Designing Dexterity Gameplay to Impart Awareness among Children

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Abstract

Growing children, especially those aged 4 to 6, are surprisingly intuitive and impressionable. Imparting the awareness of essential topics among children in this age group can assist in building a curiosity-driven and aware generation. The utilization of dexterity gameplay as a medium for teaching can benefit by allowing the children to be involved in the learning process rather than being taught directly. Solely imparting knowledge about the crucial matter through games would not be sufficient to reach the masses. The concept of developmental play has become a key contributor to the toys and games industry over the last few years. With the newfound requirement for indulging indoor play, there is great potential for products that assist in fine motor development, giving us the avenue to teach through play. For this paper, the implications would be tested through the design and development of an economic dexterity board game that imparts awareness of endangered native animals of India. Through this paper, we can look at the learning stages of children in this age group and understand ways to promote understanding and awareness among children at their own pace by designing a dexterity game that imparts learning while ensuring a playful experience. The research entails the target age group's key milestones in learning, followed by proposing a design for developing a suitable and economical dexterity game solution that would help venture into the arena to target the statement at its core.

Keywords: imparting awareness; intuitive learning; dexterity gamification; value from play visual interaction;

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Introduction:

Play is pleasurable, internally motivated, requires engagement, and is voluntary (Garvey, 1990). However, while these attributes for play are similar for children and adults, designing for children differs in many aspects from designing for adults (Torres, 2008). Dexterity games refer to games in which players must reach their end goals using manual dexterity and hand-eye coordination. At

their core, they are games that require users to utilize fine or even gross motor skills to complete or accomplish tasks in a stipulated period in the duration of the gameplay. Dexterity games have various sources of difficulty in manual dexterity that affect each player's experience and may or may not require a certain skill set to be developed. For example, popular games like Jenga or Rhino Hero: Super Battle require steady hands and strategic placements to prevail, whereas games like Carrom require a strong set of fine motor skills and precision.

One of the prominent milestones of the age group of 4 to 6 years involves the inference and abstract comprehension of diverse topics, making them an ideal audience to teach. This unbiased and open thought process can result in them thinking in a divergent direction with ideas that could have been unseen or overlooked by others, preparing them and assisting in their development for the future.
Integrating motor and cognitive development with play has become a key contributor to the toys and games industry over the last few years due to the increased demand for hyper-functional products. Parents have started looking for product alternatives to engage their children and benefit their overall growth.

The concept of nature is a major element in conveying the topic of native animals to children as they tend to relate senses to understand things around them. This indicates that providing visual and tangible interaction through natural textures and colours during play is necessary and can also help ensure that the child is engaged throughout playtime, interacting and learning with the game.

In this paper, we focus on the aspect of dexterity gameplay that utilizes strategy comprehension and the requirement of fine motor skills to appeal to players with vast abilities. Through this act of dexterity and developmental gamification and to test the implications of this paper, we are creating a dexterity board game that can help achieve a medium to impart knowledge, for example, about endangered native animals of India, while meeting the requirements of the masses and staying interactive and exciting.

Literature Review

Strategic Dexterity Board Games

One of the most common forms of games includes 'Board Games.' A board game is a generic term for a game played by placing, moving, or removing pieces on a board and that utilizes a game format in which pieces are moved in particular ways on a board marked with a pattern. (Noda et al., 2019). Although the physical movement over the pieces on the board attributes to manual dexterity, this category of games only comes partially under the umbrella topic of dexterity gameplay. Through a small sample telephonic survey, it was understood that board games are considered one of the simplest and most commonly acknowledged way of passing the time indoors and is considered efficient during group get-togethers. The same survey also determined that 10 of 10 households with children have or have owned board games. This shows the exposure of children to this category of games, leading to the derivation that children are or would be willing to try out a new game in this category, proving the market potential of designing the solution in the form of a board game.

According to the Cambridge Dictionary, dexterity can be defined as "The ability to perform a difficult action quickly and skillfully with the hands." In games like Jenga, strategy is the ability to make quick decisions and quick reflexes for the best possible outcomes. However, games like 'Escape and the Curse of the Temple' require more wit, thinking, and management among the chaos of multiple players and planned actions. Players'

dexterity affects their ability to use game controls to execute a strategic plan accurately. The concept of dexterity also brings out the use of fine and gross motor skills. These skills are highly targeted by the children's design market and trend (analysis of the market and trend forecasters) as they prepare children for the future and assist in motor skill development, a vital skill development, especially at young ages. This shows the prominent value of dexterity games in the current-day market.

One concept to be considered while designing dexterity board games is accessibility and dexterity errors. Dexterity errors are issues faced in the act of manual dexterity and are a term often used for fine motor dexterity activities. These occur when a player does not execute a move correctly. They might want to place a piece in a particular location but fail, perhaps due to time pressure (Isaksen et al., 2017). While designing dexterity games, the accessibility aspect must be considered to allow the players to play efficiently. This can be done by analyzing the target audience and their general scope of dexterity to minimize the extent of dexterity errors.

Teaching through Gameplay

In an unconstrained setting, games may simulate processes of decision-making and can enrich teaching strategies. Therefore, games are increasingly used as supplemental teaching tools in medical education (Avedon and Sutton-Smith, 1971; Henry, 1997; Karlin, 2003). This application of educational play also works with other teaching subjects and mediums, allowing students to learn more interactively and efficiently.

Traditional lectures often do not reflect the complexity of practical applications or real-life situations. By contrast, games are simplified models of complex systems that clarify difficult issues by presenting them as simple game processes. (Bochennek et al.,2007) In addition, they have the potential to motivate students and include an element of competition and surprise (Marsh, 1981; Gershen, 1974; Zeedyk et al., 2001).

Many schools worldwide have already started incorporating gamified education into their curriculum. In the early 2000s, when the concept of interactive whiteboards or 'smart boards' grew rapidly, the act of gamifying education had already begun. Providing a 'games period' aka 'PT period' is also considered a playful break from studies, especially in the Indian education system. This, too, shows the importance of play and its relevance in education.

Development through Gameplay

Learning through play has become one of toy and game design's most integral trends and concepts over the last five years. This shows the need for parents to provide multi-functionally (In terms of growth-stimulating or developing) products for their children and their result-oriented approach. Play is essential to development because it contributes to children's and youth's cognitive, physical, social, and emotional well-being (Ginsburg and American Academy of Pediatrics, 2007). Play with objects allows children to try out new combinations of actions, free of external constraint, and may help develop problem-solving skills (Smith and Pellegrini, 2008).

Play is seen as the primary mode of education for young children. It has underpinned early childhood programs since the initial kindergarten developed by Froebel (1782 – 1852) belief that play is the way that children integrate their learning, gain understanding, apply this understanding and begin to work in more abstract ways(Wood and Attfield, 2005). All these theories offer insights into how play enables children to develop their ideas, thoughts, feelings, relationships, knowledge, and

understanding of the world around them. Play is firmly embedded within current curricula initiatives for young children across the UK. Children who have practised tasks under playful rather than formal conditions have demonstrated significantly greater performance improvement across various activities(Whitebread et al., 2009).

Development through play and games can be categorized into the following major categories

- Cognitive development
- Fine and Gross motor skill development
- Emotional development / STEM development
- Educational development
- Social development
- Creative development

Research Gap

Despite the rise in popularity and acceptance of learning through play, the act of teaching about awareness-related topics through board games is yet to be explored to its full potential. Introducing children under this age group to semi-sensitive issues like environmental protection or the safety of wildlife can help raise more conscious young adults who could impact these aspects in the future. Therefore, involving the act of spreading awareness through games could create a more involving experience and impart better knowledge.

Keeping in mind the current market requirement of developmental products for children, there is scope to create new games and toys that incorporate both learnings (educational and awareness based) as well as develop into a single game or toy, increasing its desirability in the market and attracting more parents. This would benefit the children and bring in the concept of prolonged use of products, as these games would also help in the long run.

This scope in requirements leads to the understanding that most games available in the market deliver subject or topic-wise educational attributes, leaving the potential to be explored in terms of opening the single-play experience to various educational topics in one game.

Research Objective

In a digital age marked by rapid technological advancements, fostering meaningful engagement with educational content among children has become a pivotal challenge. As a response to this challenge, our research endeavors to investigate the potential of harnessing dexterity gameplay as a dynamic tool for imparting awareness of pertinent subjects to young learners. In light of this overarching aim, the following research objectives have been formulated:

- To explore the feasibility of utilizing dexterity gameplay as an effective means to convey awareness of pertinent subjects.

- To enlighten parents about the inherent developmental benefits associated with dexterity board games in fostering awareness.

- To formulate a comprehensive design framework for the development of a dexterity board game aimed at imparting awareness regarding endangered native animals of India. This design proposal will underscore the significant implications highlighted within this paper.

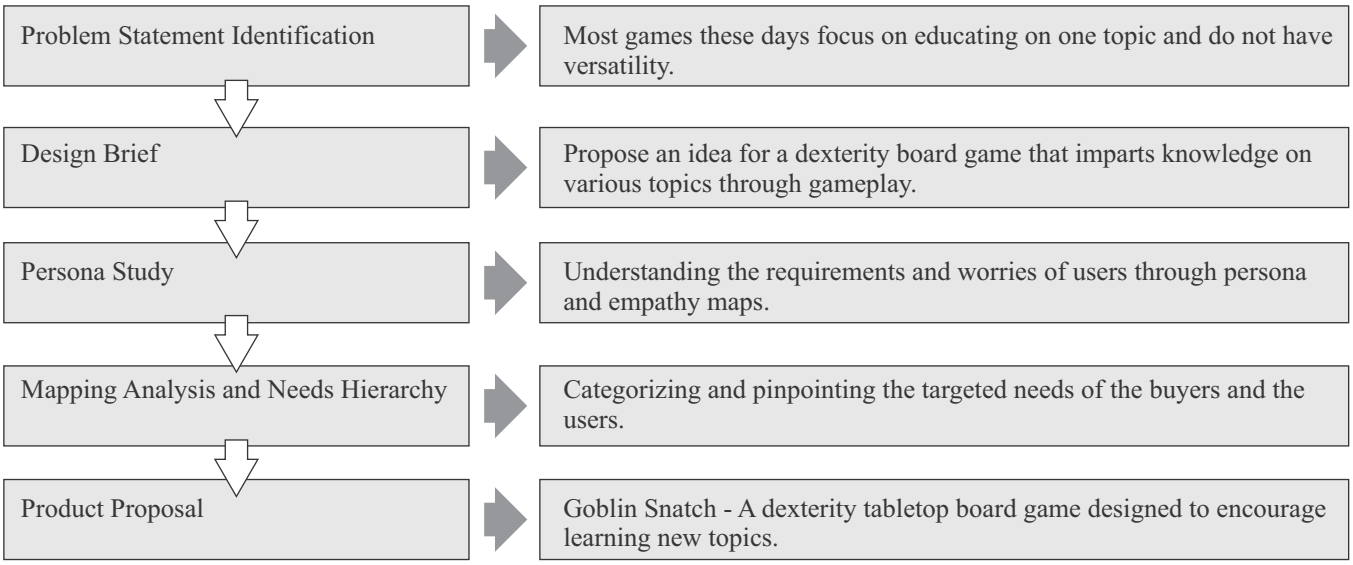
Through the pursuit of these objectives, the research endeavors to contribute valuable insights to the realms of both education and conservation, ultimately fostering a deeper appreciation for critical topics among young minds.

Research Methodology

The research methodology employed in this study follows a contextual design approach as outlined by Holtzblatt (2001). This methodology integrates the perspectives of key stakeholders, namely parents and children, in the design process as deemed necessary. By doing so, designers are enabled to craft solutions without relying solely on external references. This approach emphasizes the identification of requirements from a secondary standpoint while actively engaging clients in pivotal stages such as ideation, finalization, and testing.

The involvement of both parents and children as clients is rooted in their crucial roles within the context. Parents hold primary decision-making authority when it comes to purchasing products and play a pivotal role in motivating and encouraging children to engage with the game. This grants them a significant degree of direct involvement in the utility process. Furthermore, parents are better attuned to the child's needs and preferences at this developmental stage, thereby contributing valuable insights to the design process. Simultaneously, children serve as the primary users, necessitating their direct participation to ensure the final product resonates positively and is effectively utilized.

By integrating the perspectives of parents and children through the contextual design approach, this research methodology endeavors to create a product that aligns with both user groups' expectations and preferences.



Authors concept

Figure1. Methodology

Analysis and Discussion

Analysis of the target audience

Learning and Developmental Milestones of Age Group 4 to 6 Years

The learning and developmental milestones of different age groups of children differ from child to child. Often, there is a significant overlap in the category switch of ages. Hence, the classification of these milestones should also overlap for at least half a year before and after the targeted age group.
The list below states the major developmental

milestones of children between the ages of 4 to 6 years old while considering 3.5 and 6.5-year-old milestones. This data has been collected by comparing and analyzing multiple medical and non-medical sites and journals.

Developmental milestones of children of 4 to 6 years

- Has mastered some basic rules of grammar
- Able to draw a circle and square and even some characters of their own
- Able to draw stick figures with two to three features for people
- Tries to play acrobatically
- Balances better may begin to ride a bicycle
- Begins to recognize written words, reading skills start
- Catches a bounced ball
- Often cannot distinguish between fantasy and reality
- Sometimes demanding, sometimes eagerly cooperative
- Tells longer stories
- Knows about things used every day in the home (money, food, appliances)
- They will make themselves clearly understood by using more specific terminology, e.g., I don't want to wear my stripy socks; I like the blue dotty ones.
- I will ask lots of how and why questions.
- Enjoys doing most things independently, without help
- Enjoys rhymes and wordplay
- Starts school and making friends
- Understands size and time concepts
- Follows three-part commands
- Interested in new experiences
- Cooperates with other children
- They play "Mom" or "Dad."
- Increasingly inventive in fantasy play
- Negotiates solutions to conflicts
- Imagines that many unfamiliar images may be "monsters."
- Views self as a whole person involving body, mind, and feelings

The overall analysis of these developmental milestones shows a strong sense of cognitive and motor development and significant growth in curiosity-driven language and skill development. It also indicates the start of understanding and implementing new information and the essential surface analysis of knowledge being imparted. This shows the ability of children this age to grasp and even utilize the information being taught to them at a basic level, hence emphasizing the need to teach during this age.

Dexterity-Specific Milestones of Age Group 4 to 6 Years

Similar to the learning and developmental milestones, dexterity milestones also differ by age and capabilities of the child. The general dexterity milestones can be categorized according to the child's age and hence can be considered a guideline for understanding a child's motor skill level. The list below states the major dexterity milestones of children between the ages of 4 to 6 years old while considering 3.5 and 6.5-year-old milestones. This data has been collected by comparing and analyzing multiple medical and non-medical sites and journals.

- Goes upstairs and downstairs without support

- Able to draw basic geometric shapes and imaginative organic ones as well
- Writing skills start developing further
- Colouring skills begin to develop
- Able to skip, jump, run and try out basic acrobatic moves
- Hops on one foot
- Rides a tricycle
- Able to cut out simple shapes roughly using child scissors
- Able to dress and undress with easy clothes

A brief study of the example discussed in the product proposal

Brief About Endangered Native Animals of Indian States

Over the years, animals have acquired the attention of people from all over the world. Also, India is home to some of the unique wildlife on the planet, but over the years, much of this diversity has been in danger of becoming extinct. In biogeography, a native species is indigenous to a given region or ecosystem if its presence in that region is the result of only local natural evolution (Bergman, 2000) With the importance and awareness of local biodiversity are the key to sustaining indigenous environments, it is necessary to ensure that the concept is embedded into the people, especially at the earliest stages of childhood. A list of 10 lesser-known and at-risk native Indian animals that may be learned through gameplay is shown in Table 1.

Table 1. List of 10 lesser-known at-risk native animals of India

Name of the Animal	Location	Present condition
1. Pondicherry shark	Pondicherry	Critically Endangered
2. Forest Owlet	Central India	Critically Endangered
3. Namdapha flying squirrel	Arunachal Pradesh	Critically Endangered
4. Malabar civet	Western Ghats	Critically Endangered
5. Pookode Lake barb	Kerala	Critically Endangered
6. Amboli bush frog	Western Ghats	Endangered
7. Poona Skin	Maharashtra	Endangered
8. Hispid Hare	Assam	Endangered
9. Stump-tailed macaque	Seven Sisters	Vulnerable
10. Nilgiri marten	Nilgiri	Vulnerable

Phase 1 – Design Brief

The brief proposes a design for an interactive and developmental dexterity game that encourages children between the ages of 4 to 6 years to learn about different topics by imparting awareness during play.
The imparting of awareness should be indirect, not to burden the child, allowing them to primarily focus on play and also learn indirectly along the process.

Some aspects to target include;

- Creative and imagination-driven aesthetics.
- Dexterity and fine motor involvement.
- A natural approach to forms and textures.
- Imparting awareness on a relevant topic.
- Encouraging play through interactivity.

- Developmental in both cognitive and motor skills.

Phase 2 – Persona Study

The ideal target users are children between the ages of 4 years and 6 years whose parents are able and willing to invest in a game that would encompass dexterity and fun as well as educational advantages. The market range being targeted is the 'Mid-Premium' segment to reach the target audience efficiently.

The pre-schoolers who were chosen for this study fall under the ages of 3, 4, 5, 6, and 7. An age below and above the intended target range has been taken to accommodate and be inclusive to children with different developmental abilities. This considers both the 5th and the 95th percentile of users to ensure ease in accessibility. Discussions were conducted with the parents and children through semi-scripted telephonic and video interviews on a contextual basis.

Persona and Empathy map analysis.

Through the maps, we can understand the various physiological and psychological requirements of both the buyers and the users. This will help us determine the necessities in the game and the areas to work on in-depth. 10% of the users did not entirely understand the need for educative play, while the remaining agreed about its requirement. This showed the basic awareness of educative play that has been circulated over the years.

In terms of major requirements, one of the most notable thoughts between buyers and users was the playing range of the game. This refers to the time the game can be played, either in terms of duration in one sitting or the repeats. The solution for this was that the game would ensure that children would have access to different levels of play to ensure that they do not outgrow the game easily.

Another major question the buyers raised was about the game's educational properties. This brought us back to the research problem statement of needing more versatility in topics to educate about through the game. From the child's perspective, the educative qualities are considered much after the play experience.

The parents' major requirements revolved around development and play. In contrast, the requirements of the children, aka the users, revolved around the play experience and playful fun they could have with the game itself. In these requirements, the major overlap was the need for a game that would engage the child and that the child would enjoy (Figure 2).

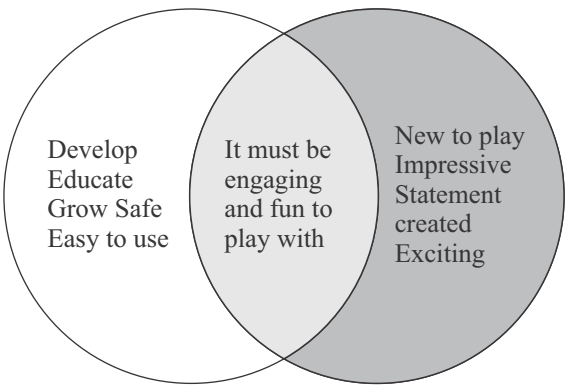


Figure 2: Needs analysis through Venn diagram

Maslow's Hierarchy of Needs

There are multiple ways to identify needs, of which Maslow's Pyramid can help define which needs the user is primarily focused on fulfilling.

Maslow's hierarchy of needs is a pyramid of motivational stages considered a basis of human decision-making psychology. Through this map, we can determine the categories of needs for the users and the buyers to narrow down the requirements by category. This need pyramid is created by analyzing the empathy and personal mapping structures.

In the case of the users, the physiological and belongingness needs categories were given the most importance. This is because, as children, their main aim is to have fun, explore and imagine, and like the activity they are engaged in. Apart from this, constant validation or attention from others also is an integral part of their happiness scale.

In the case of the buyers, the physiological, safety, and self-actualization needs were given the most importance. As seen in the user study and the market, it is evident understand the need of parents for multi-developmental toys for their children. This is because parents are looking at the long run of the product and its impact on their children. Apart from this, they also equally want their child to enjoy the experience and be engaged with play.

Safety is crucial when designing toys or games, as the user's well-being is the highest priority. In terms of self-actualization, the buyers understand the future need for the long-term growth and development of the child. The difference between physiological and self-actualization in terms of growth lies in the core understanding of self-growth, which is yet to be developed in the child but is already being recognized by the child's parents.

Phase 3 – Product Proposal

After an ideation process of concept, form, and design generation, these design ideations were discussed with potential buyers and shown to users to understand their take on the designs as a part of a contextual user-centric design approach. It was realized that children preferred character-based game ideations over entirely open-ended ones, as they seemed to relate better to them.

Parents, too, enjoyed the idea of storytelling but preferred past or current story scenarios over futuristic ones. One of the potential buyers quoted that "futuristic robots are already seen in their digital games."

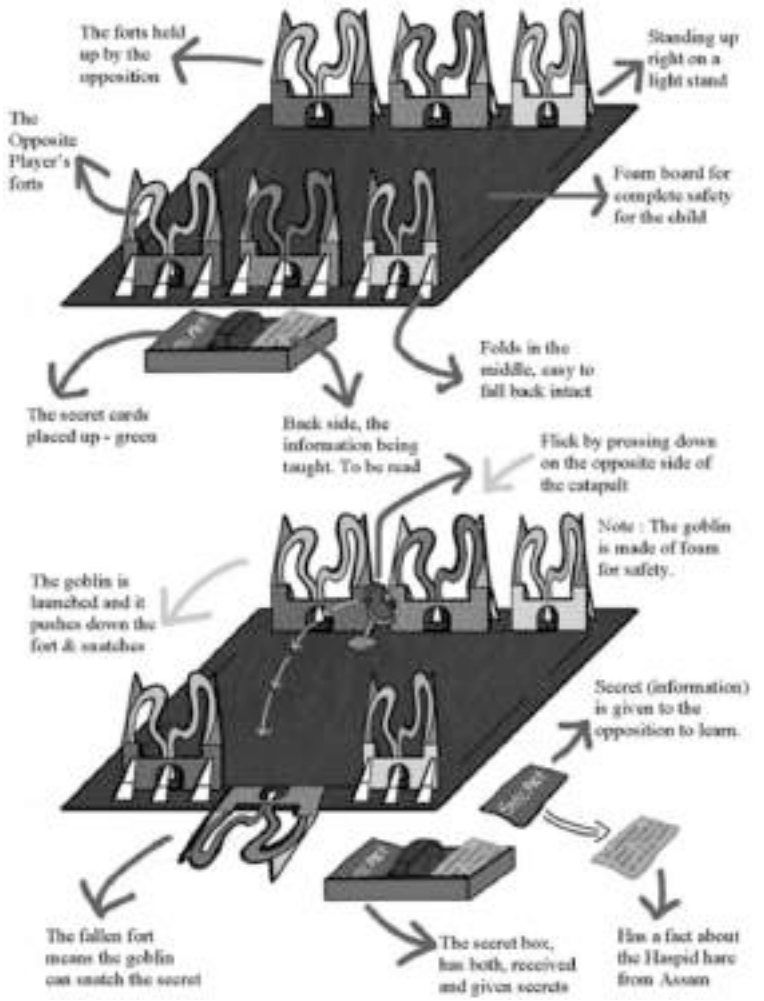
This led to further form and ideation generations with inputs received from the users and buyers. Through this, the concept of dexterity through action was undertaken to bring in a hands-on activity that resembled the digital world in which children were involved without the parents' disliking aspects.

The Game – Goblin Snatch

These discussions with the parents formed the basis of 'Goblin Snatch,' a dexterity tabletop board game that involved hands-on involvement that left the player wanting to learn more throughout the game. The basic concept of 'Goblin Snatch' revolves around obtaining the information to proceed through the game. The more you know, the closer you get to winning. This encourages a positive drive to learn and poses as a challenging means of play when required or can be simplified when not.

The gameplay works such that the player must attempt to break the fortress of the opposition and retrieve one of their secrets (an educational/awareness card that they learn with the help of their parents). The game stops when a

player has collected six such secrets; now, if this player can explain 3 out of the six educational learnings without peeking at the card, they win. If not, they will keep two cards in the forgotten pile, and the game resumes. (Figure 3)



Note: One can create stronger forts with add-ons when the game is to be more challenging

(Authors concepts)

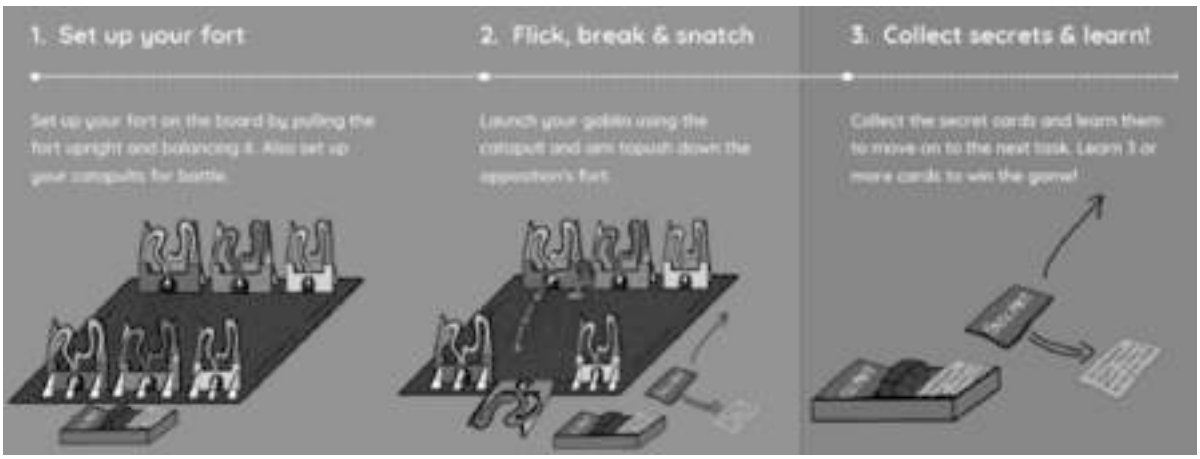
Figure 3. The Game – Goblin Snatch

Goblin Snatch encourages players to want to learn from the secret cards, hence making this an intuitive way of learning rather than being taught. This ensures that the knowledge is retained in the child's mind and would help them in the long run. The aim is to imbibe intuitive learning; hence, the multiplayer approach allows the parents to be a part of the entire experience and help or teach the child without them feeling like it is a part of learning. The flicking action is one major fine motor skill developmental activity suggested and would benefit the player.

Goblin Snatch solves the problem area of versatility by providing additional blank secret cards that the children or parents can fill out, opening the learning spectrum up to any possible topic. This means a parent can teach vocabulary, English, geography, or even maths through the 'Goblin Snatch Game play.' (Figure 4)

Apart from this, a wide range of study and awareness topics would be sold separately with the game, allowing the buyers to choose according to the topic they want to teach and when they want to teach it. Similarly, templates and topic cards can be available online on the website for easy reach to a wide range of buyers.

This entire approach to open-topic learning not only benefits the users and buyers with a range but also increases the usability lifespan of the product as it can still be used as the child grows older to learn more advanced topics. Additional 'Level Booster' add-ons can be provided to make the game



Authors concepts

Figure 4. Goblin Snatch –Steps of play

Research Findings

With the versatile use and play options of the 'Goblin Snatch,' it is evident to see the wide range of possibilities and potential of dexterity board games in terms of imparting educative knowledge or awareness. The potential of 'Goblin Snatch' is unending as the open-topic option allows the players to explore new educative topics, learn more, and even challenge themselves with higher-level forts and information. This encompasses the essence of learning through play.

When discussed with potential buyers and users, the game's design received highly positive feedback, and 98% of the sample users were certain that they would want to purchase the game for their children. This shows the level of acceptance brought into parents about learning through play as they were more educated on the topic than in the beginning. One worry raised by a parent was the impact safety of the product. To address this, it was decided that the product would be made of child-safe, soft EVA (ethylene vinyl acetate) and would ensure that all pieces would be equal to or larger than 0.75 inches to avoid choking hazards.

Conclusion

The 'Goblin Snatch Gameplay' has immense potential to expand due to its versatility in the education sector through play. This also signifies the potential of all dexterity board games for the gamification of education, learning, and awareness. Through this, more children can be taught more intuitively and efficiently and be made aware of semi-sensitive topics more quickly and efficiently. The wide range of uses and modes of playing this game opens it to players of all categories, widening the market reach. The market is booming with requirements for educative toys and games, and 'Goblin Snatch' seems to be a

promising direction towards creating more dexterity board games that impart awareness among children.

Recommendations

Designers can create dexterity gameplay that effectively imparts awareness while providing a safe and engaging experience for children. Regular evaluation and updates based on user feedback and changing needs can further enhance the effectiveness and impact of the gameplay. Designing a board game to impart awareness requires careful planning, thoughtful consideration, and attention to detail. By addressing these factors, one can create a board game that effectively communicates the awareness message, engages players, and provides a valuable and enjoyable learning experience.

Limitations

Making board games is very complex and requires a long time. It is therefore important to consider carefully the topics, characteristics, and impact on the final stage. While dexterity gameplay can be a valuable tool for imparting awareness among children, it also has certain limitations to consider.

Dexterity gameplay often focuses more on the physical skills and coordination required to play the game rather than delving deeply into the awareness topic itself. This may result in a limited understanding or superficial knowledge of the subject matter.

Dexterity games may not always provide a comprehensive context for the awareness topic being addressed. Without proper contextualization, children may struggle to connect the gameplay mechanics to real-life situations or understand the broader implications of the concepts being taught.

Dexterity gameplay tends to focus on specific aspects or skills related to the awareness topic, which may limit the breadth of knowledge and understanding that children can acquire. It may not cover all relevant subtopics or explore the complexities of the issue at hand.

Children have diverse learning styles, abilities, and preferences. Some children may excel in dexterity gameplay but struggle to grasp the underlying awareness message, while others may find the physical demands of the gameplay overwhelming. Designers should consider these individual differences to ensure inclusive and effective gameplay experiences for all children.

The skills and knowledge acquired through dexterity gameplay may not always easily transfer to real-world situations. While children may demonstrate proficiency within the game, applying the learned concepts to different contexts may require additional support and reinforcement.
Designing and developing a dexterity game with educational elements can be time-consuming. Meeting project deadlines and balancing the need for both educational content and engaging gameplay mechanics can be challenging.

While dexterity gameplay can be engaging and enjoyable, the educational impact and effectiveness of the game in imparting awareness should be rigorously evaluated. Conducting research and assessments to validate the learning outcomes and measure the effectiveness of the game may be necessary.

Dexterity gameplay may face technical limitations based on the available platform, budget, and resources. These limitations can affect the complexity of the gameplay mechanics, the quality of the components, or the accessibility of the game to a wider audience.

It is important to recognize and address these limitations during the design and development process. Combining dexterity gameplay with other educational approaches, such as discussions, supplementary materials, or real-life applications, can help mitigate some of these limitations and provide a more comprehensive learning experience for children.

Scope for Future Research

There is still ample scope for future research to explore and enhance the effectiveness of dexterity gameplay to impart awareness among children. Further research is needed to understand how to tailor dexterity gameplay to different age groups effectively. Explore the cognitive and developmental factors that influence children's engagement and learning outcomes, and identify design strategies that align with specific age ranges. A more interesting game can be developed by introducing new ideas and increasing the play level.

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