screen characters to solve problems and make decisions that may be influenced by or have consequences for the actions and thoughts of one or more other characters.
- Present children with activities that allow them to experiment with changes of state in a way that explains the differences.

Theory 2: Vygotsky exhibited that learning of concepts and strategies creates more complex cognitive structures and viewed development as contextually determined and driven by external factors (Gelderblom and Kotzé 4).

Resulting Design Guideline:

- Designers must know the cultural context of their intended users.
- They must acknowledge their own context and how that may consciously or subconsciously influence their design practice.
- They must consider the specific learning or entertainment goals of the product and how these goals fit the context of different kinds of users.
- If a product is aimed at children from a variety of cultures, designers may settle on one generic scenario, but it may be difficult to find one that all children can relate to.
- In the same way, as some applications allow users to pick a language of choice, children may be given a choice of scenarios.
- The software should assess children's level of understanding of a concept or their competence in skill and so determine their ZPD for this specific concept or skill.
- Determine each user's individual ZPD and then use that knowledge to direct further action.
- Make sure the application and its user share the required common knowledge.
- Present children with tasks that they are capable of performing (so that they can get the reward of being successful at those tasks) and provide them with opportunities to practice newly acquired skills.
- Then give them challenging tasks that are just beyond their reach, providing supportive scaffolding.

Theory 3: Case supposed that both Piaget and Vygotsky's approaches explain aspects of cognitive development, and he unearths a balance between them through neo-Piagetian theory (Gelderblom and Kotzé 5).

Resulting Guidelines:

- Designers should
    - identify all the underlying operations that a child will use when learning the new skill,
    - determine whether the child can perform these operations,
    - find out if the child has the mental capacity for the new skill,

    - present the child with problems that require the use of two operations independently, and then in succession, and
    - present the child with activities that facilitate the merging of the two operations into one that forms part of the new skill.
- When the child acquires an operation or a skill, designers should present opportunities to practice a skill until it becomes automatic.
- Once an operation becomes automatic, some working memory becomes available for other operations. Since working memory is so important in development, designers should strive to relieve children's working memory of extra processing that may prevent them from moving forward with the coordination of knowledge structures. For example, interpreting and navigating the user interface must require as little working memory capacity as possible.
- Children in the same age group may have different upper bounds of memory capacity. Therefore, support should be adaptable to variation in memory capacity.
- Children younger than six should be presented with activities that require them to deal with only one dimension of a situation. From six to eight they can be presented with activities that involve two dimensions (but not more).
- Identify particular problems that are important in that culture and the tools typically used to solve that kind of problem.
- Designers should not assume that if a child can solve a specific kind of problem in one domain that they can transfer that skill to a different domain.

Theory 4: Fischer builds on Case's theory. He describes the development as a constructive web, where skills develop in a specific order but with significant variation due to contextual, biological, and emotional factors (Gelderblom and Kotzé 6).

Resulting Guidelines:

- Designers would ideally support the independent development of skills in different domains, while at the same time considering how a skill is applicable across disciplines.

- A task or activity chosen to develop a specific skill should be one that can be naturally associated with that skill.
- Carefully consider the role of culture, experience, emotion, and biological maturation in the skills they require or want to develop.
- Investigate how different cultural groups use or teach the skills that the product will support (when a product is aimed at children from other cultural groups) (F04).
- Know the minimum requirements of the intended product concerning biological maturation.
- Designers should not assume that children will transfer the skill to the real-life or school education context and need to make the connection explicit.
- A designer does not have control over factors outside the game environment that may influence the child's emotional state but can use game elements to suggest emotions that may enhance skill development.
- Designers should identify all the skills involved and support differentiation and integration of these skills in their design.
- Designers should know the sequence through which the skills to be addressed develop.

Gelderblom and Kotzé's investigation of the four theories by Piaget, Vygotsky, Case, and Fischer produced admirably and variety of guidelines for the design of technology focusing on age-related requirements for young children. This study can be a great source to demonstrate that theories can be applied to specific design features of technologies. Technology can be created grounded on these theories.

2.4 Applying Motivational Theories to the Design of Educational Technology

Tran et al. generated comprehensive theoretical frameworks of motivation to the study and design of educational technology. Several motivational theory's implications had been discussed in their study such as Eccles's and Wigfield's Expectancy-Value theory and Self-Determination theory.

The expectancy-value framework of motivation posits that individuals will be motivated to engage in a task to the extent that they feel they can be successful at it and to the extent they perceive the task as being vital to them. Applying Expectancy-Value Theory to a virtual environment, the study illustrated the importance of algebra knowledge (utility construct) and presenting careers that may be appealing to some students to increase motivation to pursue STEM careers (interest construct) (Tran et al. 6).

The Self-Determination Theory suggests that motivation arises from the needs for competence, autonomy, and relatedness being met. That is, to be motivated, people need to feel that they are the following: (1) capable of understanding the material; (2) in control of their environment; and (3) socially connected in the process (Tran et al. 3). Research shows that these three needs contribute to inherently enjoyable activities that are, therefore, intrinsically motivating. Compared with those pursuing an action for external rewards such as money or grades, intrinsically motivated individuals are more creative, enjoy the activity more, and process information more carefully and thoroughly (Tran et al. 3). Applying Self-Determination Theory to mobile learning, the study suggested some tech-rich activities that can enhance the learning experience, such as tactile features of mobile devices allowing tangible technology designs that increase motivation.

Tran et al. employed frameworks that are established through well-established theories of motivation. Their study produced meticulous theoretical frameworks of motivation to the research and design of educational technology. The study charted key motivation constructs that constitute Eccles and Wigfield's Expectancy-Value theory and the Self-Determination theory and discuss their implications for education. Through a case study, the study exemplified how motivational theories informed the current development of a virtual learning environment designed to promote students' interest in and motivation to pursue science, technology, engineering, and mathematics careers.

2.5 Creativity and Collaboration in Technology Design for Children

Any technology that assists supporting creativity and collaboration in a learning environment is considered as new leeway of learning for children using technology (Resnick 6). Some research claimed that children could gain more productive and more meaningful learning experience from supportive learning environments than from instructional learning (Wilson 7). Such research is Wyeth et al. 's early research on designing appropriate, usable, and most significantly an inspirational, educational technology through kidprobe. Probes are an approach to gaining contextually sensitive information in order to inform the design of technology (Wyeth et al. 2). Kidprove is a lightweight method for capturing contextual data about children's interactions with 'fun' technology (Wyeth et al. 1). kidprobe had demonstrated to be producing design inspiration focusing primarily on the social and emotional connections children made. Kidprobe usage grew imperative ideas for improving the use of probes with children. The study suggested that it is a vital first step to understand how to successfully acclimatize probing techniques to inspire the design of technology for children.

2.6 Playful Learning Tangibles for Technology Design for Children

Emphasizing technology design for children, new forms of tangible and spatial child computer interaction and supporting technologies were suggested. Such technologies were recommended to be designed to influence children's intelligence development in the world. Tangible systems have a powerful ability to engage school-age children in active play, which promotes cognitive development. Alissa N. Antle depicted the importance that designers must understand how children interact with and understand the representations embedded in tangible systems before designing any playful learning tangibles. She abridged applicable theory from cognitive developmental psychology, which may provide grounding for the design of tangibles to support children's learning.

2.7 Virtual Manipulative Design for Children

A virtual manipulative is defined as an interactive, Web-based visual representation of a dynamic object that presents opportunities for constructing mathematical knowledge (Paek et al. 2). Paek et al. examined aspects of multimedia design in virtual learning environments for children. To explore the role of multiple modalities on learning with virtual manipulatives, a game-based virtual manipulative, Puzzle Blocks (PBs), was designed based on multimedia learning principles (Paek et al. 3). The research proposed that virtual manipulatives, designed with multimedia learning principles in mind, can act as successful environments for young children's math learning.

2.8 Analysis of the Nature of the Child Computer Interaction (CCI)

Read and Bekker highlighted the key differences that set Child Computer Interaction (CCI) distinct from Human-Computer Interaction (HCI) and discovered the degree to which both similarities and differences impact on the methods and approaches needed for research and practice in CCI. Commencing with a historical look at this field and identifying some of the critical moments in its development, Read and Bekker's study conveyed images from experience, and knowledge from literature, to describe and explain the nature of CCI. The study recognized crucial dissimilarities such as the rate of change of children, the involvement of adult participants in children's interactions, the contexts in which children use computer technology, and the underlying cultural and societal assumptions about technology and children that determine what is suitable for children and what has value.

2.9 Theory of Intrinsically Motivating Instruction in Technology Design

To understand how a computer-based learning environment is engaging, Thomas W. Malone studied computer games. He developed a theory that is consists of challenge, fantasy, and curiosity. According to Malone, challenge is assumed to depend on goals with uncertain outcomes. Fantasy is claimed to have both cognitive and emotional advantages in designing instructional environments. Curiosity is detached into sensory and cognitive components, and it is proposed that cognitive curiosity can be aroused by making learners believe their knowledge structures are incomplete, inconsistent, or not parsimonious (Malone 1). Malone's theory investigated why computer-based learning environments are entertaining and alluring.

2.10 Designing for Children's Emotional Need

Grundy et al. proposed a new method for helping to understand the emotional requirements of children during the conceptual phase of designing an interface. The approach expected to be valuable when the feelings of the child are critical but are challenging to investigate, such as when the issues are sensitive and may intensify emotional responses. Grundy et al. 's study also reconnoitered an approach that draws on the social agency that characters can provide to help the children articulate their opinion.

To understand children's emotional needs, children were asked to create fictitious cartoon 'personalities' that have desired attributes, personal qualities, and behaviors that are relevant to a given scenario. Afterward, this influenced the conceptualization of a product under development for the context defined. Character design was found to be an engaging activity for the children. The study suggested an outcome that can facilitate communication between the designer and the pupil. It also provided a sensitive method for getting information about children's feelings through the dialogue that took place in the study.

2.11 Children's Fiction on Technology Design

Concentrating on environmental sustainability themes for children (primary school), Ferraz et. el offered the design process of a learning computer game. To control the game, children used "Alberto's Gravimente Toys," everyday life objects (e.g., inflatable bat) that incorporate different sensors that are able to detect users' input actions. The game allowed children to move around the physical space (indoors and outdoors), thus also allowing simultaneous cognitive and motor exercise. This study intended to find new principles by which to conceive technological tools for children, connecting both virtual and physical realities, in direct proximity, and within different contextual environments. Children were involved in the design process from the very beginning, helping to improve the game design and usability. Children's attitude while playing (e.g., individual/collaborative) were also given attention in the study.

2.12 Cooperative Inquiry in Developing New Technologies for Children

Giving importance to fulfilling the technology needs of our children, Allison Druin had developed a research approach that enabled young children to have a contribution throughout the technology development process. Techniques of "cooperative inquiry" were described along with a theoretical framework that situated this work in the HCI literature. Two examples of technology resulted from this new research approach, including a short discussion on the design-centered learning of team researchers using cooperative inquiry. The first example was KidPad using cooperative inquiry. KidPad is a zooming storytelling tool that enables children to collaboratively create stories (Druin 6). The second example was PETS, which is a Personal Electronic Teller of Stories. The PETS environment makes use of physical robotic animal parts to enable children to build fanciful animals that can act out the stories they write (Druin 6). The study also included another critical outcome of the cooperative inquiry process - design-centered learning.

2.13 Applying Motivational Affordance Theory (MAT) in Information and Communication Technology (ICT) Design

How motivational approach can be advantageous in designing ICT, Ping Zhang had scrutinized. Motivational affordances comprise the properties of an object that determine whether and how it can support one's motivational needs. According to Zhang, when using ICT involves our motivational needs, we feel interested (thus attend and engage), and when using ICT satisfies our motivational needs, we feel enjoyment (therefore want more). Zhang suggested that the ultimate goal of designing an ICT for human use is to achieve high motivational affordance so that users would be attracted to it, really want to use it, and cannot live without it. His study proposed ten high levels and context-free design to guide ICT design with high motivational affordances. The principal goal of these design principles is to ensure that ICT can support people's motivational needs. However, Zhang's design principles had limitations, such as supporting conflicting goals. This means that the same design principles may not assist all ICT design goals the same way, and not all principles are of equal interest in designing a particular ICT The design principles are the following

Motivational Needs	Design Principles	Some Existing Design Examples
Psychological: Autonomy and the Self	Principle 1. Support autonomy. Principle 2. Promote creation and representation of self-identity.	Desktop skins, cell phone ring tones, application toolbar customization
Cognitive: Competence and Achievement	Principle 3. Design for optimal challenge. Principle 4. Provide timely and positive feedback.	Games and learning systems with various challenge levels and immediate performance feedback.
Social & Psychological: Relatedness	Principle 5. Facilitate human-human interaction. Principle 6. Represent human social bond.	Group based games (e.g. online Bridge) with a chat section, visualizations of email exchanges over a period of time to show both tasks and social related messages.
Social & Psychological: Leadership and Followership	Principle 7. Facilitate one's desire to influence others. Principle 8. Facilitate one's desire to be influenced by others.	Blogs (satisfy one's desire to influence by authoring, and to be influenced by reading), virtual communities where leaders sometimes emerge.
Emotional: Affect and Emotion	Principle 9. Induce intended emotions via initial exposure to ICT. Principle 10. Induce intended emotions via intensive interaction with ICT.	Slick/attractive look of iPod or cell phones, engaging games, ICT that induce optimal flow.

Table 1. Summary of design principles for motivational affordance

2.14 Applying Motivational Affordance Theory (MAT) in Exploring the Relationship between Gamification Design and Motivational Needs

Where in the previous literature, Motivational Affordance Theory was suggested in ICT design, the same theory was proposed to explore the relationships between Gamification and motivational needs.

Motivational affordance theory (MAT) hypothesizes that "technology can be designed in a way that affords possibilities to satisfy basic human needs" (Tang and Zhang 4). To explore the gamification effect on technology, Tang and Zhang stunningly proclaimed game design features and their potential relationships with basic human needs. From the literature analysis of 60 journal articles, they found that researchers from various disciplines showed interest in implementing gamification design in technology design to enhance user motivation. They identified 147 game design features in the pool of literature, such as badges, trophies, leaderboards, points, levels, avatar, virtual teams, etc. (Tang and Zhang 3). They examined how gamification design and human motivational needs are associated with the existing literature. However, though doing an enormous literature analysis, this research was limited to a motivational affordance perspective to interpret the impact of game design features.

2.15 Evaluation of the Effectiveness of Educational Technology Systems on Learning Outcomes

Given that educational technologies are currently receiving significant attention, Jones and Rocco presented a general framework that can enhance student learning and achievement with the use of educational technology. To do such, they investigated some questions that are rarely addressed and created a framework. The questions are

1) What is the most appropriate technology to use?
2) In what educational context is a particular technology most effective?
3) How effective is the chosen technology?

Following below is Jones and Rocco's framework that they fetched together with the multiple dimensions of integrating technology with the learning process.

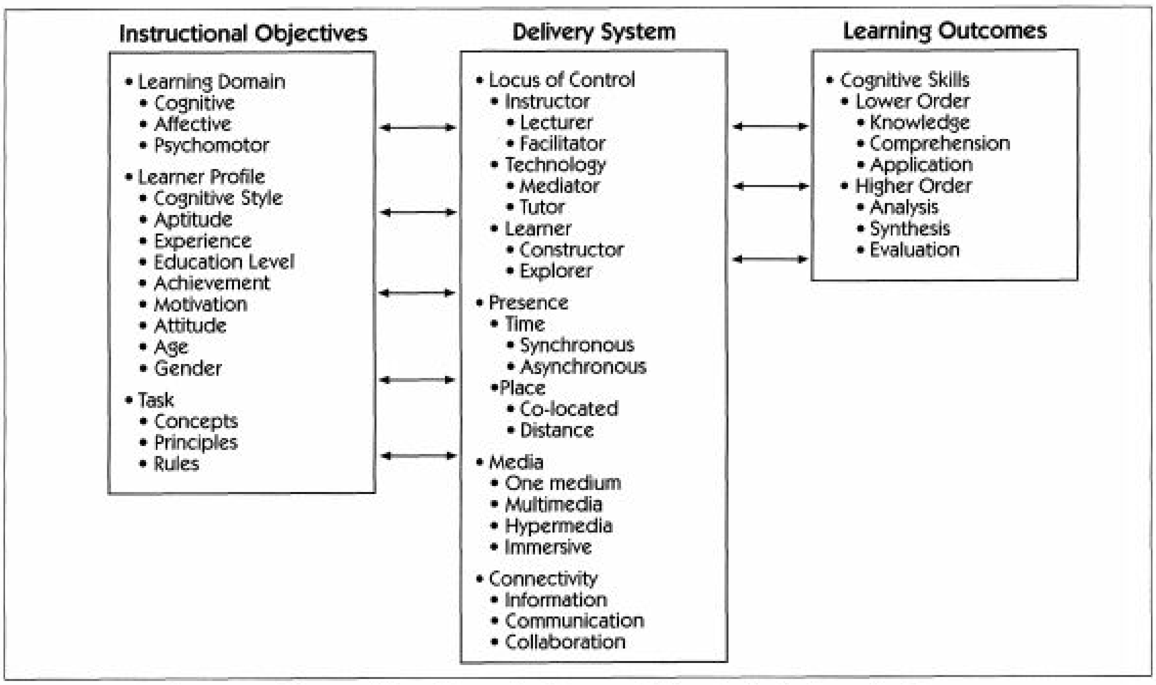


Figure 2. Research dimensions and framework for evaluating the effectiveness of educational technology on learning outcomes

2.16 Situated Motivational Affordances of Game Elements to Motivate User Behavior in Non-game Contexts

An increasing number of applications use game design elements to encourage user behavior in non-game contexts (Deterding 1). Gamification is ensured to drive 'user engagement' such as motivating users to engage with an application or service, usually by making it more 'fun' to use. Sebastian Deterding sensed that so far, current models of video game motivation do not connect to the coarse level of single design elements. He also highlighted that they do not speak of the social situation of gameplay. To report this deficiency, the concept of situated motivational affordances is introduced to his study to conceptualize the motivational pull of single-game design elements in varying contexts.

Deterding suggested that a hopeful method to thoroughly conceptualize and experiment this granular level is through motivational affordances. It transfers the well-established concept of affordances from perceived opportunities for action to questions of motivation, linking up with need satisfaction theories of motivation, which is called Self Determination Theory (SDT). Need satisfaction theories to argue that human beings seek out (and continue to engage in) activities if these promise (and succeed) to satisfy motivational needs, such as competence, autonomy, or relatedness (Deterding 2).

The study claimed that the concept of motivational affordances and self-determination theory could provide good theoretical starting points to the study of the motivational dynamics of 'gamified' applications and services, if we extend them towards situated motivational affordances.

2.17 Gamification in Education

Incorporating game elements have also seen in education. To provide an opportunity to help schools solve these problems, such as lacking student motivation and engagement. Before applying gamification in schools, Lee and Hammer suggested a better understanding of what gamification is, how it functions, and why it might be useful. Their study addressed three questions – what, how, and why bother; while discovering both the possible benefits and downsides of gamification

The study answered the "what" question by providing an overview of current uses of gamification in education. Second, it answered the "how" question by discussing some potential areas in which gamification techniques can provide meaningful interventions for today's schools, such as conversing three significant areas – cognitive, emotional, and social in which gamification can assist as an intervention. Finally, it considers "why bother," discussing the importance of gamification along with its benefits and risks.

3. Drawing on Previous Researches

There had been a wealth of research investigating motivation and engagement levels in people within technological environments for effective technology design. Drawing knowledge from the previous research literatures, this paper significantly contributed to exploring specific design features of technologies that not only have a relationship with children's needs but also specified how design features are meeting their needs. Furthermore, this study conducted a separate investigation for entertaining and educational technologies to recognize what design characteristics make children use them differently. The features that were preferred by children was suggested to append to the redesign of the educational technology. The features that were ostracized was offered to eschew. The redesign features in technologies can support in perpetuating children becoming a long-standing user of educational technology.

4. Problem Statement

Today from the Internet to multimedia authoring tools, technology is changing the way children live and learn (Druin 1). Many objective observers on this issue are beginning to realize that the research supporting the massive adoption of technology does not claim that these extensive trends are reasonable. Educational technology involves the use and application of technology-based tools in the educational process (Jones and Rocco 4). The use of technology in education had shown little effect on productivity (Jones and Rocco 2). Instead of being motivated to use educational technology, children are interacting with an outstanding number of apps, which are not a productive consumption of technology (Ingram-Cauchi 3). How effective educational technologies are and what are the causes of ineffectiveness is not well-researched. This study investigated and found such cause and suggested how these educational technologies should be designed in such a way so that they can support the prolific consumption, such as directing children to become inspired to learn educational content.

5. Significance of the Research

If it is possible to explore the features of technologies that can encourage children to use it, it might suggest that children might use and prefer educational technology similarly if these design features are added in educational technology. It can recommend the practical use of technology, such as encouraging children to learn educational content, which is lacking in current technology use in children (Aagaard 1). This research redesigned an educational technology for children with these motivations, and engagement promoter elements and suggested that these elements can endorse more engagement, and improve the use of educational technology and aid children become scholastically advanced.

6. Research Procedures

6.1 Participants Information

The primary purpose of the research was to analyze the characteristics of technologies that can be implemented in educational technology to help children learn academic content more. It necessitated children to have a practical understanding of what educational technology is and know how to use essential technologies. To be able to use technology and participate in the surveys and observation effortlessly, the participants were selected in the range of ages 5 to 11. There were a total of 11 participants in the study.

6.2 Research Methodology Applied

The research was conducted after obtaining approval from the Institutional Review Board at the University of California, Irvine. The study had a triangulation or multi-method approach to collect and evaluate data such as in-person surveys and observation.

6.3 Research Site

The research site was located at the University of California, Irvine Verano Place Housing, named Verano After School & Summer Program.

6.4 Research Schedule

The research was conducted from the beginning of January 2020 until the end of March 2020. The study was done from 4:30 pm to 5:45 pm from Monday to Thursday and from 2:00 pm to 5:54 pm on Friday. The in-person surveys about technology were conducted for 10 minutes to 30 minutes. The survey questions were read and clarified to children. For each observation session, one hour or more was spent on children's adored technology. Approximately 20 to 30 minutes was allocated to children's abhorred technology observation. During the observation sessions, notes were taken while children were using technologies.

6.5 Justification for the Research Procedures

The thought behind choosing in-person surveys instead of online surveys was, there were possibilities where children might not understand some questions. Thus, there was a likelihood that they could answer something that is not the expected answers to the questions. To avoid this situation, lead researcher sat with them, similar to an in-person interview. Every question was explained and clarified with the participants as many times as it was needed.

The purpose of conducting a field observation study on children was because we know that children are sincere in their feedback and comments concerning technology. Much of what they say may be in their actions and needs to be interpreted within the context of actual experiences (Druin 2). Field research could explore children's real experiences about the technologies they use.

Researchers tried to recognize the influence existing technologies have on child users through the role of users played by children so that future technologies can be changed, or future educational environments can be improved (Druin 3). Understanding which features of technology can inspire children to become a regular user of the technology, exploration through observation of children's technology usage behavior was essential for this research.

For the observation session, the technologies were chosen following the survey results. Minecraft was chosen as the entertaining technology to observe as it was rated as the most liked entertaining technology by children in the survey. Children were given an iPad to play with Minecraft since iPad was chosen as the highest-ranked device from where children use entertaining technology.

ABCya was chosen as the educational technology to observe as it was ranked as the most liked educational technology by children in the survey. Children were given a computer for observation sessions with ABCya since the computer is the device where children use educational technology the most, according to the survey data.

6.6 Data Analysis

Data analysis was done by comparing study findings regarding children's preferred and shunned entertaining and educational technology features. After data analysis was finalized, the last step of the research was to create a mock-up of a user interface of an educational website for children applying the research result.

6.7 Funding for the Research

This research was sponsored by the Undergraduate Research Opportunities Program at the University of California, Irvine, under grant # GF11116 .

7. FINDINGS

7.1 Survey Findings

The below demonstrates the survey findings from the study.

7.1.1 Features that Motivate Children to Use Entertaining Technology

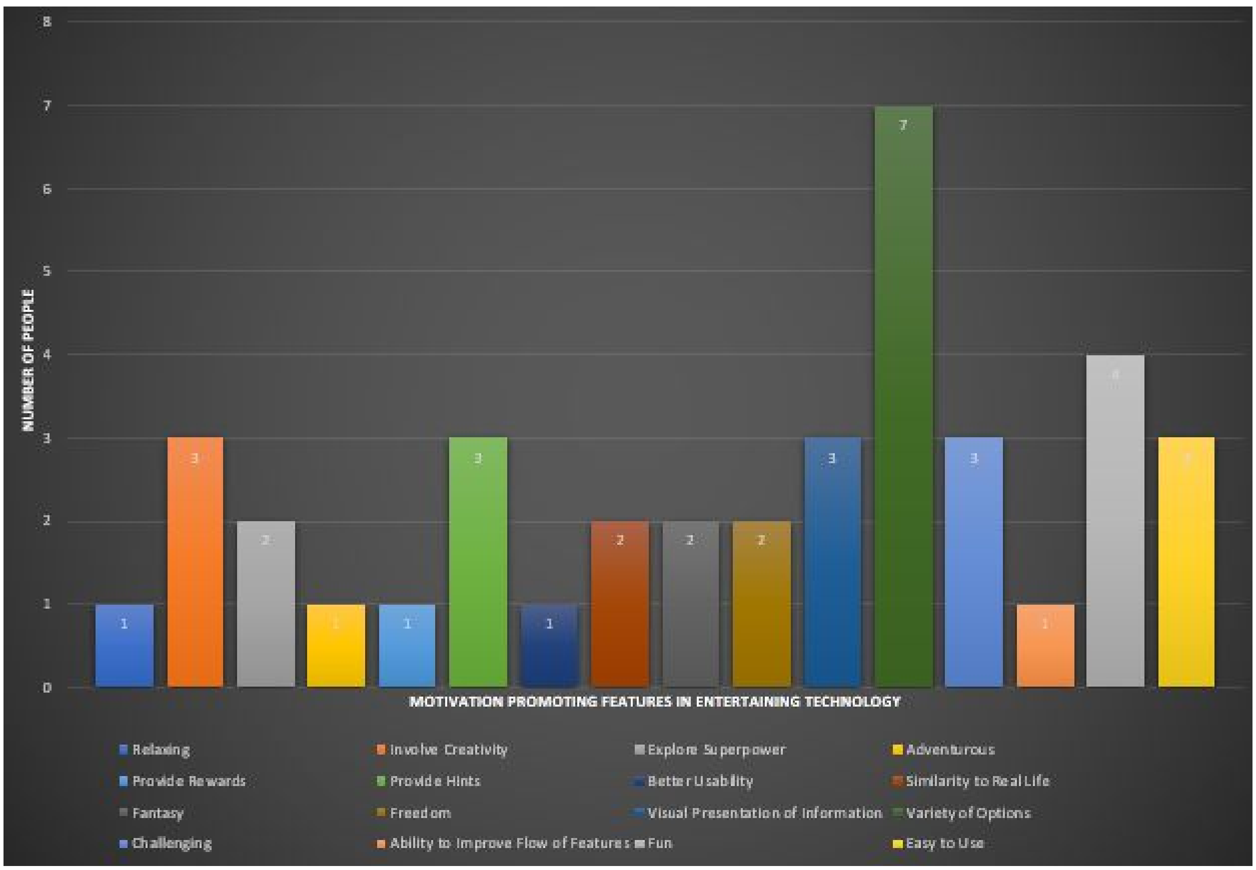


Chart 1: Motivating features in entertaining technology

Variety of options - In general, entertaining technology that has features providing a variety of options to use every single feature had been favored by participants the greatest. According to them, if the elements in entertaining technology contain variations of activity such as creating objects, building houses, playing different types of games, or interacting with various memes, enthuse them to continue with it. According to them, if the technology has unlimited ways to achieve a specific task, that can help them to continue the task as they do not become frustrated if one way to do the task does not work. Besides, they preferred if technology lets them choose their own approaches to utilize a feature.

Fun - The second most favorable feature was fun producing qualities in an entertaining technology. Technologies that had provided them with superior amusing experience became their adored technology.

Creativity - The features that involve creativity, participants can show how creative they are. They can create or build according to their own choices.

Provide hints - Features that provide hints are also favorable by children. For example, one participant stated that in a game, an artifact like a map tells what actions he should take. It helps him to move forward with the task he was doing in the technology.

Visual presentation of information - Better visual presentation of information was preferred as it provides better visualization. For example, one participant mentioned that comparing to Google, YouTube is more favorable to her. When she searches an item on the search bar on Google, it shows all the websites containing the information. She manually has to go inside the websites and choose the one she wants. On the other hand, searching an item on YouTube gives her all the videos associated with the items, which helps her better visualize information.

Challenging - Challenging features also favored by participants, though it was not expected. Participants told that the amount of happiness they achieve after playing a challenging game that requires a lot of hard work does not give them that pleasure otherwise. The challenge causes them to continue with the technology.

Easy to use - Easy to use features were preferred by children as it supports them winning a game. They believed that the primary aspiration of using entertaining technology such as playing a game is winning, and easy features help them to achieve this goal.

Explore superpower - Superpower features had been discovered as the second-highest selected source of encouragement in entertaining technology. For example, in a game "Kick the Buddy" with superpower attribute such as Katana sword, they can slice something with and get rewards such as coins. Another superpower artifact they mentioned is Darold, which is a type of robot who has guns, exposures, and fire. When they kill a puppet with Darold, they can get rewards like tickets, coins, or gems. The superpower artifacts like the sword and robot enable the participants to have a superpower which does not exist in their life.

The similarity to real-life - Entertaining technology that has contents that are similar to their real-life experiences has been adopted as well. If real-life experiences such as being bullied by others and defeating bad people are depicted in technology, children favored them.

Fantasy - Dissimilarity with real-life or imaginative items was also their favorite component of entertaining technologies. The pure visionary features were invisible fire puffs or defeating others with stuff that we generally do not use in real life, such as chickens, robots.

Freedom - If a game had an abundant amount of freedom on playing such as playing the game in whichever way they want, that became their favorite game or entertaining technology.

Relaxing - Features that relax them, such as peaceful music is one of the looked-for features.

Adventurous - Adventurous activities to achieve a greater goal, such as unlocking rare battle rats after playing certain levels of the game, is one of the desired components.

Provide rewards - Rewarding features such as getting tickets, coins, or gems after a specific action in entertaining technology is a motivation promoter for children.

Better usability - Features that have better usability, such as doing different actions by touching different areas in the interface of a touchscreen device, can act as an inspiration booster in playing games.

Ability to improve the flow of features - If features can help change the flow of the entertaining technology like playing a game where fighting against something change or enhance the flow of the game, it is cherished similarly.

7.1.2 Features that Motivate Children to Use Educational Technology

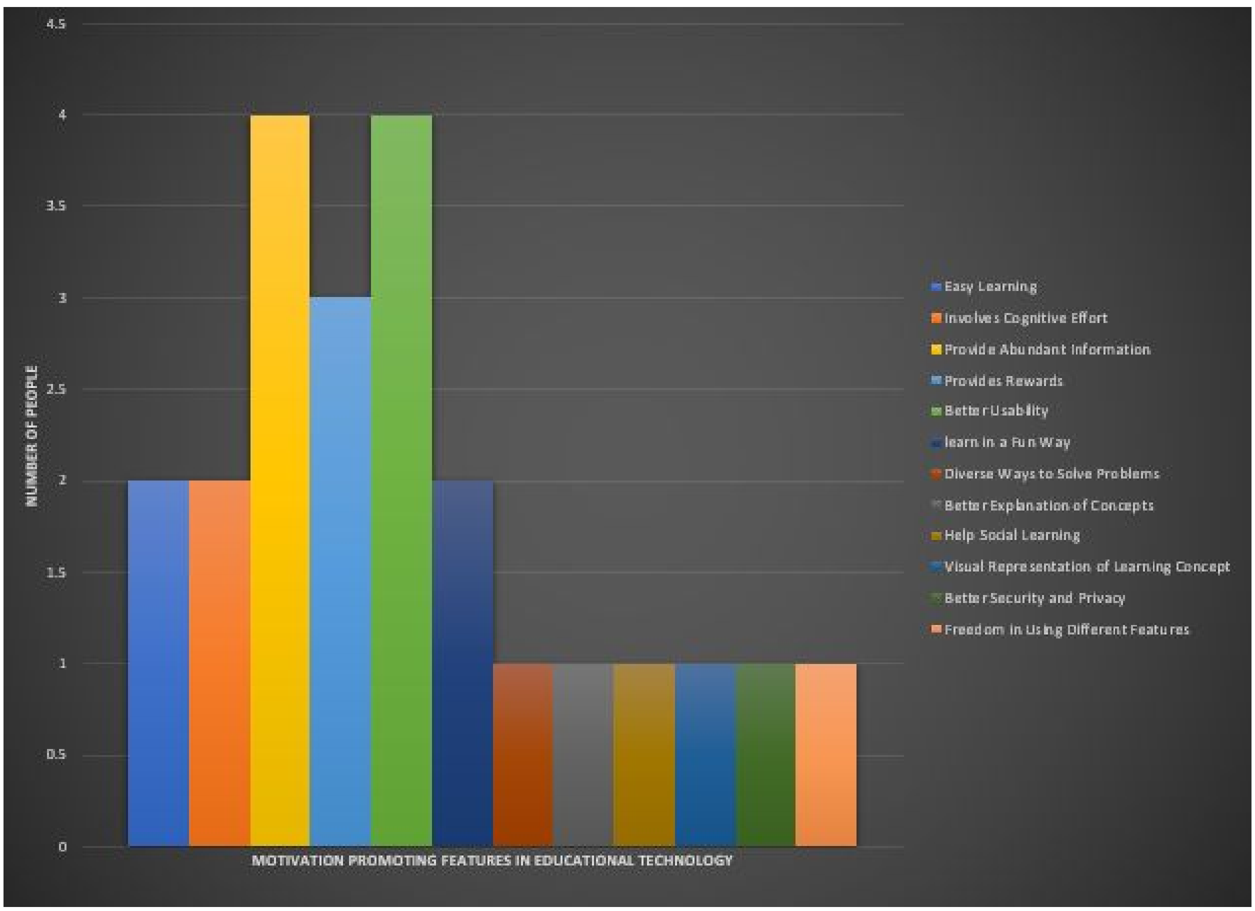


Chart 2: Motivating features in educational technology

Provide abundant information - Providing plentiful information was the most selected feature from educational technologies. While utilizing the technology, participants preferred when it helped them obtain the bountiful information they were looking for. For example, if the technology supported plenteous books to read, that helped children become more knowledgeable on the educational content.

Better usability - Technologies that include better usability have also been demonstrated as helpful for children. For example, if book chapters are accessible through headphones, that was helpful for children to read books with more comfort. Furthermore, if some features direct them to go to the next section of educational content smoothly, they were happy with it. For example, if in a technology participant types a word which is the name of a city, the word directs them to the city and helps learn about the city. Additionally, effortlessly moving between levels of learning content sections is also chosen. Uncomplex and easy to use features aided children do their projects efficiently.

Provide rewards - Features in educational technology that rewards children proved to be motivation booster. For example, if a person reads a lot, then he or she can go from picture books to chapter books. Every time someone reads books without any help, he or she gets 50 stars. Also, instead of the narrator reading to someone, if the person reads the book to the narrator, then the reader gets rewards of ten stars. Every time someone passes a level, he or she gets a pass level badge.

Easy learning - Though being educational technology, some of them do not require the user of the technology to have extensive knowledge of the content. When reading books in technology, it helped children to learn from their existing knowledge. For example, if children do not know reading big words, technology helps them learn starting with the words they know.

Involves cognitive effort - While easy learning was chosen as an encouragement booster, learning with cognitive effort was also selected. When solving math problems, if levels get harder after moving to further levels, it was considered to be more enjoyable.

Learn in a fun way - Children preferred solving math problems in a fun way. Computer programming became a favorite topic to learn for them if it was depicted in technology in a fun way, such as creating their puzzles through coding.

Diverse way to solve problems - While solving math problems in educational technology, if it is different than traditional ways of solving, then it is liked as well.

Better explanation of concepts - Well explained educational concepts or study subjects is admired in educational technologies.

Help social learning - Features such as posting videos what their teachers ask them or learning about how their special techniques that their friends are using support advancing social learning.

Visual representation of learning concept - Features that assist solve math problems with visual representation are a worshiped quality similarly.

Better security and privacy - Educational technology with better security and privacy turned out to be participants' favorite.

Freedom in using different features - Having freedom in learning is an inspiration promoter additionally. For example, in technology, users can type in a word which is the name of a city, then users have the freedom to change the word to anything they want.

7.1.3 Features that Discourage Children from Using Entertaining Technology

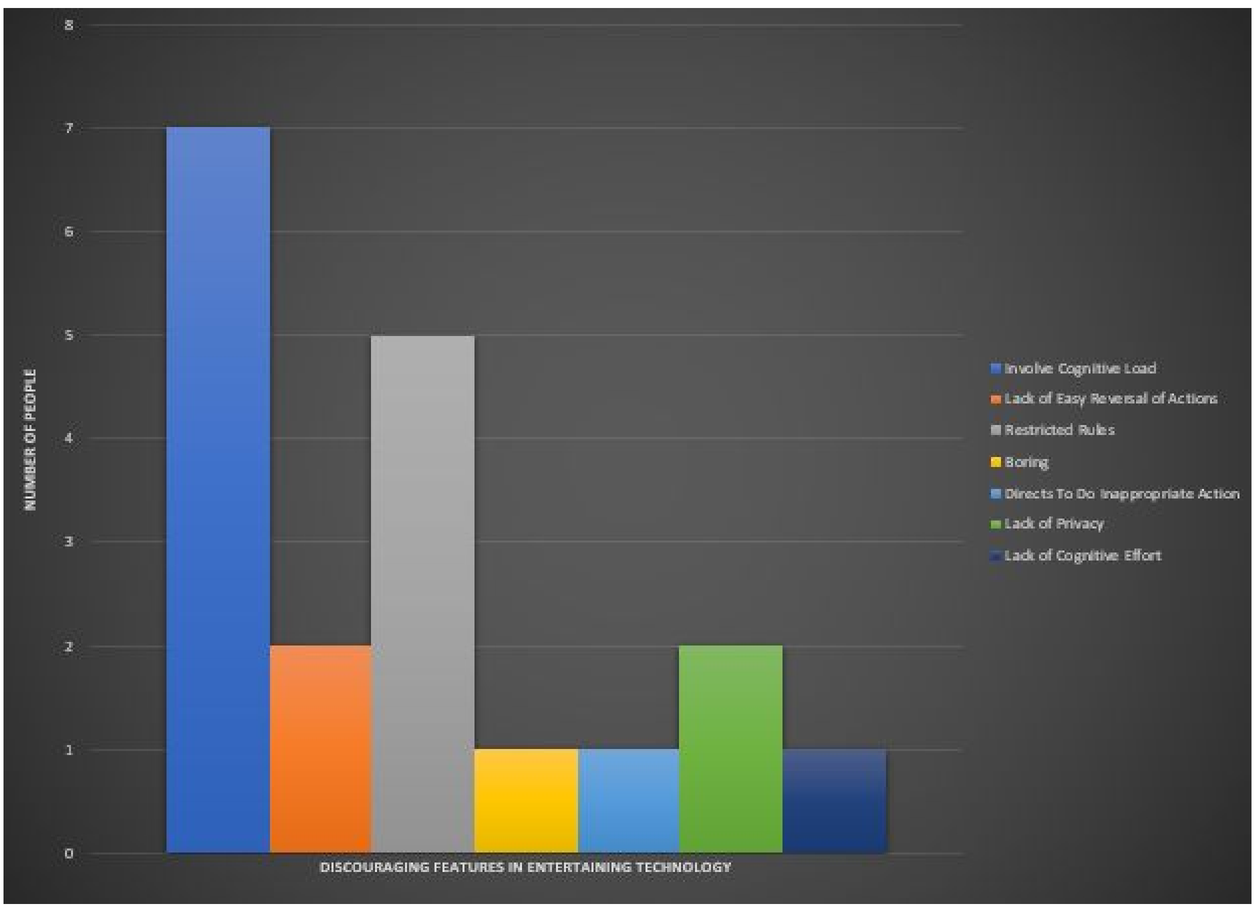


Chart 3: Discouraging features in entertaining technology

Involve cognitive load - In entertaining technology, the way some of the features are presented is very difficult for participants to use. For example, when playing a folding block game, there was no space for any squares. As a result, that become very difficult to fill in the blocks, which rendered them discontinue the technology. Furthermore, in a word puzzle game, it requires to fill in words that participants do not know yet. Also, in a maze game, the more moves they make, the harder it becomes. If they move to only one direction, they cannot stop moving forward in the game. They have to move to the end of the maze. If game features are too hard to play, it becomes losing easy, and participants do not like the experience of losing.

Restricted rules - Sometimes, in a game, though things are present to play with such as houses, spas, however, no one can use those. To use those features, they have to be bought. At the beginning levels, users can buy those. Nonetheless, after certain levels, they become restricted to use. Thus, users of the game have to stop the game immediately. Participants cannot use the features anymore and become discouraged from continuing with the technology.

Lack of easy reversal of actions - In a matching game, if participants get stuck and cannot match further, they cannot move backward and redo the steps where their performance was flawed. To go back to previous steps, they had to initiate the game from the beginning.

Lack of privacy - In a collaborative game, there is no restriction on who can join. As a result, a lot of unwanted people such as online daters can be present in the game. It is not an acceptable feature in technology by the participants.

Directs to do inappropriate action - Though being created for children, some contents in entertaining technologies show or direct to do tasks that are not appropriate for children.

Boring - Though being an entertaining technology, some of them are unable to entertain the users at all. Such technology is uninteresting. Participants feel a lack of attraction to use it.

Lack of cognitive effort - If games are too easy, they require the least amount of work. That is a detested quality in technology for a participant.

7.1.4 Features that Discourage Children from Using Educational Technology

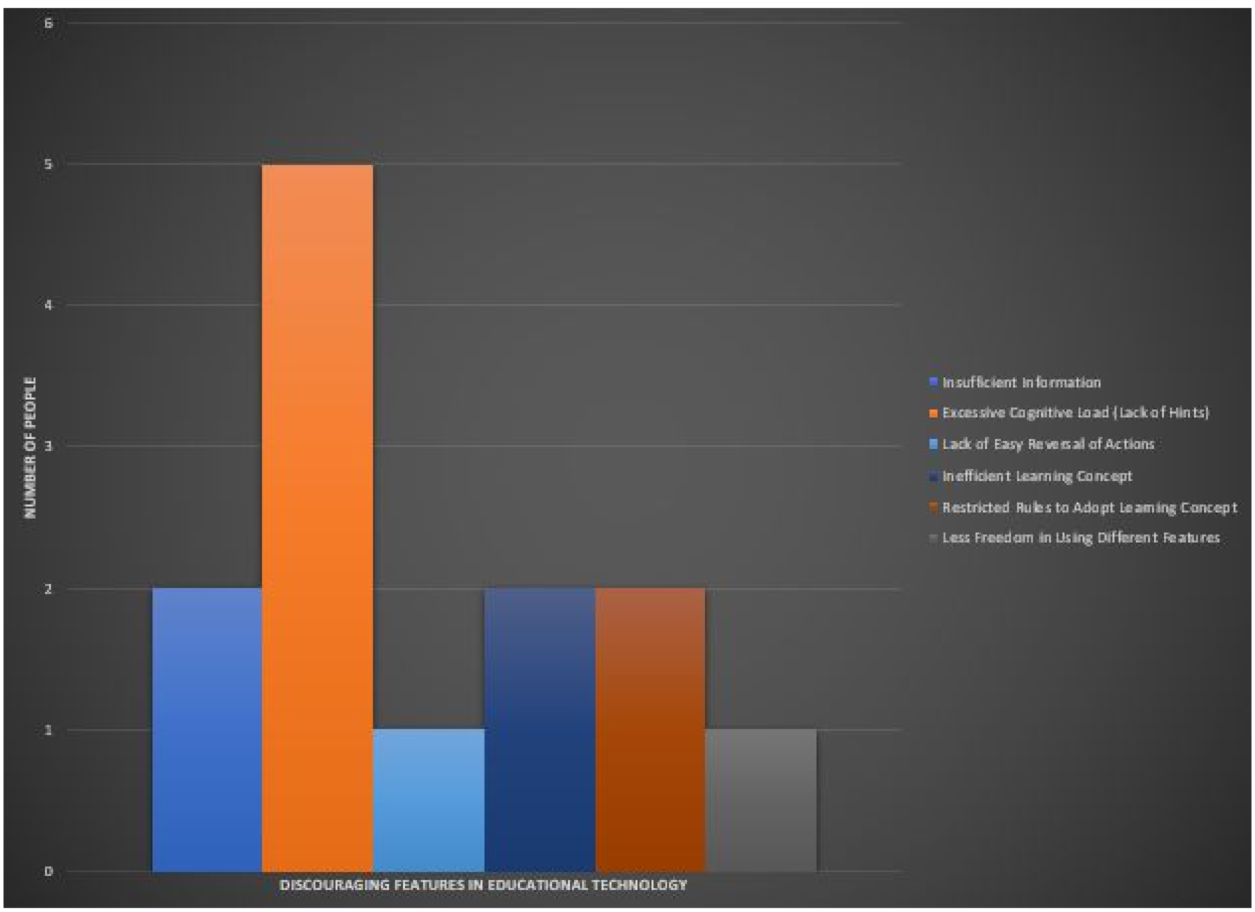


Chart 4: Discouraging features in entertaining technology

Excessive cognitive load (lack of hints) - When solving math problems, some of the numbers were very elongated. Participants had to guess it. There were no hints given. It was a difficult and unwanted task for the participants. In addition, some math problems are too tough to solve, and the technology also timed them. This feature of educational technology caused tremendous cognitive difficulty for the participants.

Insufficient information - In educational technology, it is expected that the user will find educational information easily. However, it did not happen to be true for some of the participants. For example, one participant searched for information on an educational website, but the search result gave her the information she did not need and provided unnecessary information. She was able to obtain only a little amount of information that she needed.

Restricted rules to adopt learning concept - Some features are too restricted. For example, in a reading session, a narrator kept talking and did not let a participant read by himself.

Inefficient learning concept - Though being an educational technology, sometimes it does not use educational content that can help learn.

Lack of easy reversal of actions - In some technology, it is not possible to go back if the user entered the wrong input and wants to change it. This feature makes them fail on the task.

Less freedom in using different features - While working at a certain level in educational technology, it is sometimes never possible to go to the next level. One of the participants was never able to go to the next level since he had to buy it to move forward.

7.2 Observation Findings

For entertaining technology observation sessions, children played Minecraft game through an iPad. For educational technology observation sessions, children operated ABCya via a computer. To better depict how Minecraft and ABCya works, a brief description of Minecraft and ABCya is demonstrated below.

7.2.1 Description of Minecraft

Minecraft is a game about placing blocks and having adventures. It's a survival experience about staying alive in your own fantastic world that's also a creative space to build almost anything. The steps to play Minecraft are labeled below (Stone 1).

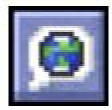
Logging in and the main menu

The launcher opens the News screen, which displays game updates and links. Enter your username and password in the lower right corner and click Log In to continue to the main menu (Stay et al. 2).

This list describes what you can do after you click the buttons on the main menu:

SinglePlayer: Start or continue a basic game. The remaining portion of this article covers the options for starting a game in SinglePlayer mode.

MultiPlayer: Join other players online.



Languages: Change the language of the text in Minecraft. This tiny button, next to Options, is a speech bubble containing a globe.

Options: Manage game options such as sound, graphics, mouse controls, difficulty levels, and general settings.

Quit Game: Close the window, unless you're in In-Browser mode.

Starting your first game in SinglePlayer mode

To start your first game in SinglePlayer mode, follow these steps:

- Click the SinglePlayer button to view a list of all worlds.
  If you're just starting out in Minecraft, this list should be empty.
- Click the Create New World button to start a new game.
  The Create New World page appears.
- In the World Name text box, type whatever name you want and click the Create New World button at the bottom of the screen.

Turning on game cheats increases or decreases the level of difficulty as you play and switches between Creative mode and Adventure mode. Cheats give you more control over the world when you're just getting started (Stay et al. 4).

When you finish creating your world, the game automatically starts by generating the world and placing your avatar (character) in it (Stay et al. 4).

Selecting the Right Game Mode in Minecraft

Minecraft offers several different types of game modes that allow you to experience the open world in a unique way (Stay et al. 4). The types of Minecraft game modes available are:

Survival – after randomly being spawned in a new world, players have to try and survived by gathering material, building shelter, gaining experience, and fighting off hostile mobs.

Creative – a game mode where players have immediate access to almost all blocks and items, are invulnerable & immunes to death, and have the ability to fly. The purpose of this game mode is to create or design unique worlds.

Adventure – players interact with objects (levers, buttons) and mobs to complete an adventure.

Spectator – Invisible to everything and cannot interact with blocks, entities, or your inventory. This mode is typically used to observe other player's created worlds.

Hardcore – Similar to survival mode, Hardcore is set to the "hard" difficulty level permanently and players cannot respawn; once you die, the map is deleted (or you permanently become a spectator).

7.2.2 Description of ABCya

ABCya.com is a website that provides educational games and activities for school-aged children. The games on the website are organized into grade levels from pre-kindergarten to Sixth grade, as well as into subject categories such as letters, numbers, and holidays. Many of the games meet standards associated with the Common Core State Standards Initiative ("ABCya.com").

7.2.3 Entertaining Technology Observation Findings

In Minecraft, children always generated a new world. In survival mode, they bought staffs such as swords, construction materials like wood pixels to break stuff, torches to help see dark inside the cave. They kept breaking the things surrounding them to own the item. The rule of breaking things is – "whatever you break it, you own it." Children constantly broke items and owned them. There was always something in the surrounding where they can kill it and own it. Also, participants selected clues such as a map that helped them to tell where they currently are and directed them to move in the right direction.

In the creative mode, they created gardens, crowns, or houses.

Children were observed to choose survival mode the most, where they had a significant amount of helper or clues that helped them continue or win the game. Also, in survival mode, children had the privilege to own the stuff they killed.

7.2.4 Educational technology observation findings

Children mostly chose poping words, word clouds, holidays, puzzles, and number games in ABCya. It was observed that they kept changing games while they were using the word or pattern games and were observed having difficulty playing them. Whereas when they chose creative games such as painting or making pizza, etc. where they created things according to their determination, they continued it for a longer time.

7.3 Overall Research Findings

The following are the overall findings of the research. The findings are demonstrated by answering the research questions that the study investigated.

Q1. Which entertaining technologies children like the most?

Children's mostly liked entertaining technologies are Battle Cats, Minecraft, Minion Rush, Pokemon, Puzzle of Blocks, Roblox, Uno, YouTube, Escape Schools from Roblox, Final Fantasy

Game, Kick the Buddy, Kitty Town, PBS Games, Rescue Cuts, and Unnie Doll. Minecraft was the most liked among all of the technologies.

Q2. Which entertaining technologies children dislike the most?

Children's disliked entertaining technologies are Coco, Mogi, Cuzy.com, Folding Blocks, YouTube, Minecraft, Roblox, Kitty Town, Amaze, Paint the Cake with Icy, Uno, and Wordscapes.

Q3. From which device they access entertaining technologies?

Entertaining technologies are accessed from the iPad the most, followed by iPhone, samsung phone, computer, 3DS, Xbox, and TV.

Q4. Which educational technologies children like the most?

Children's most favorite educational technologies are Word City, Raz Kids, Khan Academy, ABCya, ST math, Go math, Code.org, Google Doc, Flipgrid, and Google.com. ABCya was the most liked among all of the technologies.

Q5. Which educational technologies children dislike the most?

Children's most disliked educational technologies are ABCya, Raz Kids, ST math, Sumdog, firstmath.com, missioncalifornia.com, Hooked on Phonics, and My Little Pony.

Q6. From which device they access educational technologies?

They access these technologies mostly from computers, followed by iPads.

Q7. What are the design features of an entertaining technology that encourages children to use it?

Design features in entertaining technologies that encourage children to use it are a variety of options, fun, creativity, providing hints, visual presentation of information, challenging, easy to use, superpower, similarity to real life, fantasy, freedom, relaxing, adventurous, provide rewards, better usability, ability to improve the flow of features, and provide clues. Variety of options was the highest selected feature by participants.

Q8. What are the design features of an educational technology that encourage children to use it?

Design features in educational technologies that encourage children to use it are that provides abundant amount of information, better usability, provides rewards, easy learning, involves cognitive effort, learn in a fun way, diverse way to solve problems, a better explanation of concepts, help social learning, visual representation of learning concept, better security and privacy, and freedom in using different features. Providing abundant information and better usability was the topmost nominated features by participants.

Q9. What is the difference between how features in entertaining and educational technologies had been heartened by children? How can that help redesign educational technologies?

There were similarities in the entertaining and educational technology features that had been favored by children. However, the goal of using entertaining technology features was for entertaining purposes, whereas educational technology features were associated with learning educational content. In the redesign of educational technology, these enthusiasm endorsing features was added abundantly as they can inspire children in using educational technologies.

Q10. What are the design features of entertaining technologies that discourage children from using it?

Design features in entertaining technologies that discourage children are involving cognitive load, restricted rules, lack of easy reversal of actions, lack of privacy, boring, and lack of cognitive effort.

Q11. What are the design features of educational technology that discourage children from using it?

Design features in educational technologies that discourage children are those that involves excessive cognitive load (lack of hints), insufficient information, restricted rules to adopt learning concept, inefficient learning concept, lack of easy reversal of actions, less freedom in using different features.

Q12. What is the difference between how children had disheartened features in entertaining and educational technologies? How can that help redesign educational technologies?

When a feature was acted as a restriction to enjoy the technology, that became their detested feature in the entertaining technology. Educational technology features were disliked if they restricted children from learning the educational content they are looking for. In the redesign of educational technology, these constraints are suggested to eliminate and avoid.

Q13. How Motivational Affordance Theory apply in this study?

According to motivational affordances, the term affordance refers to the actionable properties between an object and an actor. When perceived, affordance allows actors to take actions that may satisfy certain needs. Motivational affordances comprise the properties of an object that determine whether and how it can support one's motivational needs. In the redesign of educational technology, features were added if participants pointed out at them as a source of motivation for them to use it. Users can satisfy particular needs or achieve specific goals by utilizing those features such as reading a book, googling educational content, solving math problems, or finishing a certain level of an educational game.

When using ICT involves our motivational needs, we feel interested (thus attend and engage). When using ICT satisfies our motivational needs, we feel enjoyment (thus want more). The ultimate goal of designing an ICT for human use is to achieve high motivational affordance so that users would be attracted to it, really want to use it, and cannot live without it (Zhang 2). In the redesign of educational technologies, implemented motivation boosting features from entertaining that children mentioned in the study, can help achieve high motivational affordance so that children become attracted to use it and want to use it.

Q14. How can Field Theory be applied in this study?

Kurt Lewin's field theory can be applied in creating the mock-up as a redesign suggestion for educational technologies containing the research findings. Kurt Lewin said that you could explain all your actions with one simple fact - we see specific paths and ways to unload inevitable tensions. We are attracted by the actions we see as ways to let that tension out ("Kurt Lewin and Field Theory")

He also suggested understanding our behavior and proposed that we have to keep in mind all the variables that play a part in it in real-time. Lewin came up with three key variables for explaining this idea. They are:

1. Need: what gives the motivating tension a start. When a person has a physical or psychological need, an internal state of tension will awaken inside them. This state of tension makes the system or the person change to try to get back to its initial state and satisfy its need ("Kurt Lewin and Field Theory"). In the redesign of educational technology, the need a child might have while using educational technology is the motive to finish the learning concept,

such as reading a book, googling educational information, solving a math problem, or completing a certain level of an educational game.

2. Energy: It is what causes actions and what motivates them. When there's a need, an energy or energy field will appear, and that will lead to an action. All these actions have a charge, either positive or negative. The charge of these actions also leads to other actions (positive) or pushes back (negative). The behavior that comes from all this reacts to the psychological mix of different energies ("Kurt Lewin and Field Theory"). In our redesign of educational technology, the motivation promoting features from entertaining technologies from this research findings can be the energy to cause an action such as continuing with the technology for a more extended period.

3. Tension: It is the difference between a person's goals and their current state. The tension is internal and pushes us to go through with our intentions. Kurt Lewin said that we could explain all our actions with one simple fact - we see specific paths and ways to unload certain tensions. We are attracted by the actions we see as ways to let that tension out ("Kurt Lewin and Field Theory". In our redesign of educational technology, while implementing only the motivation promoting features from educational and entertaining technologies and eliminating the discouraging elements that the research found can help children having a path to achieve their goal of learning through enjoyment. It can act as a way to let the tension out to follow the path to achieve children's goals faster. Though this study found that challenge can act as a motivation promoter, it is also found that if the challenge is too difficult, that is not favorable by children. An optimal challenge should be neither too difficult nor too easy ("Intrinsically Motivating Instruction (Malone)"). The redesign avoided too difficult challenge that might increase the tension and added the challenge that is necessary to push children through their intentions and reduce the tension momentarily.

8. Implications

This study investigated what features inspire children to use technology. The research showed promising results. Participants pointed out to every small component on technologies that they experienced in their life that drove them to use or make them disheartened towards them. This study recommends the design of educational technology with the features that children have declared as motivation promoters for their technology usage. Below is a mock-up of the redesigned educational website ABCYa designed with the research findings, including all the features that children affirmed to be enthusiasm booster. The mock-up was created with the wireframing and prototyping tool Axure.

The initial page of a number comparing game in ABCYa.

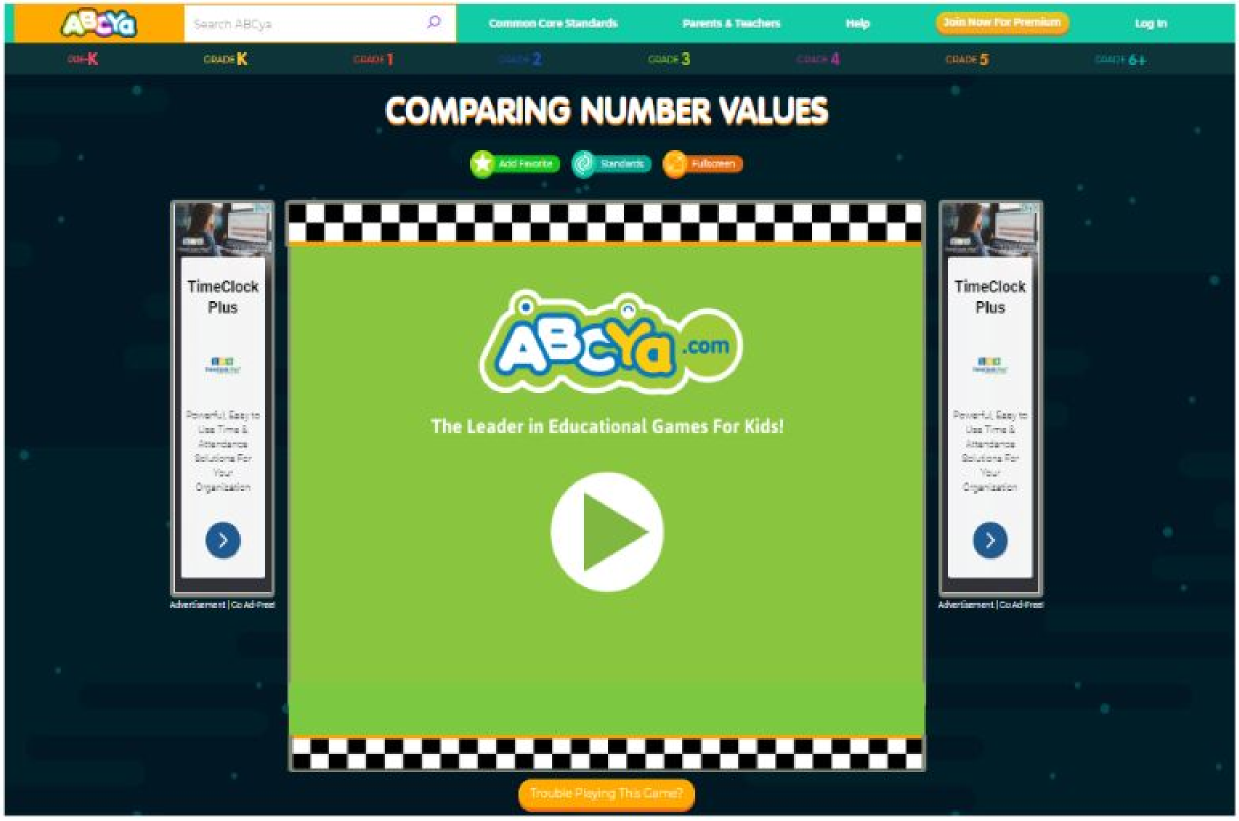


Figure 3: Mock-up screen 1

If the user wants to be in create objects mode in full screen and click on the full-screen button, they will get a prompt showing two options. The first option is regarding joining a premium plan. The second plan will be showing other options to view the full screen. By providing other options, the technology does not restrict the user to sign up for a premium plan.

Features applied from research findings: variety of options

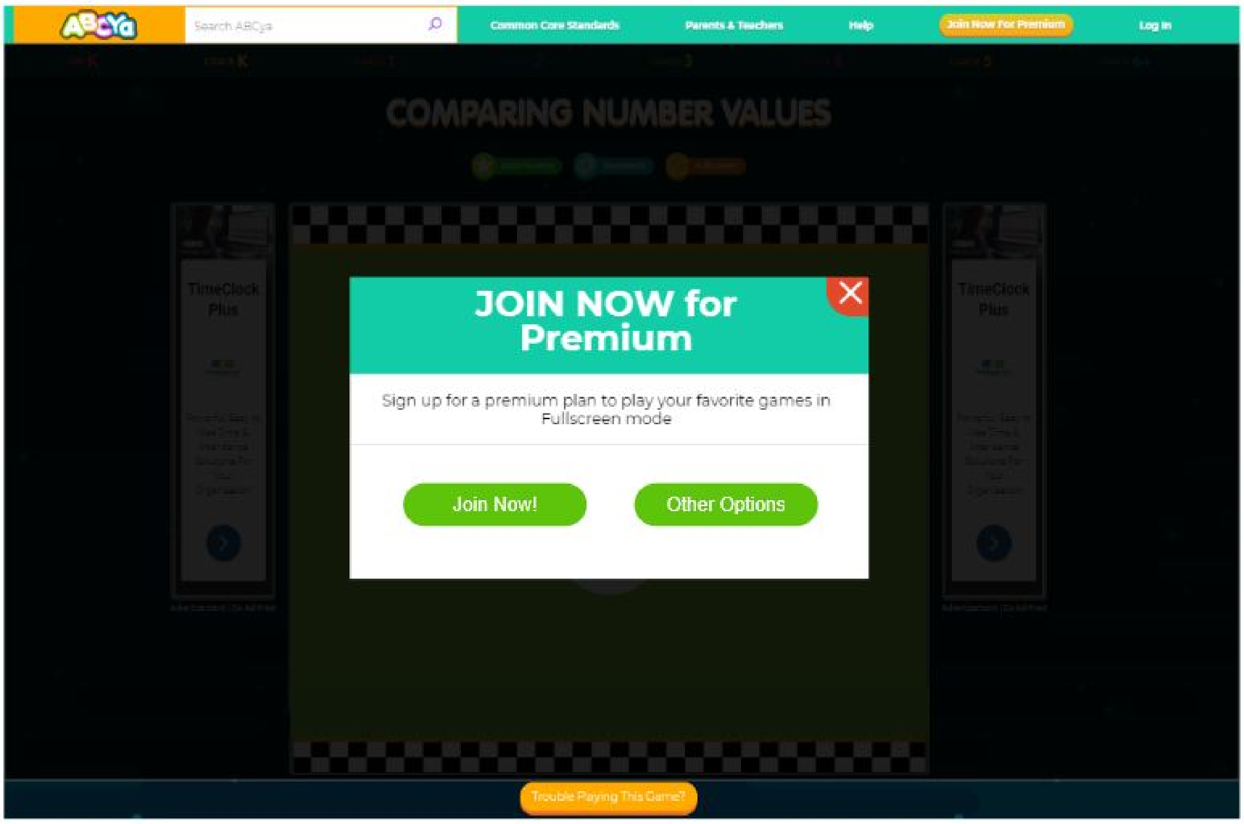


Figure 4: Mock-up screen 2

After clicking on the other options button, the user will be given a chance to view the game in full-screen mode if they win two consecutive games in a row. This feature is applied to motivate users to put an effort to win the game and become challenged.

Features applied from research findings: challenging

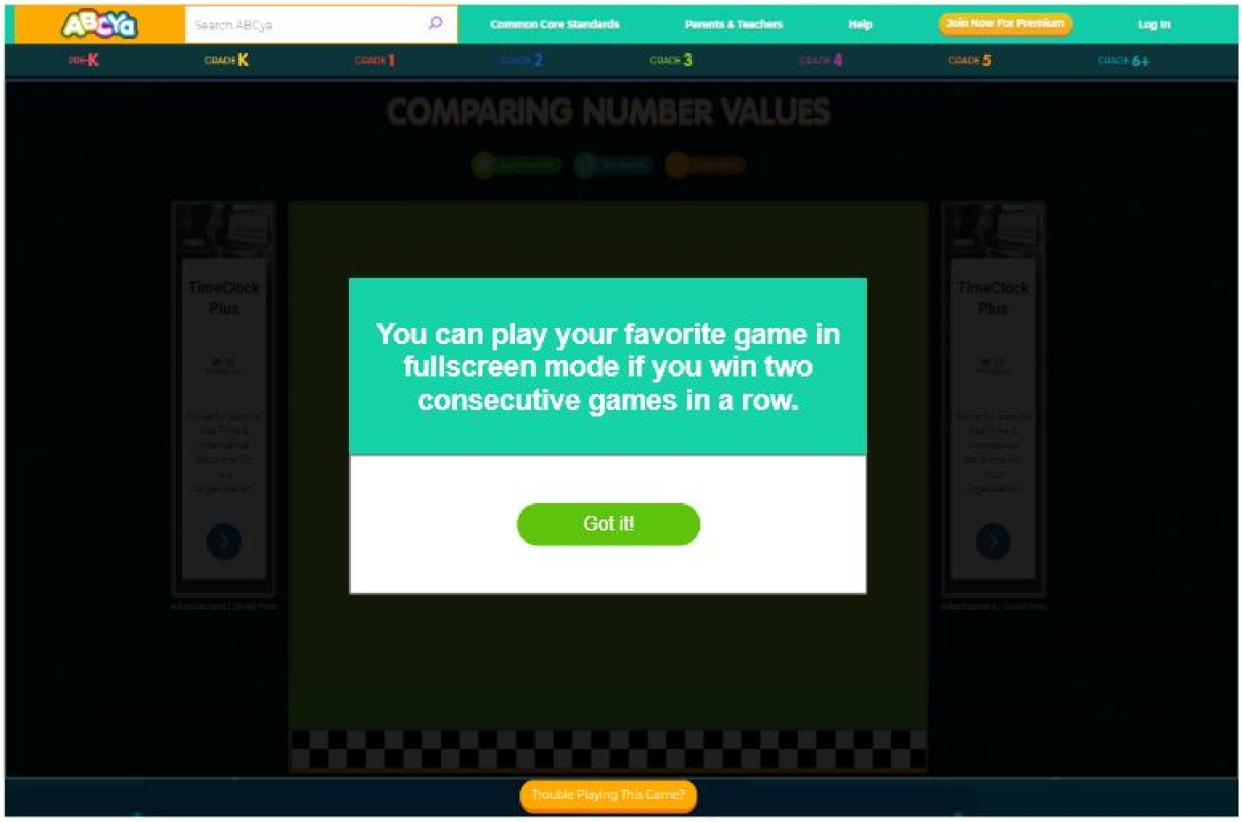


Figure 5: Mock-up screen 3

After the user clicks on the "Got it!" button, they will be directed to choosing game helper options and player modes. The game helper options will act as helpers in playing the games. The helpers are the features that children stated as a source of encouragement to use entertaining technologies. Users can create or edit the helpers the way they want.

Features applied from research findings: provide clues, variety of options, freedom

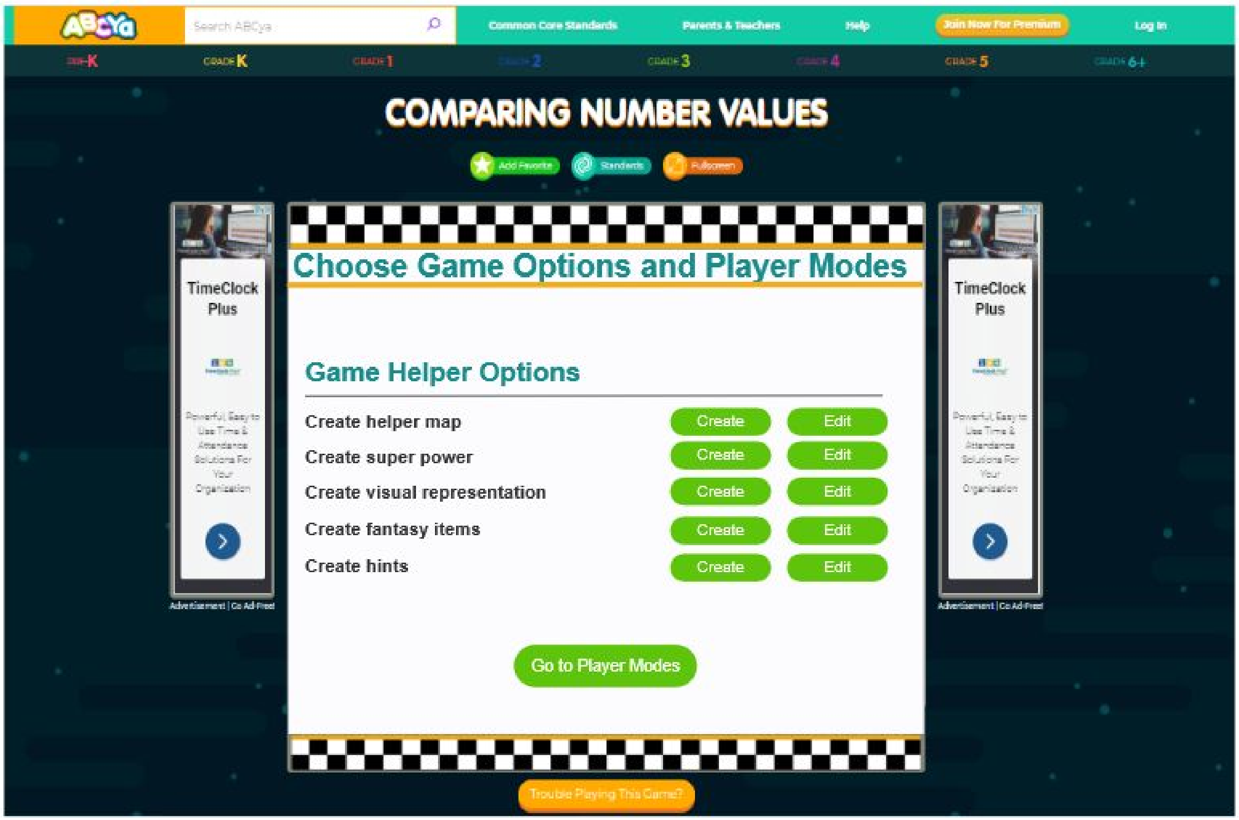


Figure 6: Mock-up screen 4

For the player modes options, the user can choose a specific mode for the game. Like the game helper options, player modes are designed with the features that participants specified as a foundation of inspiration to use entertaining technologies. Users can create or edit the player modes according to their choice.

Features applied from research findings: variety of options, freedom

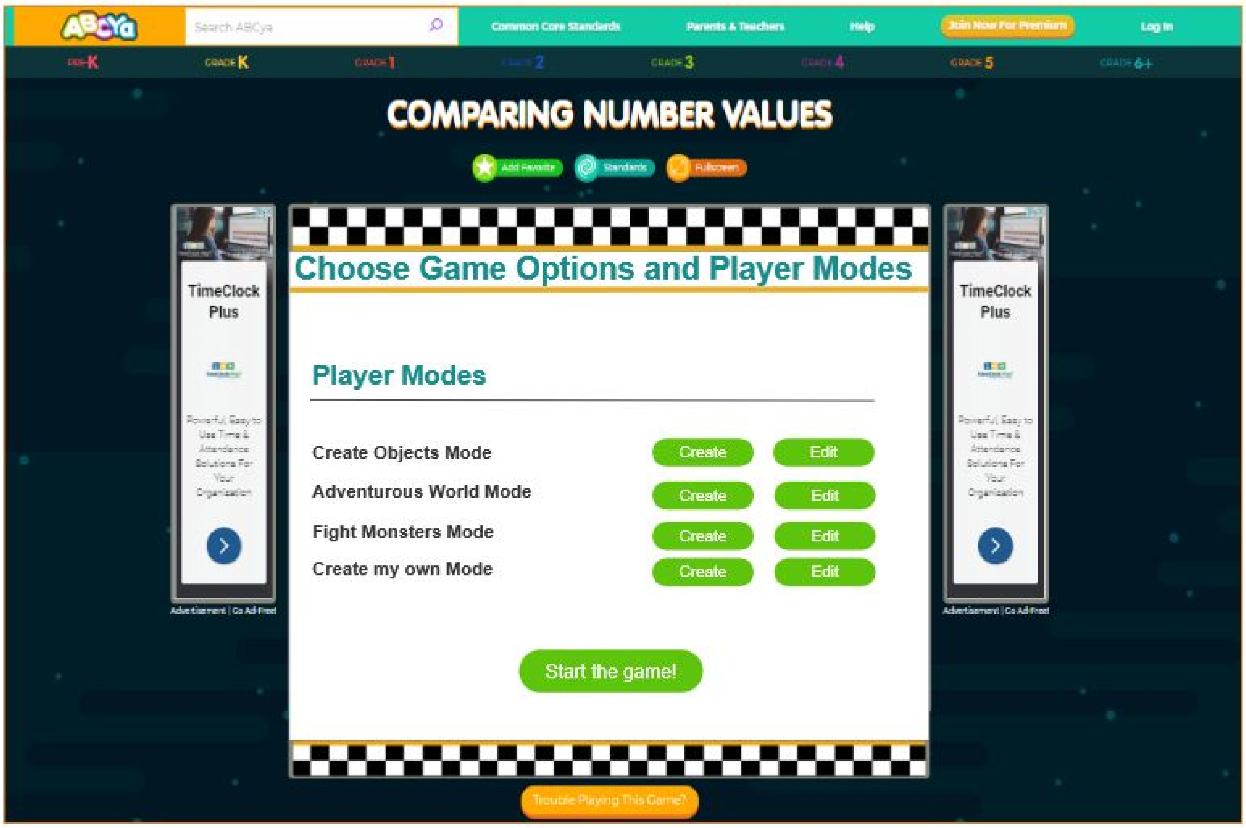


Figure 7: Mock-up screen 5

After the user creates one mode, which is in the following example is "create objects mode," the user will be able to build anything according to the way he or she wants, such as building a house portrayed below.

Features applied from research findings: variety of options, creativity, freedom

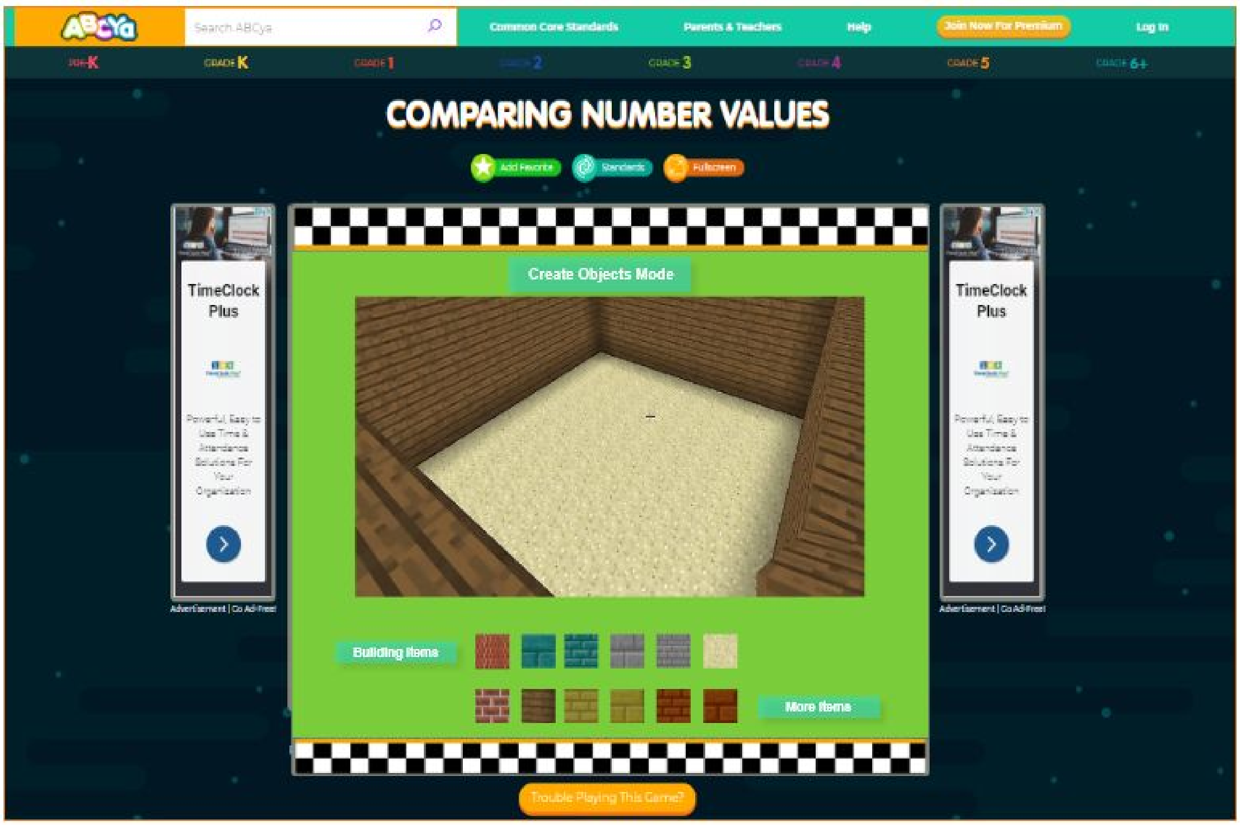


Figure 8: Mock-up screen 6

After some amount of time, while building a house, the user will get a prompt in the screen directing him or her to solve a math problem. If the math problem approaches difficult to the user or the user wants to solve the problem faster, he or she can take helpers' assistance.

Features applied from research findings: provide hints, ability to improve the flow of features

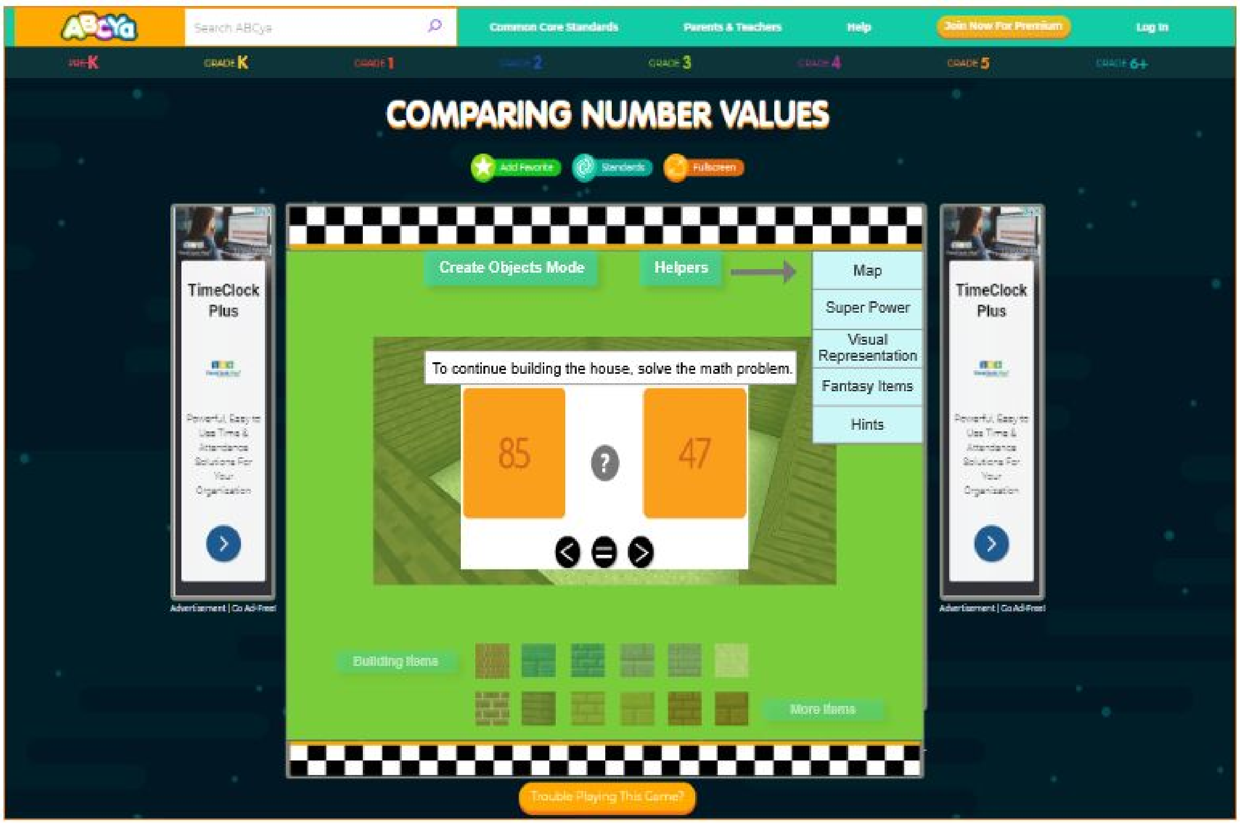


Figure 9: Mock-up screen 7

Below is a black colored thought or speech bubble where a user is depicting his or her thought process of how he or she is using different features of redesigned ABCYa. When the user needs a helper to play the game, he or she might like to access all the helpers and their categories first and choose the one that meets his or her need. All the helper features are represented in a menu with submenus, which can help users find the helpers they need effortlessly.

From the game helper options, the map can guide the user through the entire game process. The map can provide the user descriptions of how different levels of math problems work so that users can prepare to solve the math problem accordingly. The map can be fast or slow. If a user has a significant amount of knowledge about the math problem, then he or she can choose a fast map. If a user has a lacking knowledge about the math problem and wants an in-depth understanding from the map, he or she can select the slow map. The map can guide the user with the features that can be beneficial to solve the problem or win the game, such as describing how all the other game helpers work and how they can help the user. This way, the user can move fast and easily in the game and improve the flow of the game instead of being trapped in certain levels of math problems.

Features applied from research findings: variety of options, freedom, better usability, ability to improve the flow of features, easy to use

Figure 10: Mock-up screen 8

Superpower features such as a sword or robot can assist in playing the game additionally. As soon as a user selects a superpower, it will appear on the screen and help the user in learning educational content.

Features applied from research findings: superpower, variety of options

Figure 11: Mock-up screen 9

If users want to see any visual representation to solve the math problem, they can choose the visual representation option from the menu. The visual representation option can have sub-options to help users choose a specific type of representation, such as number comparison video, number comparison meme, and number comparison with real-life examples. If users click on any of the sub-options, there will be more sub-options such as easy, medium, and hard levels.

Features applied from research findings: visual representation of information, variety of options, similarity to real life

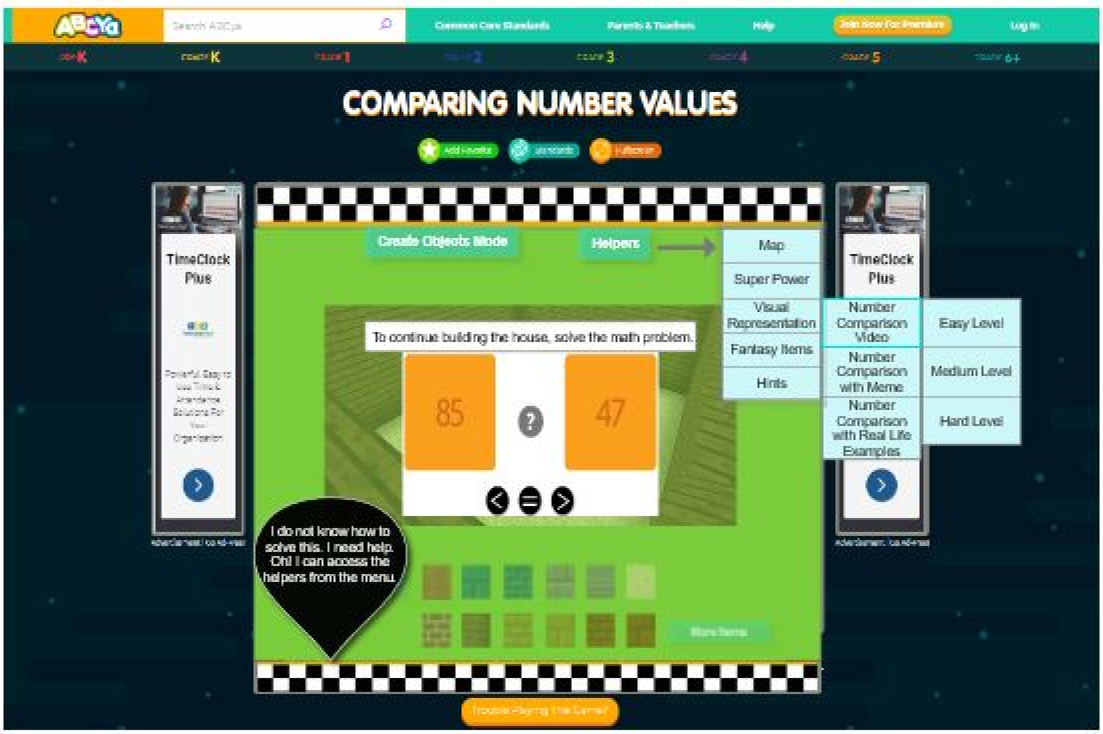


Figure 12: Mock-up screen 10

If users want to seek a fantasy item to solve the math problem, they can choose a fantasy option from the menu. The fantasy item option can have sub-options to help users choose a specific type of fantasy items such as chicken and fire puffs. If users click on any of the sub-options, they can use the feature subsequently.

Features applied from research findings: fantasy, variety of features

Figure 13: Mock-up screen 11

If users want to have hints to solve the math problem, they can select hints option from the menu. The hint option will have sub-options to help users choose a specific type of hint, such as hints to solve the math problem and hints to understand the math problem.

Features applied from research findings: provide hints, variety of options

Figure 14: Mock-up screen 12

After the user looks through all the helper options, he or she can freely decide to select an option that he or she assumes will be the most supportive feature to learn the educational content.

Features applied from research findings: variety of options, freedom

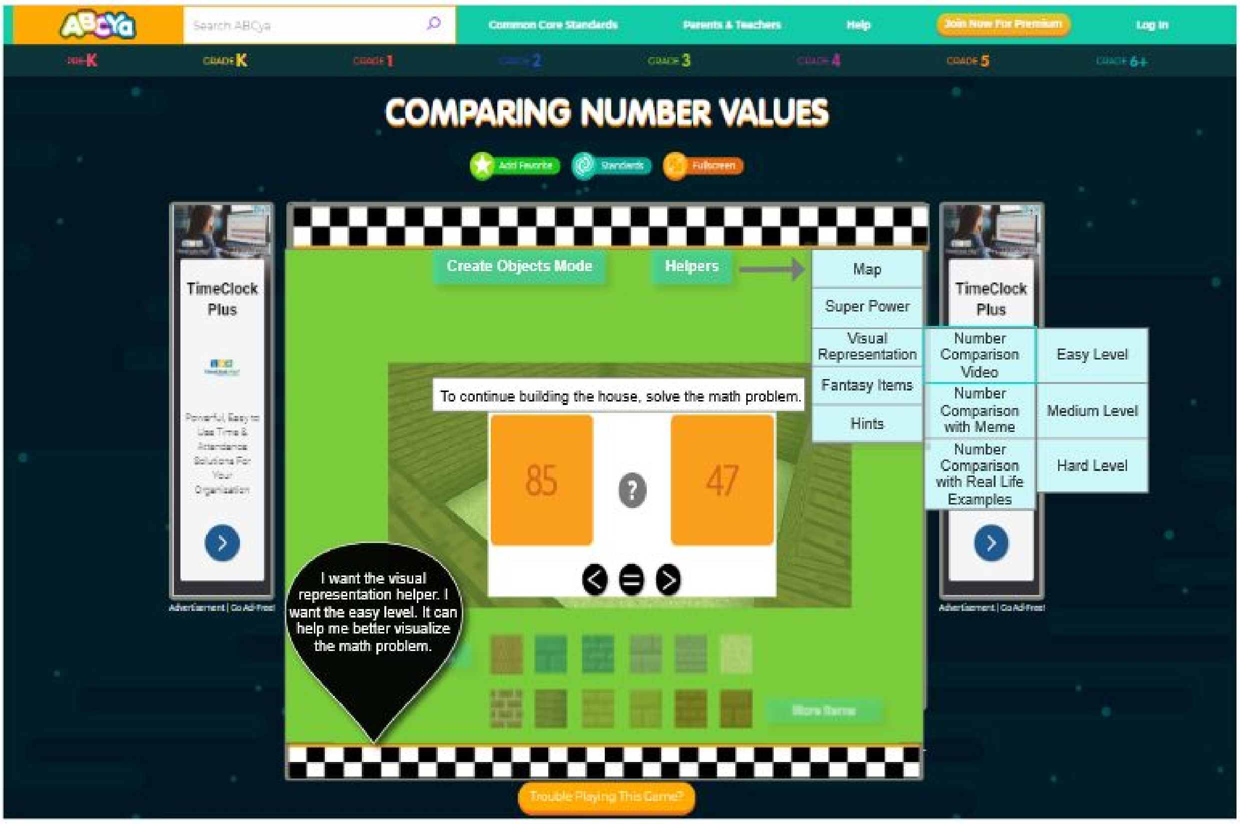


Figure 15: Mock-up screen 13

If the user chooses the visual representation of information helper, he or she can view a number comparison video demonstrating what number comparison is and how to solve number comparison math problems.

Features applied from research findings: visual representation of information

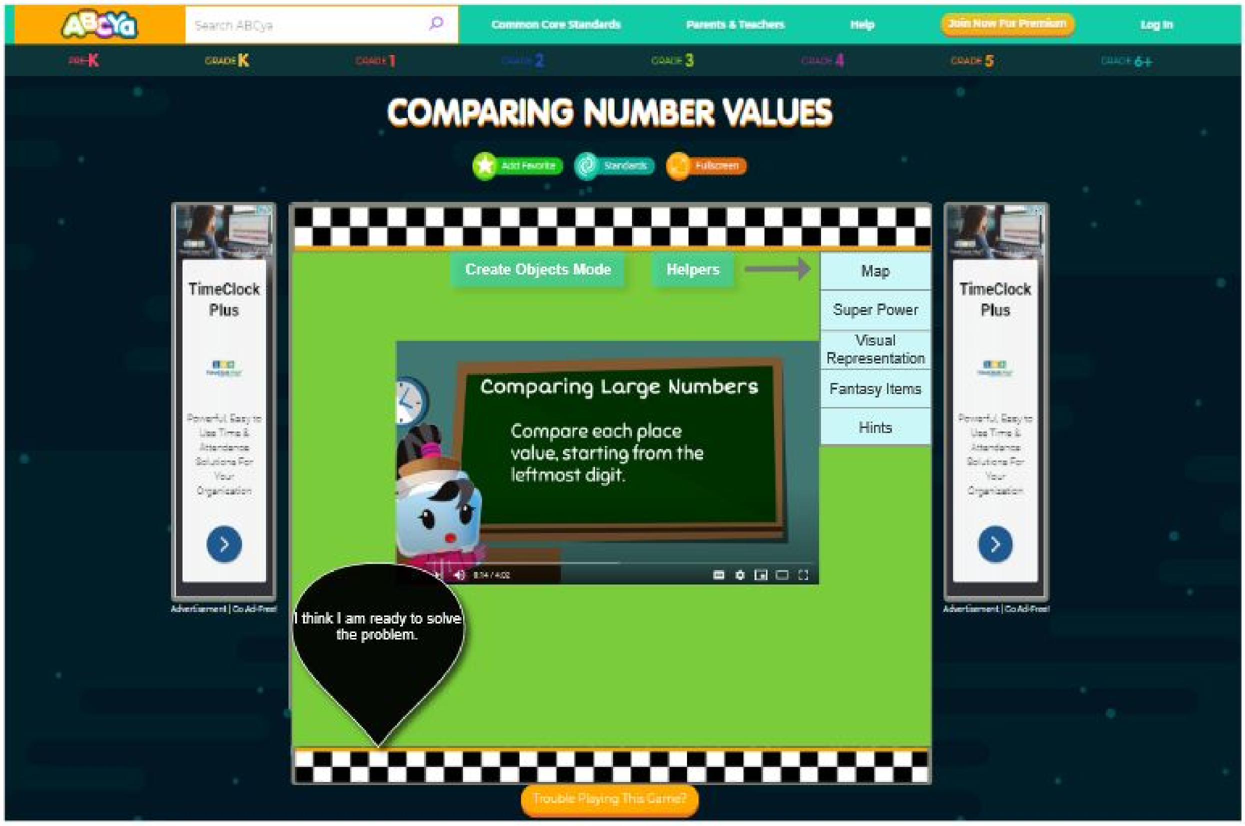


Figure 16: Mock-up screen 14

After watching the number comparison video, if the user still finds difficulty solving the math problem, he or she can choose another helper option for help without restrictions.

Features applied from research findings: variety of options, freedom

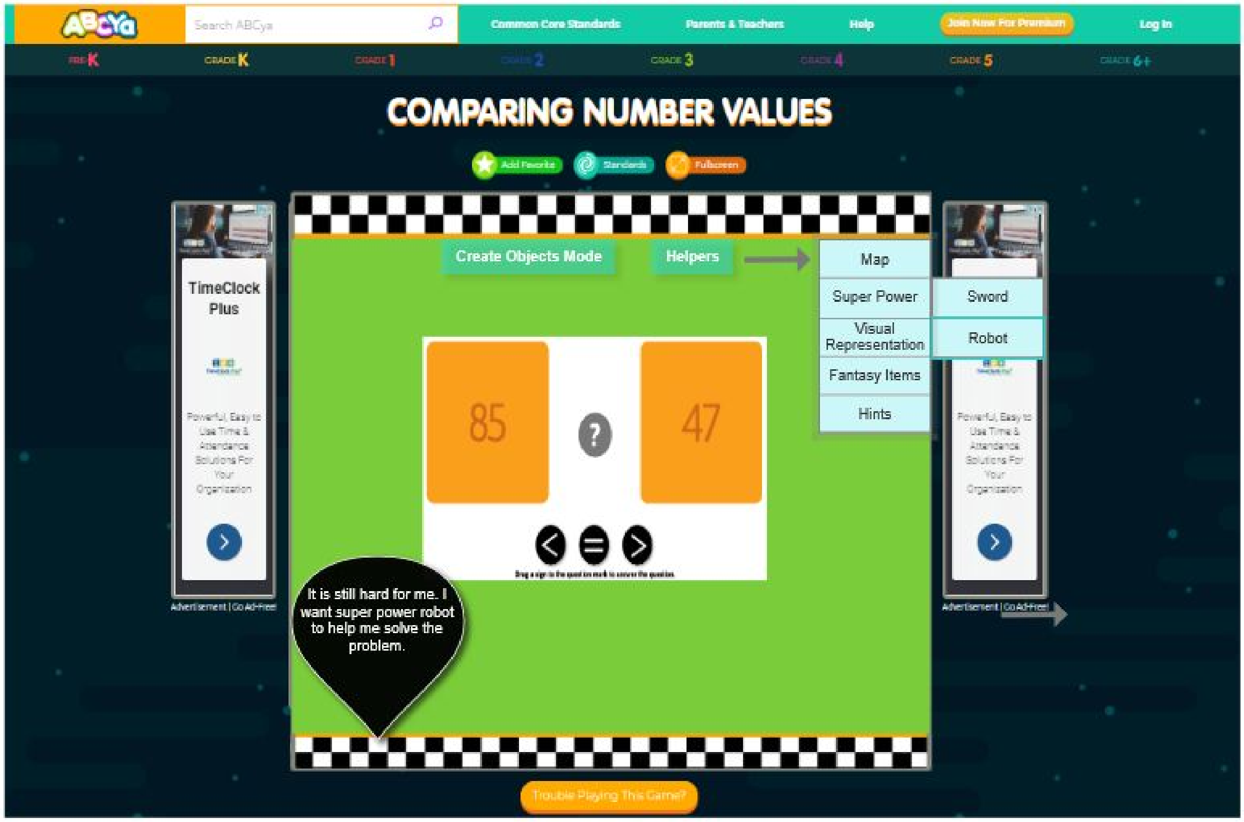


Figure 17: Mock-up screen 15

Users can choose superpower as the second helper. If the user selects robot as a sub-option from the superpower options, a robot will approach the screen changing the background color of the screen. The robot can solve the math problem on behalf of the users.

Features applied from research findings: superpower

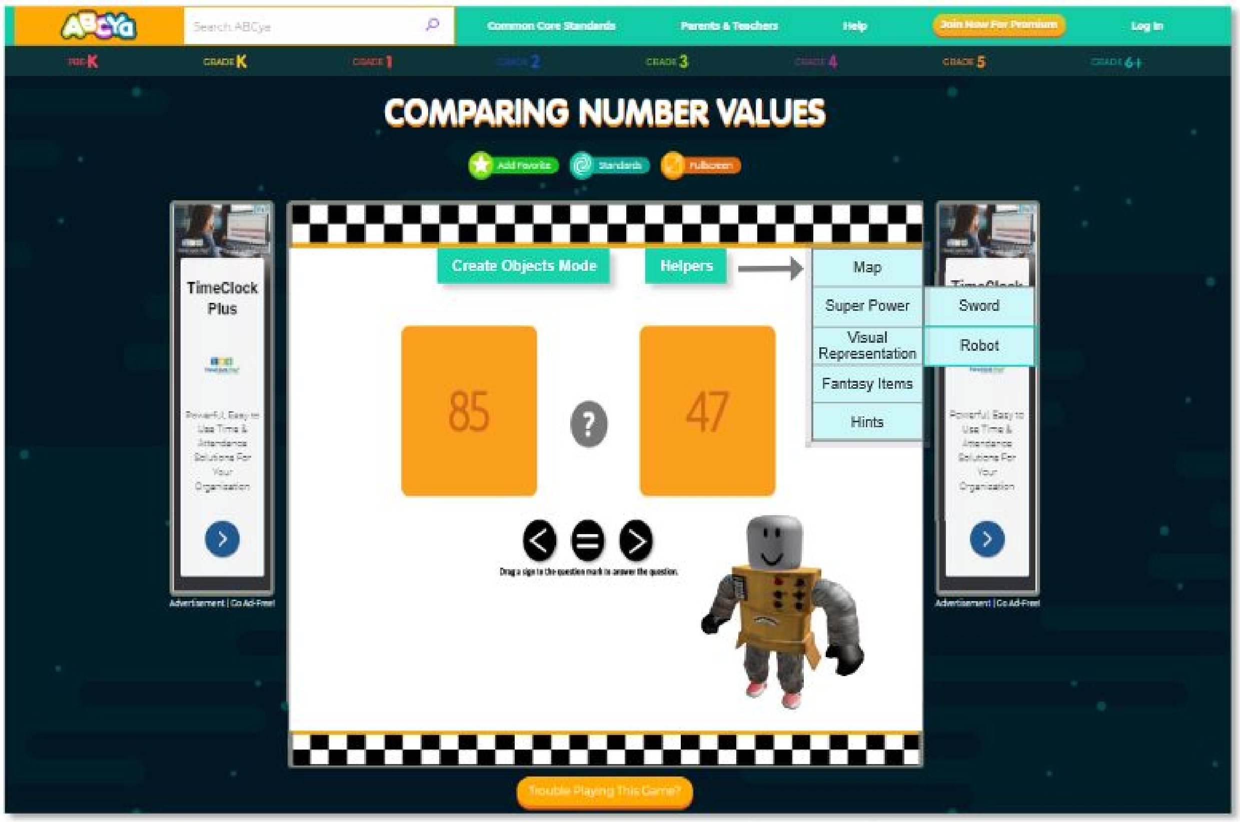


Figure 18: Mock-up screen 16

After solving the math problem, the screen will resume to create content mode. If users solve or win the math game two consecutive times, they will be rewarded to access full-screen mode. According to Gloria Mark, a powerful form of learning is through random reinforcement, or a variable interval schedule. Randomly reinforced behavior is like playing the slot machines in Las Vegas. People keep playing the machines because they believe that at some point, the reward will come (Mark 99). This redesign will shadow Mark's idea. The more user will win math problems, the more they will be rewarded. As a result, users will keep playing or winning in order to get awards, which eventually will help them learn. Furthermore, users will be rewarded to make their own game helper options, such as creating a new superpower or a new fantasy item. More helpers can help them learn educational content with more portrayal, thus improving the learning process.

Features applied from research findings: provide rewards, freedom, variety of options

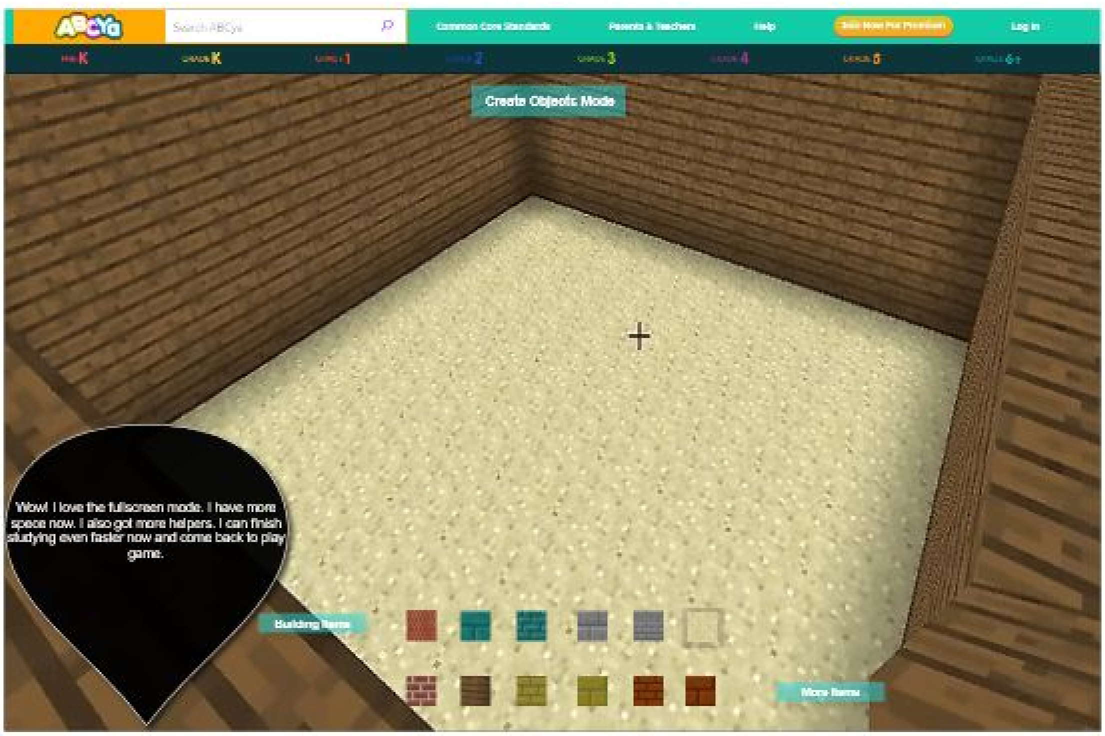


Figure 19: Mock-up screen 17

9. Limitations

1. **Lack of Features in Redesign according to Children's Age:** The redesign mock-up was created with the overall research findings. It did not suggest how features should be created differently for different aged children.
2. **Being Participant Research:** As children were stated to use specific technology for the observation, and they were also notified about the research regarding their interaction with the technology, this research does not contain real-life technology usage. Children might behave different when they use technology in their real-life, which this study was unable to unearth.
3. **Undistinguishable Findings of Observation Research:** During the observation session, children had been observed using entertaining and educational technologies. Children were observed taking specific actions. Nevertheless, no clarification was uncovered on why they took those particular actions.

10. Conclusion

Technology is a powerful tool that can transform education for children. New technologies created for children can show triumph in the way they learn. The integration of technology in education provides excellence in the educational system. If properly constructed, educational technology can significantly assist in learning and ensure a good education. To ensure that we create the right educational technologies for children, we need to know what can motivate them using. This study found these motivating features.

This study found that the encouraging features in entertaining technologies for children are variety of options, fun, creativity, provide hints, visual presentation of information, challenging, easy to use, superpower, similarity to real life, fantasy, freedom, relaxing, adventurous, provide rewards, better usability, ability to improve flow of features, and provide hints. It also found that encouraging features in educational technologies are providing abundant Information, better usability, providing rewards, easy learning, involves cognitive effort, learn in a fun way, diverse way to solve problems, better explanation of concepts, help social learning, visual representation of learning concept, better security and privacy, and freedom in using different features. This research suggested redesign of educational technologies with that of motivation strengthening features from entertaining technologies as the principle features followed by educational technology features that children venerated in the study. This way, children's goal of technology usage can be entertainment. While getting entertainment, they can learn educational content by accessing the educational technology features.

This study understood why and how younger people are using technologies and informed technology design for them according to this understanding. It suggested that in the future, we should design systems for children the way they want, not the way we want them to be. Children have their own likes, dislikes, curiosities, and needs (Druin 1) that designers might like to investigate before designing educational technology for them. If technologies are redesigned for children with the features they want, that can show triumph in the way they learn.

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