# Exploring AI in Finding Mathematic Mobile Games for Children in Application Marketplace Based on User Interface

**Auria Farantika Yogananti**
*Ph.D. Candidate, Faculty of Art and Design, Universiti Teknologi Mara, Melaka*
*20232922432@student.uitm.edu.my*

**Azahar bin Harun**
*Assoc. Prof. Dr., Faculty of Art and Design, Universiti Teknologi Mara, Melaka*
*azahar581@uitm.edu.my*

**Nurhikma Mat Yusuf**
*Dr., Faculty of Art and Design, Universiti Teknologi Mara, Melaka*
*hikmayusof@uitm.edu.my*

**Abstract**
Mobile educational games can be found in the mobile application market, one of which is on the Google Play Store. The Play Store provides a place for hundreds of thousands of applications in addition to educational games. Users can search for the desired application by selecting the desired category or writing keywords to find a specific application quickly. However, users still cannot find applications with more specific keywords. This study aims to create a list of new educational game categories based on User Interface design for math games on the Google Play Store. This study used the Open AI platform, GPT-3.5, to process and analyze textual data to determine new categories for educational mathematic games. The Mathematic game dataset was collected from the Play Store. Data grouping includes game titles, descriptions, user ratings, and teacher-approved to ensure a comprehensive data set for analysis. In conclusion, the categories obtained based on User Interface Design are from the visual design category and online math games for children using thematic categories. Interaction style, button-based interaction, and virtual manipulation have been the most widely used categories. The menu-based navigation system is the first category chosen for the navigation system. While Achievement is a category in the feedback system, unity is chosen in the aesthetics category.
**Keywords:** AI, Mathematic, Mobile games, OpenAI, User Interface

## INTRODUCTION
Games are a product that makes an essential contribution to human life. Over time, games continue to develop with the development of technology, from offline to online games, from console to mobile games. Mobile games have become a part of people's lives because they offer entertainment and social interaction in cyberspace (Villacís et al., 2016). Mobile games have also emerged as a powerful alternative medium for engaging students and improving learning outcomes in education. Not only that, the use of mobile games in educational settings offers a learning method that goes beyond traditional learning methods, offering an innovative approach to teaching and learning.

Mobile educational games can be easily discovered in mobile application marketplaces like Google Play Store. As the world's most significant mobile application market, Google Play Store has millions of applications, including around 445 thousand educational applications in various subjects, such as mathematics, science, and language. Google Play provides a tool to search for the desired application by selecting the desired category or writing keywords to search for specific applications quickly. However, even though these

conveniences have been provided, due to the abundance of online games and ambiguous descriptors, which creates confusion for users users still cannot find applications with unique keywords to search desired online games.

This research aims to create a list of user interface design categories for mathematical games on the Google Play Store. Mathematics has broader academic knowledge among those subjects because academically studied games focus primarily on it (Hedrick, 1917). Design considerations for mathematics in mobile games have been highlighted to aid students in mastering complex mathematical concepts through interactive gameplay (Smith et al., 2019). By incorporating elements of game design, such as interactive gameplay and feedback mechanisms, educators can create engaging and effective learning experiences that cater to diverse student needs (Smith et al., 2019). Categorizing mathematics online games based on User Interface Design is essential to understanding the diverse range of games available.

Over the past few years, Artificial Intelligence (AI), which has extraordinary intelligence like the human mind, has been used in many aspects, including applications (Centre & Studies, 2017). AI can do many things humans usually do: completing tasks, designing, learning, searching, etc. (Kavanagh, 2019). ChatGPT is a generative AI that allows users to ask things they ask the chatbot. This study aims to explore the use of AI in identifying online math games within the user interface design category for baseline study. The role and contribution of AI are expected to maximize the discovery of mobile math learning games by exploring various categories of online math games so that users can meet specific needs to improve learning goals.

## LITERATURE REVIEW
### a. Mobile Game Application on Marketplace
The evolution of mobile games is driven by the development of increasingly advanced and intelligent smartphone technology and the proliferation of mobile games in application markets, such as the Apple App Store and Google Play Store, which collectively host millions of applications, including games (Meacham et al., 2020). Mobile gaming applications in the marketplace constantly also evolve due to technological advancements, player preferences, and innovative design strategies. Mobile game applications on marketplace platforms are essential for the digital gaming industry because they provide players with diverse gaming experiences. It also has the potential to serve as an educational tool, as they use game mechanics to enhance the learning experience. The design and development of mobile game applications for marketplace platforms requires careful consideration of user engagement, motivation, and usability.

In the current market, most mobile games are available for free, with their main revenues generated through in-app purchases and advertising (Muqarrabin et al., 2021). This has proven to be an effective win-win solution, as it lowers the user entry barrier while providing monetization opportunities for developers. The rise of e-marketplaces has also facilitated the buying and selling of in-game currencies, ultimately enhancing the economic ecosystem around mobile games (Herman & Kho, 2021). In addition, the competitive mobile gaming landscape has led to the emergence of various innovative game genres and mechanics, catering to different user preferences (Kurniawan & Aprilia, 2021).

The application marketplace categorization of mobile games into genres is essential to helping players find games that suit their preferences and interests (Wei & Lu, 2014). Game genres provide a fundamental framework for categorizing and understanding the diverse landscape of digital games, encompassing a wide range of categories that define the core mechanics, themes, and player interactions within each genre. By categorizing games into genres such as adventure, role-playing games (RPGs), shooters, platformers, simulation,

strategy, action, puzzle, sports, and music games, users can tailor game-based learning experiences to different learning styles and preferences (Qaffas, 2020).

The classification of game genres is essential for game developers and user engagement, as it helps developers communicate the unique features of their games and enables users to discover new gaming experiences that align with their preferences and interests (Hassan et al., 2019). The evolution of game genres reflects the dynamic nature of the gaming industry, with new genres emerging to accommodate innovative gameplay mechanics and storytelling approaches. Scholars emphasize that game genres should consider ludological aspects, focusing on gameplay mechanics rather than solely aesthetic or narrative characteristics, to comprehensively understand each genre (Sjöblom et al., 2017). This approach ensures that game genres are distinct and reflective of the interactive experiences of players, distinguishing them from genres in other media forms such as film or literature. The diversity of game genres allows players to explore various gaming experiences, from immersive storytelling in RPGs to fast-paced action in shooters, catering to a broad spectrum of playstyles and interests.

## b. Mathematic Mobile Games

Integrating educational content into a game format has increased motivation and knowledge retention, making mobile games a valuable tool in contemporary education (Huang, 2019). Research has investigated the use of mobile games for educational purposes, emphasizing the role of mobile games in supporting the development of learning communities, experiential learning, and meta-level thinking skills (Papastergiou, 2009).

Mobile games are increasingly popular among children, impacting various aspects of their lives (Adelantado-Renau et al., 2019). The emergence of mobile learning applications has provided education with powerful learning alternatives that can improve students' skills. In recent years, mathematics online games have gained significant attention. It has offered a dynamic and interactive approach to engaging students and enhancing their learning experience. Not only on the student side, educators can cater to various learning styles and preferences by creating a dynamic and immersive learning environment, fostering positive attitudes toward mathematics, and encouraging more profound engagement with the subject matter. Several studies also have shown that mobile games can effectively support learning in mathematics and science by providing interactive and engaging experiences (Flores-Velazquez et al., 2021). Mobile games provide educational content and foster critical thinking and problem-solving skills among users (Agustian et al., 2021).

Mathematics educational games have been developed to enhance contemporary users' learning behavior, focusing on improving interest and proficiency in mathematical concepts (Hidayat et al., 2024). Nevertheless, the study has also been widely explored to assess its effectiveness in enhancing the learning experience (Edmonds & Smith, 2017). Developing educational games targeting specific mathematical concepts and skills has also improved student learning outcomes and performance.

Academic research has focused on the educational benefits of mobile gaming, especially in mathematics education (Al Khateeb, 2019). One of the benefits of mathematics mobile games is the incorporation of gamification elements, which can increase student engagement and motivation in learning mathematics lessons. Not only that, but game-based mathematics learning applications have also been designed to improve students' number sense and verbal abilities through interactive games (Hui & Mahmud, 2023). The development of mobile game-based learning applications with mathematical content has also been explored to create unique learning experiences for students, integrating various mathematical concepts into gameplay (Rahayu & Rukmana, 2022). Lastly, Studies from Ramli indicated that educational mobile games can enhance students' math learning

performance and engagement by drawing their attention to learning materials and promoting active learning experiences (Ramli et al., 2020)

### c. Mobile Games User Interface Design

Mobile game User Interface (UI) design research has investigated various aspects to optimize user experience. It happens because the UI ensures players can navigate the game without confusion or frustration (Sudarmilah et al., 2016). One crucial aspect influencing enjoyment in playing comes from game User interface design. Effective UI design increases usability, engagement, and player satisfaction (Arifin et al., 2022). Inappropriate UI designs can lead to user errors and diminished enjoyment, highlighting the need for careful categorization based on usability principles.

The design of mobile game user interfaces must consider factors such as playability heuristics, design aesthetics, and user enjoyment to create a compelling and immersive gaming experience (Cheng & Mustafa, 2016). A mobile game's user interface (UI) includes all user interaction elements, including menus, buttons, icons, and visual feedback. User interfaces are elements used to manipulate digital objects (Galitz, 2007), and are considered reasonable if they are used to function correctly. In creating a user interface design, design principles are, of course, still applied so that the visual aesthetics of the existing interface are not reduced. The design principles include balance, emphasis, proportion, rhythm, harmony, and unity. Mobile game UIs have also evolved to enhance user interaction and provide better feedback mechanisms, reflecting a growing trend in human-computer interaction (Pan et al., 2022). This evolution can be categorized into various stages, from basic touch interfaces to more complex systems that incorporate gestures and voice commands. Such advancements necessitate a classification system that can accommodate the diverse range of mobile games and their respective UIs.

### METHOD AND STUDY AREA

This study applied a qualitative analysis approach to provide a holistic view of game categorization based on User Interface (UI) and matrix analysis. It will also involve using OpenAI's language models, GPT-3.5, to process and analyze textual data related to educational mathematics games. A dataset of Math games will be collected from Google Play, the application marketplace. The dataset will include game titles, descriptions, user ratings, and teacher-approved groups to ensure a comprehensive dataset for analysis.

The textual data will be processed using OpenAI's language models to extract relevant features for categorization. This will involve using NLP techniques to analyze game descriptions and user reviews. Key features such as keyword extraction and topic modeling will be applied to identify common game themes and characteristics. The categorization process will utilize OpenAI to classify games into predetermined UI categories, which include Visual Design, Navigation, and interaction style. Afterward, the author shorted data by theme and categories.

The study area for this research will encompass educational games, specifically Mathematics games. By analyzing a diverse set of mathematical games, the research aims to identify the list of game categories by User Interface. The scope will be limited to Mathematical games for children at Playstore.

### RESULTS AND DISCUSSION

The research began by making a list of games available in the Play Store by typing Mathematic games for children in the search box. The number of games collected was 150 games. This sample size was taken from the total number of educational games available in the Play Store, which was 398,000 thousand applications (Curry, 2024), with a confidence level of 95% and a margin error of 8%. Besides collecting a list of the games,

the author also provides additional information about the games, such as game information, game ratings, and teacher-approved information provided by Playstore. The list of Mathematic mobile games can be seen in Table 1.

## Table 1. List of Mathematic Mobile Games on Playstore

| Game list | | | | |
|---|---|---|---|---|
| Math Kids: Math Games For Kids | Prodigy Math : Kids Games | Gogomath – Fun Math Game | Baby Panda Learns Numbers | King of Math Jr - Light |
| Math Games: Math for Kids | Math Games for Kid & Toddlers | Math Land: Math Games for kids | Toon Math: Math Games | Baby Panda's Math Adventure |
| Kids Math: Math Games for Kids | Kahoot! Multiplication Games | Number Puzzles for Kids | Math Games for kids: addition | Hunter's Math for Elementary |
| Baby Panda's Number Friends | Math Master Puzzles & Riddles | Kids Math Game For Add, Divide | Dinosaur Math Games for Kids | Smart Math Kids: Record & Play |
| Kids Multiplication Math Games | Kids Academy: Learning Games | Kahoot! Big Numbers: DragonBox | Math Games – Brain Training | Math Matching Games, Math quiz |
| Math Games - Maths Tricks | Dragon Math : Play-based learn | Cambridge Primary Math Game | Math Master Kids | Addition Flash Cards Math Game |
| Baby Panda's Number | Math Games for kids: addition | Math Game - For Learn Math | Cool math games online for kid | Learn and Count for Kids |
| Dinosaur Math – Games for kids | Math games: Zombie Invasion | Bmath: Learn math at home | Mental Math to 30 ANIMATICS | Math Race 3D: Play & Learn |
| Magic Math: Games for Kids | Animal Math Games for Kids | Math Lingo: Be Fluent in Math | Times tables for kids & MATH-E | Math Race: cool math games |
| Monster Math 2: Fun Kids Games | Math Master: Play & Learn Math | Learn Number 123 – Kids Games | Multiplication by AvoKid | Math Kids |
| Math&Logic games for kids | Cool & Fun Math Games for Kids | Math Makers: Kids School Games | NumMatch: Logic Puzzle | Pinkfong Numbers Zoo: Kid Math |
| King of Math 2 | Math for Kids: Math King Battle | Think!Think! Games for Kids | Math games for kids: Fun facts | Magrid – Early Math Learning |
| Dinosaur Math 2 games for kids | Genie's Math Farm | Mathopolis - Kids Math Games | PEMDAS: It's A Math Game | Numberblocks World |
| Monkey Math: Kids math games | Math Game collection for you | MathTango: Gardes K-5 Learning | Math Games: Learning, Training | Numbots |
| Mathopolis – Kids Math Games | Pinkfong Fun Times Tables: Kids | Mental Math Master | Math Challenges : Math Games | Phytagorea |
| KIDS MATH | Todo Math | Times table for kids & MATH-E | Math Game For Kids : Kids Math | Vkids Number - Counting Games |
| King of Math Jr | Math for kids - Logic Games | Math Crossword - Number Puzzle | Number Puzzle for Kids | Mimi Morfi Math |
| King of Math Jr 2 | Math games for kids – Lite | Math & Logic – Brain Games | Math Multiplication Games | Number Sums – Number Game |
| Khan Academy Kids | Kids Numbers and Math Lite | Intellecto Kids Learning Games | Number match - Number Games | Math games, Mathematics |
| Pet Bingo by Duck Duck Moose | Math Games, Learn Add Multiply | Number Sums – Numbers Game | Math Games: Brain Qiuz | Math Ninjas |
| 123 Numbers – Count & Tracing | Crossmath – Math Puzzle Games | Math Games - For Learn Maths | Multiplication Games For Kids | Mathy learn math for kids |
| Moose Math by Duck Duck Moose | Kahoot! Numbers by DragonBox | Edujoy Math Academy | Math Games - Brain Training | MathPuz - Kids Games Challenge |
| Math Land: Kids Addition Games | Learning Numbers Kids Games | Math Games for Kids & Toddlers | Twinkl Rapid Math Practice | 1-Minute Maths |
| Babybus Kids Math Games | Pinkfong 123 Numbers: Kid Math | Math Games: Play, Learn & Win | Twinkl MTC Practice | MathMaster |

| Game list | | | | |
|---|---|---|---|---|
| The Castle of Multiplications | KING OF MATH | Math Games: Brain iq riddles | Multiplication Table Game | Number 123 Math learning game |
| Funexpected Math for Kids | King of Math | Addition and Subtraction Games | Matix - Mental math game | Kahoot! Algebra by DragonBox |
| Teach Monster Number Skills | Math Puzzle & Calculation Game | Monster Math: Kids Game | Meet the Numberblocks | Adapted Math - Fun Mind Games |
| Monster Math – Math Facts | Multiplication Tables Game | Crossmath Games – Math Puzzle | 123 Number Games for Kids | Kahoot! Algebra 2 by DragonBox |
| Math games for kids Premium | Math Ascension | Speed Math Mental Quick Games | Math Star: Math Games for Kids | Marbel Fun Math & Numbers |
| Math games For Kids : Kids Math | Matific: Math Game for Kids | Math Games – Maths Tricks | The Fixies Math Learning Games | Number Blocks-Math Puzzle Games |

From the data obtained, the author also collected other information regarding the game, such as game description, game rating, and teacher-approved information. This information was the base data before being categorized into UI categories. UI categories are divided based on 5 keywords:

a. Visual design: Minimalist, Realistic, 2D, 3D, Thematic, storybook
b. Interaction Style: Touch-Based Interaction, Gesture-Based Interaction, Button Based Interaction, Voice Controlled, Virtual Manipulative
c. Navigation System: Linear Navigation, Free Exploration, Menu Based, Interactive Maps.
d. Feedback System: Instant Feedback, Delay Feedback, Progress Bar, Achievement, Reward.
e. Aesthetic graphic: Balance, Emphasis, Proportion, Rhythm, Harmony, Unity.

Each point written is one form to categorize online mathematics games on how users interact with the game.

The results of the UI categories after being categorized with the help of OpenAI are shown in Figure 1.
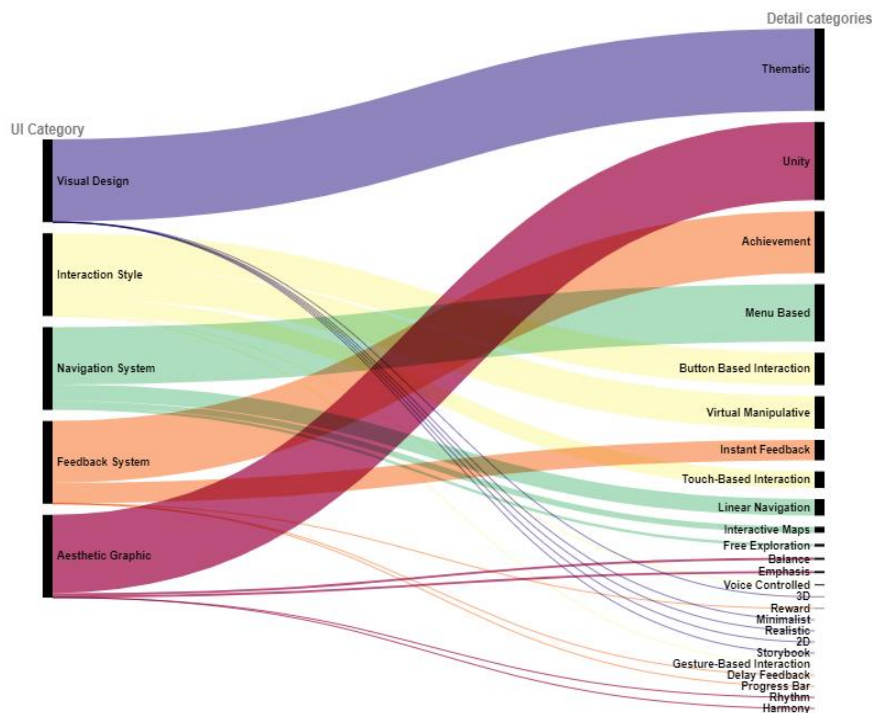


**Figure 1. Visual design keywords**

From figure 1 it is known that in the visual design category, almost all existing games fall into the thematic visual design category. What is meant by thematic visual design here is that each existing game has its own theme or its own theme for the game they have, such as the example of the game, one of the top ten games on the list and also got the Teacher Approved, this game has a hunter theme, in the game the user is likened to a hunter who will later get a monster when solving the math problems in the game.

There are three major styles that are usually used in the games, respectively, button-based interaction, virtual manipulative and touch-based interaction. Button-based and virtual manipulative have the same number of games that use it. Button-based interaction utilizes virtual buttons to facilitate user commands and actions by offering a structured and often intuitive way to interact with technology, while virtual manipulative simulates real objects that are used to understand mathematical concepts visually and interactively. The interaction style plus touch-based interaction used in games is the object of research. In this category, the navigation category that is often used is menu-based navigation. Besides that, there are also games that use linear navigation, Interactive Maps, and Free exploration. This happens because of the differences in themes and game play that each game has. This can also be unique in each game.

Most of the games use achievement on their game as a feedback system. Achievement feedback can give encouragement to users, in this case children, because they can know that they have done their best when playing games. Achievement feedback can also give encouragement to children to continue to improve their performance when playing games. Instant feedback also helps children to know the results of what they do when playing games. For aesthetic graphics, Unity is the most widely used game that is the object of research. Unity is the unity that arises from adjacent elements in a design work. Furthermore, few game use balance and also emphasis in their game.

## CONCLUSION
In conclusion, Categorizing mathematics online games based on user interface design is essential to understanding the diverse range of game categories. It is a multifaceted endeavor encompassing various aspects of visual design, interaction style, navigation system, feedback system, and Aesthetic graphics. Regarding visual design, mathematics online games for children use thematic categories. Considering the interaction style, button-based interaction and virtual manipulation have become the most used category. In the navigation system, the menu-based navigation system became the first category that has been chosen. Whereas Achievement became a category inside the feedback system that had been used, and in the end, unity was chosen inside the aesthetic

Categorizing mathematics online games based on User Interface Design is essential to understanding the diverse range of games. Developers can create more effective and engaging mathematics games by leveraging existing research on UI categorization. Integrating these categories into the design process enhances user satisfaction and promotes better educational outcomes, making mathematics more accessible and enjoyable for players of all ages.

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