COMMUNICATION AND MEDIA IN ASIA PACIFIC (CMAP)
2025, VOL. 8, NO.1, 42-57.
http://doi.org/10.14456/cmap.2025.4

Virtual Context: Gamification Strategy for the Dissemination of Urban Safety Information in Shanghai

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ABSTRACT

This qualitative study aims to develop a communication strategy for the Shanghai police, focusing on creating a sustainable and organized model for urban safety information dissemination to primary school students through gamification. Data were gathered via in-depth and focus group interviews with nine Shanghai police officers and one security expert. The research reveals that the virtual tasks and challenges inherent in a gamified environment effectively present critical safety knowledge. Moreover, virtual cooperation and identity exchange cultivate primary school students' multi-perspective judgment of safety situations and enhance their collaborative escape abilities. Autonomous exploration within the game context fosters students' capacity for proximity-based escape thinking. Our findings suggest that successful gamified urban safety education necessitates a long-term collaborative mechanism between game development teams and the police, considering primary school students' specific information acquisition and memory preferences.

Article Info
Received August 21, 2024
Revised April 21, 2025
Accepted May 26, 2025

Keywords: Gamification, Urban Safety Communication, Virtual Context, China

Introduction

With the acceleration of the urbanization process, the dissemination of urban security information has important role in safeguarding the social and economic development of residents' life and property security and maintaining social stability. The Shanghai city security information spread from the traditional mass media (Shanghai Municipal People's Government, 2021), which was represented by television, radio and newspapers 40 years ago, and gradually turned to digital media based on large Numbers and mobile Internet. In 2010, the Shanghai government proposed the strategy of "the wisdom city" of the development and management of the city, and put forward the system of intelligent urban framework (Shanghai Municipal People's Government, 2021). With this idea, the spread of urban security information in Shanghai is beginning to explore the independent transmission of the single medium, and turn to the new medium, new technology, and the three-dimensional mode of communication that is fused with each other. The main idea of the dissemination of urban security information from "coping type strategy" to "coping with the normal prevention combination strategy (Shanghai Municipal People's Government, 2021). In this context, the Shanghai police of the publisher of the city security information need to find new media docking methods for different people.

The Shanghai Education Commission established a safety situation notification system for primary and secondary school students in 2009. This system mainly includes measures to prevent

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injury accidents among primary and secondary school students and an analysis report on the main characteristics of safety accidents. However, this system serves as a working document to guide teaching staff, not to disseminate information to primary school students themselves.

In 2023, the Shanghai Public Security Bureau, Shanghai Education Commission, Shanghai Emergency Management Bureau and other departments jointly produced the "First Lesson of Public Safety Education", which was broadcasted on television and online platforms. In interviews with the police, it was learned that having only one course at the beginning of the school year is not enough to form a sustainable and effective dissemination of safety information for primary school students. The school did not have the conditions for continuous dissemination of safety information in the future, because primary school teachers were only familiar with the content of safety information within the school, and did not have specialized knowledge of community safety, home safety, commuting safety information outside the school, and sudden urban safety issues such as epidemic prevention and control that could occur at any time. Although the police were very professional in urban safety information, they struggled with communicating and disseminating it to primary school students, and urgently needed to find a medium to communicate with them.

Since the birth of the media, the relationship between games and media dissemination has been inseparable (Yu et al., 2023). In 2021, known as the first year of the "Chinese Metaverse", games, as one of the six core technologies of the metaverse, once again had the opportunity for rapid development. Games are the embryonic form of the metaverse (Zhao et al., 2021), and are a centralized medium that can include narrative, drama, music, painting, and visual arts. Therefore, the virtual communication scenarios constructed by games are gradually changing the mode of information dissemination in various fields of Chinese society. If the dissemination of photography is based on images, the dissemination of movies is based on moving images, then the dissemination of video games is based on player interaction behavior. This behavior arises from the interaction between the player and the virtual context constructed by the game. Therefore, virtual context in games are not simply creating a visual experience space, but rather a "propagation mechanism" based on the playability characteristics of the game. This mechanism often involves both internal incentives and external stimuli, providing experiential, intuitive, and interactive information in a specific virtual space. This mechanism leaves some subjective initiative space for participants while completing the objective information dissemination.

Therefore, the research objectives for the current research are: 1) to identify the specific methods in gamification via virtual contexts that help primary school students master safety skills for living in Shanghai, and 2) to establish a sustainable and systematic urban safety information dissemination channel for police officers based on gamification.

The research target for this study is approximately 434,000 primary school students residing in the urban area of Shanghai. It examines the urban safety concerns that primary school students in Shanghai have experienced from 2019 to 2025. In addition, this study only focuses on the main core gamification mechanisms with role-playing and role-playing as the core gameplay, and does not involve research on other types of games such as simulated driving, board games, etc.

Literature Review

Gamification Application for Communication

Fabricator and Lopez (2019) were the first to propose the possibility of combining information dissemination with games. Using a task-oriented approach, the game spreads. Game tasks give contextual meaning to information, and this dissemination with task context makes it easier for primary school students to possess certain "abilities" that require hands-on practice. American educator, Greg Topo (2015) stated that "playing games" is a natural evolutionary mechanism, which is a way for humans and animals to acquire various skills necessary for survival. Therefore, this study aims to investigate methods of enhancing physical world security shaping through virtual worlds in games and summarize the application of gamification-based communication theory in the design of urban safety communication for primary school students. Brian Sutton Smith, a psychology professor at Columbia Normal School, once pointed out that "the opposite of games is not work or study, but depression. Therefore, using gamification to construct a virtual context as a means of communication should be a more effective and sustainable way of communication.

In 2018, Shanghai established a youth outdoor training base in the Qing Pu District and constructed several context-based safety information dissemination rooms equipped with game mechanisms that simulate earthquakes, firefighting, and other urban scenarios. Professionals regularly distribute information on safe survival content to middle school students. Figure 1 illustrates the use of a gamification-based communication strategy to disseminate information about fire hydrant operation methods. The game's leaderboard, medal mechanism, and shooting leaderboard assist participants in learning how to use fire hydrants effectively. This method delves into hybrid

communication between virtual and real contexts, yet it suffers from a limited number of participants, low dissemination efficiency, and an inability to swiftly adapt to changes in social security content after completion.

Figure 1: Gamification-based Communication for Fire Hydrant Operation

Source: The Fire Drill Laboratory of the Oriental Oasis Youth Outdoor Training Base in Shanghai, April 19, 2023

Therefore, this study aims to enhance the laws of physical world security shaping by exploring the virtual context in games in order to examine and verify the application of gamification theory in the design of urban safety communication for primary school students.

The Concept of Communication Context

Context has always been an essential concept in communication studies. The distribution of "meaning" is intimately linked to the "context" in which it exists. B. Malinowski, a Polish anthropologist, first proposed the concept of "context" (1923) and divided it into "context of situation" and "context of culture". He believed that "context," referring to the application context of language, is the physical and psychological environment that must be considered in the process of language dissemination. This is one of the earliest theoretical discussions on the relationship between communication content and communication background. Contextual factors influence both the encoding and decoding of information.

Herbert Blumer believed that "context" is not only an objective background or situation but also contains the interaction between individuals and the external environment (such as family, society, country, etc.) to understand themselves and give subjective meaning to the situation. The prerequisite for the smooth dissemination of symbols as carriers of meaning is that they must be in a specific contextual situation, which endows symbols with meaning. This discourse defines a close relationship between the effectiveness of communication content and the communication context. In June 2024, violinist Joshua Bell disguised himself as an ordinary person at a train station, but few passersby stopped to listen, although tickets for his Boston concert could cost up to USD100 and were in high demand. This suggests that not only does the art itself shape the information recipient's experience of the disseminated content, but also the communication context within which the art exists. The importance of context in information dissemination (Eddo & Andrea, 2006) lies in the fact that context is not only a factor in the generation and interpretation of communication behavior but also an important component of the meaning of communication in many cases.

According to the theory of technological determinism, specific technologies form the "context" of communication. As a result, the development of technology directly influences the formation and change of communication contexts. Technology iterations inevitably alter the construction of communication contexts.

The Concept of Virtual Context in Gamification

Richard Bartle, a professor at the University of Essex and one of the creators of multiplayer online games (MUDs), first proposed the concept of 'Gamification' in the 1980s, referring to the process of transforming something that is not a game into a game (1983). In 2002, British game developer Nick Pelling introduced the concept of gamification in a blog post titled "A Brief History of Gamification." Highlighting the application of gamified media features and the subsequent distribution of game products. As various fields integrate and develop, the question of whether games remain games after merging with other fields becomes increasingly irrelevant. We should interpret the current understanding of gamification from a broader perspective, referring to the use of game technology, mechanisms, concepts, and elements to serve other fields such as information dissemination, education, and healthcare.

Unlike the communication context created by movies and television, gamification's virtual contexts are not based on "narrative" foundations but on "mechanisms." One can understand the game's mechanisms as the "operational order" within the virtual world. Katie Salen (2003) indicated that games are mechanisms where players participate in virtual conflicts defined by rules, resulting in quantifiable outcomes. This is the earliest scholar to explain the relationship between "mechanism" and "virtual context" from an academic perspective. The game constructs a "virtual conflict context" through mechanisms, and the essence of "playing games" is the mutual competition and game between players and computers or other players in the virtual context (Watanabe & Nakamura, 2014). This induction explains the two main characteristics of virtual situations in games, namely rules and rule-based interactions.

Games construct a "virtual context" that not only provides entertainment but also fosters an immersive communication context in which the audience actively participates. If we understand the dissemination of photos as images and the dissemination of movies as continuous images, then the game dissemination is based on the interaction between the audience (players) and continuous images. Regarding the duration of dissemination, photos offer a fleeting context, movies provide a narrative context that spans 2-3 hours through continuous images, and games provide an " imitate social" and " imitate world" context through interaction, often lasting months or even years. It is worth noting that, based on digital media technology, the virtual contexts created by games can simulate the real world very realistically, making it difficult for users to distinguish between reality and virtuality. The essence of gamification-based communication is to provide simulations of real-life situations to improve communication efficiency and enable the communicators to master certain skills. This is very similar to the "Mimetic Activity Environment" concept proposed by Walter Lippman for mass communication.

In addition, one key element for games to form attention value in a virtual context is the "target-oriented" generation based on the "virtual context". Due to the task-oriented dissemination of games, "game tasks" endow information with contextualized added value, making it easier for people to possess certain "abilities" that require hands-on action.

The game creators selectively process information, resulting in a scenario that resembles a real-world experience, but is not entirely real. This is not a negative thing, but precisely because of its strong ability to transform, control, and edit situations, the game can simulate various crisis situations that may occur in reality at a lower cost as a pre-rehearsal for future emergencies, thereby obtaining more accurate results.

Similarities and Differences between Real Context and Virtual Context

There are similarities between real context and virtual contexts. Both the contexts in real and virtual communication have explanatory and constructive characteristics for information. Both real and virtual contexts can influence the emotions and behaviors of the audience through environmental settings and atmosphere creation. Cultural factors influence both real and virtual contexts, shaping the content of information and affecting the audience's acceptance of it. In addition, real and virtual contexts impact the audience's judgment of information credibility and the authority of information sources.

There are significant differences between the real-world and virtual contexts of gamification-based communication in terms of communication modes, participant interactivity, degree of immersion, duration, and purpose of communication effectiveness.

1) Differences in communication modes

Virtual contexts in games are interactive, situational communication spaces. It is not the one who releases information but the other who receives it. Through game mechanisms in virtual contexts, players engage in the interactive communicate and feedback of information between humans and machines, as well as between individuals. However, the context in the real world, the reception and response often limit the sustainable interactivity of the context.

The virtual context has very typical "nonlinear characteristics". Take the interactive movie game *Detroit: I Want to Be Human* (2020) as an example; the game features hundreds or thousands of "tasks," with the player having complete control over which task to prioritize. Different orders of events may result in different story narratives, ultimately leading to different outcomes.

The dissemination of 'virtual situations' is not based on what the game says to the player, but rather on what the player gains by participating in 'tasks'. This kind of acquisition can be an emotional experience, a reflection on a certain issue, or the mastery of a certain skill.

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2) Interactivity of Participants

The interaction in the game is characterized by active participation, challenge, and diversity. Firstly, unlike real-life situational communication, virtual situational communication in games is based on players' active involvement. Compared to other media where the audience passively receives information, the audience is more accepting of information. According to James Paul Gee (2018), interactive behavior in games enables participants to "experience" the world (virtual context) from fresh perspectives and methods, as opposed to merely "learning content."

Secondly, the interaction in the game is inherently challenging. Whether it's adventure games like *Super Mario Odyssey*（2017） or action shooting games like *Halo Infinite*（2021), players need to interact with the virtual environment in the game by controlling their characters, solving problems, completing tasks, and so on. This creates a communication interaction behavior oriented towards challenging tasks, enabling information receivers (players) to form stronger focus and sustained thinking. During the interactive process, the game provides players with real-time feedback through scores, rewards, and achievements, which improves the game's information dissemination effectiveness.

The forms of game interaction are very diverse. Many electronic games support multiplayer online interaction, so the game includes both player-to-player interaction and player-to-game interaction. Taking the game Monster Hunter as an example, players need to communicate with three other players to complete the "hunting task." Players must also manage and arrange their own "Hunter's Cabin," collecting herbs, honey, and other supplies in the wild, and managing them properly. Meanwhile, players can also fish in the wild and cook the caught fish into food. The diversity of this interactive form allows the virtual context created by games to simulate the operational mechanisms of the natural world more realistically.

3) Different Immersion Levels

In the game world, each level contains hundreds of interactions with the virtual game context. Continuous interaction constitutes an immersive and sustained communication mechanism. Psychologist Mihaly Csikszentmihalyi (1990) derived the Flow Theory from the immersive experience of gaming. Four points summarize the immersive experience of virtual game scenarios: the player's active and high attention to information. Gaming devices allow players to obtain comprehensive and all-round experiences such as visual, auditory, tactile, and so on. The game's interactivity enhances the virtual environment's immersive experience. The game narrative, role-playing, sound effects, and other elements elicit deep emotional resonance among players. The Flow Theory is an important theoretical basis for proving the strong immersive experience generated by virtual context in gamification-based communication, and summarizes the value of this immersive experience in communication.

Methodology

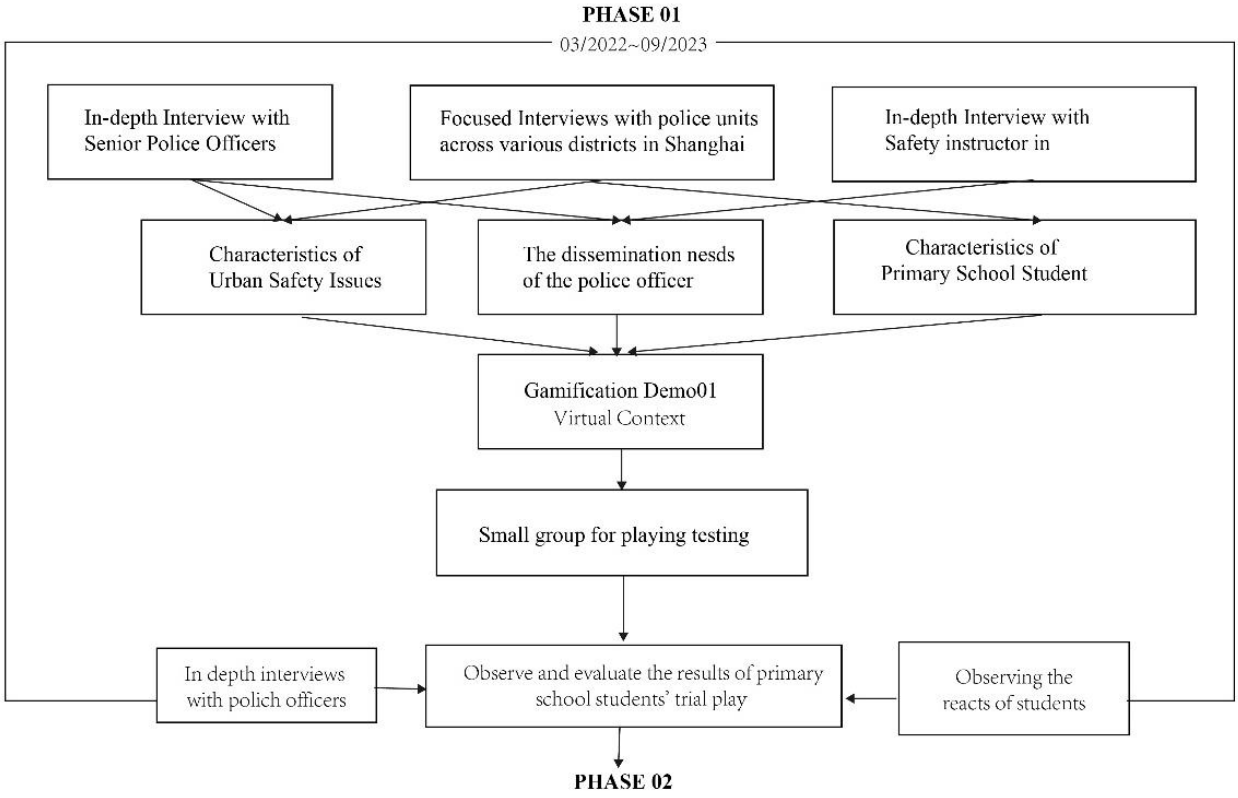
This study adopted a qualitative research method and was divided into two stages. Eight police officers from the Shanghai Citizen Police Academy, one police superintendent from the Citizen Police Academy, and one instructor from the urban practice base were invited to participate in the development and effectiveness evaluation of the urban safety gamification communication plan throughout the process.

1. The First Phase (see Figure 2)

In-depth Interviews: In the first stage of this phase, in-depth interview was conducted with one first level police superintendent from Shanghai Citizen Police Academy (SCPA) for the urban safety training base to determine the main urban safety information issues faced by Shanghai primary school students, as well as the difficulties that the police faced in disseminating information and identify the safety skills which primary school students need to possess when living in the urban area of Shanghai.

Then, in-depth interview was conducted with one instructor from the Oriental Oasis Training Base in Shanghai, to determine the advantages and disadvantages of context simulation of real-life venues in the dissemination of urban safety information, and the frequency of off campus urban safety training for primary school students in the city. The Shanghai Oriental Oasis Training Base is a camp directly managed by the Shanghai Municipal Education Commission for extracurricular practical activities for young people in Shanghai. In 2018, 15 themed training centers related to Shanghai urban safety training were built in the base, including fire safety, rail transit travel safety, road traffic safety, etc. Each theme training venue uses a scenario-based approach to simulate the dangerous situations that elementary school students may encounter in urban life.

Figure 2: The First Phase of Research Process



Focused Interviews: Next the researchers conducted focused interviews with eight frontline police officers from different regions of Shanghai to investigate whether there are differences and similarities in safety issues among different districts, and whether there are commonalities and differences in safety skills required for primary school students in each district. Those eight police officers involved in the study have more than 10 to 20 years of experience in community safety information promotion and campus safety information dissemination, and are very familiar with urban community safety, commuting safety, and home safety.

Observational Method: In addition, based on the information provided by the police, a game demo for the first phase was developed and tested on a small scale at the Summer Charity School affiliated with Shanghai Normal University. Shanghai primary schools have summer vacation in July and August every year, during which parents cannot take care of them due to work. Therefore, Shanghai Normal University will open temporary love schools in various community service centers in Shanghai during the summer vacation to provide care and learning guidance for primary school students. Every year, there are over 200 love schools in various areas of the city, and about 20,000 to 25,000 primary school students receive services from these love schools. The first phase of the study was conducted at the Summer Charity School in the Caohejing Street Service Center in Xuhui District, Shanghai. 18 students played the urban safety game Demo.

The game Demo01 is set up in a virtual scenario where primary school students go on a spring outing to a park in the urban area of Shanghai. After entering the game, players can choose to "play" as primary school students or their parents to evaluate whether identity exchange in the virtual identity helps cultivate primary school students' "empathy" ability. In the second level of the game, simulating a primary school student falling into the water in a park, players can explore various ways to rescue them. They can try using tree branches in the environment, park fence ropes, or throwing 6 packs of 200g potato chips and empty beverage bottles into a backpack as temporary lifebuoys for students who fall into the water. This will evaluate whether gamified communication can help cultivate students' "Adjacent Possible" critical thinking. Observing the trial performance of primary school students together with a superior police officer, and evaluating the trial results together with 8 police officers through focus interviews.

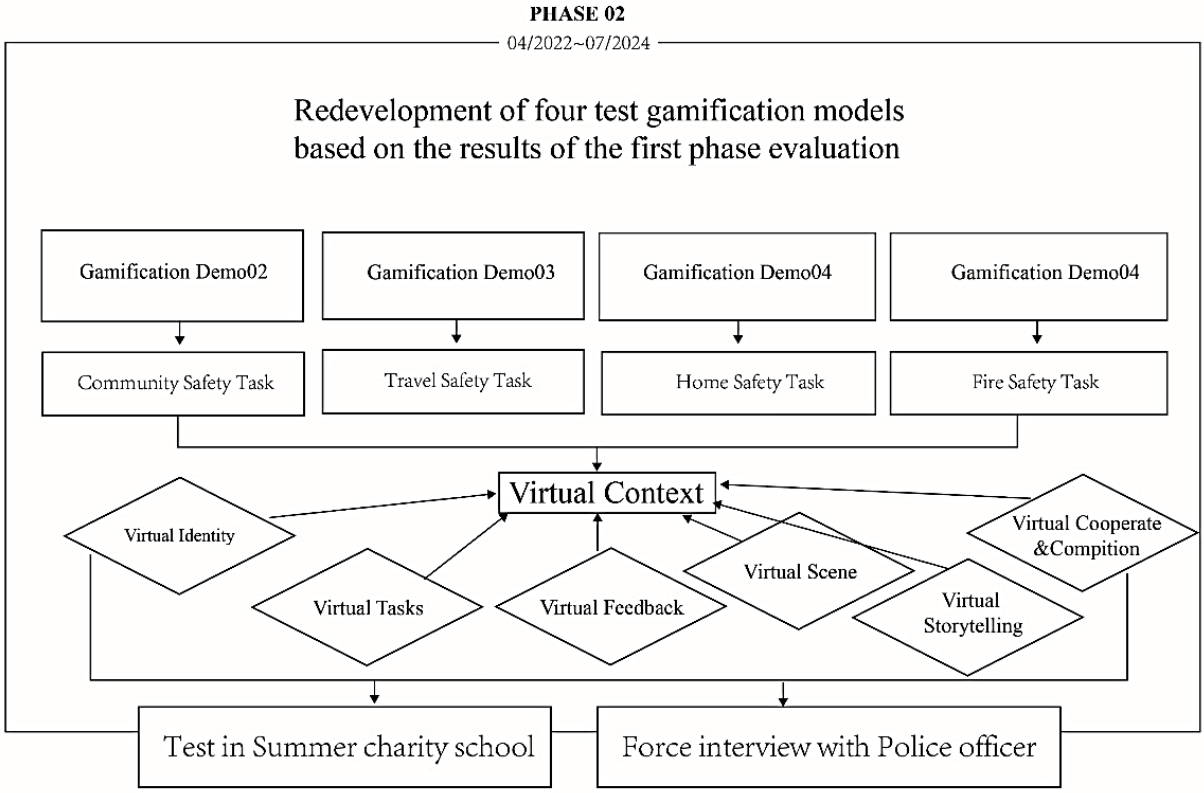
2. The Second Phase (see Figure 3)

PAR Research Method: Based on the results of the first phase of testing, we have formed four game development teams at Shanghai Normal University, and discussed the topics and evaluation results with the police in the first phase. Develop the second phase of gamified dissemination demo with the themes of urban traffic safety, community safety, home safety, and fire evacuation. These four themes were chosen based on the results of police statistics, indicating that Shanghai primary school students are most likely to encounter safety issues outside of campus.

During the research process, each of the four game teams invite one police officer as a consultant to evaluate the virtual context constructed by the gamification. The police participated in discussions during the planning stage, game architecture development stage, art concept design stage, animation resource production stage, and level testing stage of game development.

Test in Summer Charity School: Two Shanghai summer love schools and one community service center conducted game tests, with a total of around 120 primary school students participating in game trials accompanied by their parents. Eighteen parents participate the forced interviews to obtain their views on using games for urban safety information dissemination.

Figure 3: The Second Phase of Research Process



Forced Interviews with Police Officer: The nine police officers in the first stage evaluated the game again by the forced interviews. According to the first phase, virtual feedback, virtual scene, virtual storytelling and virtual cooperate & competition was added in the second phase of testing of virtual context.

In the second phase of research, the gamification model was compared in two different modes. The first method is to use China's domestically produced non-programming mode for production, which has the advantage of allowing non-gaming professionals (police officers) to work together with game production teams to develop games. The second mode was developed using mature game engine technology, with the police intervening in the game's evaluation at various stages, and the game team continuously revising the game based on the police's feedback (see Figure 4).

Figure 4: Three Games for Urban Safety Information Dissemination Were Developed Using Qualitative Research Methods

Results

The First Phase

There are seven themes emerging from the first phase of this research (see Table 1). The profile of all nine police officers and one security expert who provided information for the first phase is described as follow. P1 is from the first level police superintendent of Shanghai Citizen Police Academy. P2 is an instructor from the Oriental Oasis Training Base. P3 is an officer from Huangpu Branch, Shanghai. P4 is a police officer from Changning Branch in Shanghai. P5 is a police officer from Jingan Bureau in Shanghai. P6 is a police officer from Putuo Branch in Shanghai. P7 is a police officer from Xuhui Branch in Shanghai. P8 is a police officer from Hongkou Branch in Shanghai. P9 is a police officer from Pudong Branch of Shanghai. Last, P10 is a police officer from Yangpu Branch in Shanghai.

Table 1: Themes from Phase One of the Research

SN	Themes from Phase 1
1	Main urban safety issues
2	Urban safety skills
3	The advantages and disadvantages of real context
4	Attitude toward gamification
5	Virtual identity
6	Virtual task
7	Evaluation game Demo01 application Urban safety gamification via a mature commercial gaming platform

Main Urban Safety Issues

Primary school students face four main safety issues: on-campus safety, traffic safety, community safety, and home safety. Among these, on-campus safety is relatively well-established. This section is mainly disseminated regularly by the students' school to provide safety education for students' learning and living on campus. The safety issues outside of school are more prominent in commuting, community, and home situations.

P1 said, "*The characteristics of the Shanghai area are that there are few risks of serious violent injuries and public security incidents*." P3 said, "*The most lacking aspect at present is the dissemination of safety information about off-campus situations. On the one hand, on-campus safety education has always been relatively comprehensive*." P4 said, "*The problems faced by primary school students in urban areas are relatively similar, while there are greater differences between suburban and urban areas*." P5 said, "*With the increasing number of household appliances, the usage rate of electric cars and bicycles is also rapidly increasing, resulting in an inevitable increase in the frequency of fire incidents compared to the past*."

Urban Safety Skills

The urban safety skills of primary school students include the ability to perceive dangerous situations, the ability to escape from hazardous conditions, the ability to cooperate with rescuers in emergencies, and the ability to solve problems with a mindset that approaches possibilities.

P6 said, "*Primary School Students need to perceive dangerous situations. Kids walking on the community road are easily aware of the traffic light, but are likely unconscious of entering a blind spot for vehicles*." P2 said, "*Safe living in the city actually requires skills rather than knowledge, and our traditional way of teaching in the classroom often fails to enable students to master these skills truly."* P3 said, "*Every time a dangerous situation occurs, like a room on fire, it is necessary to quickly make an evacuation judgment, rather than 'find a perfect plan', because it will miss the best escape time."* P5 said, "*Alternative solutions are essential. Many student drowning incidents occur in lakes in parks where there may not be lifebuoys around. They should immediately use their personal belongings to rescue them."*

The Advantages and Disadvantages of Real Context

The construction cost of physical venues is high, and due to issues such as funding and government support, it is difficult to ensure that the content can be continuously updated. The advantage is that real-life scenarios are more realistic for primary school students, and having safety trainers to accompany them can quickly correct students' erroneous behaviors in dealing with danger.

P2 said, "*The second time I entered the physical training center, the content was repetitive, so that I couldn't provide continuous training for the children*." P4 said, "*The construction and maintenance costs of physical security information training venues are very high.*" P1 said, "*The construction of physical scenario training venues requires the cooperation of multiple government departments*." P3 said, "*It is usually a one-time update because there is no subsequent project funding support to update the content*." P6 said, "*The advantage is that physical venues are closer to real-life situations than virtual venues*."

Attitude toward Gamification

The police hold a supportive attitude towards the dissemination of security information through gamification; however, a security supervision mechanism is needed to ensure the integrity of the safety content in the game.

P1 Said, "*At present, we have tried to incorporate some game activities into offline interactions with primary school students and parents, and the results are pretty good. So, we also hope to have online video games that might assist our work*." P4 Said, "*Considering the healthy growth of students' eyes, they may not be able to use VR for a long time. I think it should be a gaming platform similar to mobile phones and computers, with a certain distance*." P5 Said, "*The use of games for dissemination still requires certain supervision, and elementary school students should not be left confused in games. Content related to safety should align with real-life situations*."

Virtual Identity

Virtual identity in games helps guide primary school students to develop a habit of independent observation and exploration of their environment. It enables students to form empathy when facing danger, making cooperation between students and rescue personnel smoother.

P1 said, "*It's interesting to have elementary school students play different roles in the game; they can be both seekers of help and providers of assistance*." P2 said, "*Using virtual identities in games to engage in games with virtual contexts can help reduce the cost of trial and error*." P6 said, "*Games are now also a social behavior among children, and socializing with virtual identities may also enhance their collaborative abilities when facing danger*."

Virtual Task

The virtual tasks in the game establish a practice mechanism for urban safety skills. Still, the development of game tasks should implement content supervision and evaluation to ensure that the game does not cause physical or mental harm to students. Primary school students should also play games under the guidance of the police, parents, and community. The development of virtual tasks should find a balance between game playability and the seriousness of security information.

P4 Said, "*Professional personnel supervision and evaluation are necessary for the task content in the game at all times*." P5 Said, "*There may be some exaggerated stories, but the accuracy of the urban safety information that needs to be conveyed to primary school students must be ensured."*

Evaluation Game Demo01 Application

The virtual scenes in the game are not closely tied to Shanghai, and there should be more local elements in Shanghai to help elementary school students connect virtual situations with real-life experiences. The game needs to add explanations for voiceover and dubbing, as students prioritize recognizing text and may have difficulty understanding the text prompts in the game interface.

Although the game may be suitable for primary school students in lower grades, it is too slow for senior grade students. Creating urban safety information in published games imposes significant limitations on the virtual scenes of the game, requiring the use of existing spatial measurement units in the game. *Ylands* is a Low-Polygon game, which makes it challenging to achieve exquisite design in virtual scenes. In game task design, the presentation of feedback must also comply with existing commercial games, resulting in some content being very difficult to present.

The Second Phase

Next, the findings from the second phase of the research is presented. There are six themes come out (see Table 2). Themes 1-4 use forced interviews with 18 parents of the primary school students whose children have played the Demo at the Summer Charity School. Themes 5-6 are from forced interviews with a police officer who participates in the gamification Demo design.

Table 2: Themes from Phase Two of the Research

SN	Themes from Phase 2
1	Virtual Feedback
2	Virtual Scene
3	Virtual Storytelling
4	Virtual Cooperate & Competition
5	Evaluation Game Demo02-03 Application
6	Evaluation Game Demo04-05 Application

Virtual Feedback

The virtual feedback for primary school students needs to be based on the literacy rate of primary school education in Shanghai, and some content transmitted through text should be equipped with Pinyin and phonetic systems. The phonetic systems should support both the Shanghai local dialects and Mandarin. Virtual feedback should be presented accurately, vividly, and visually. The feedback rhythm should conform to the characteristics of being short, continuous, frequent, and fast-paced. The function of virtual feedback should have clear guidance to help students "enter" the virtual tasks and inspire thinking about solving dangerous issues.

Fourteen out of 18 parents agree that game feedback with animation, role-play mechanics' is clear, and can help students understand the content. Fifteen out of 18 parents thought Shanghai dialect in the game is very friendly, but 3 of them thought some children from other provinces in Shanghai may not understand the dialect. Fourteen out of 18 parents thought Students prefer to receive continuous feedback in game levels rather than reviewing previous game results in a virtual "database."

Virtual Scene

Before designing a virtual scene, it is necessary to conduct on-site research on the real scene corresponding to the virtual scene. To ensure the authenticity and Shanghai characteristics of the scene in terms of safety hazards. The virtual scene presents not the architectural space of the game but the social ecology of a specific area. Taking the community safety game developed in this research as an example, the scene simulates three typical types of communities in Shanghai: the lane community, the new public housing community, and the high-rise community. To present a realistic ecology, many "citizens" (NPC: Non-Player Controlled characters) are designed in the scene, who may play chess on the roadside, ride bicycles in the community, or exercise and run. Each character has a certain degree of randomness. When players enter the game, they might encounter different "citizens," so that the virtual scene has a certain degree of realism when presenting urban safety information.

Sixteen out of 18 parents said, "*Cutting down the content of security information and placing it in a game scene for elementary school students to discover independently will be more impressive.*" Nine out of 18 parents mentioned that the game Demo 2 is beneficial in guiding primary school students to explore the dangers in their community independently, and the community environment where they live is very similar, much like bringing the community into a game.

Virtual Storytelling

The virtual storytelling in the game, composed of a large number of "tasks" and "player choices," enhances student engagement. The non-linear characteristics of virtual storytelling allow students to form autonomous resistance and a sense of control over urban safety situations by "player choices" to influence the direction and outcome of the story in virtual contexts. The fragmentation of game narrative helps to form a management system for the dissemination and

learning of urban safety information in a "task" manner.

Seventeen out of 18 parents thought the narrative in game Demo02 is helpful for elementary school students to understand traffic safety on their way to school. Fifteen out of 18 parents said students are very interested in fragmented stories in virtual contexts, where each person can have different choices. Fifteen out of 18 parents agree using tasks to drive the development of the story enables parents to effectively plan how many tasks their students should complete each day.

Virtual Cooperate & Competition

There is currently no consensus on whether cooperation in virtual contexts can contribute to cooperation in real-life hazardous environments. However, cooperation in virtual contexts can to some extent enhance the social skills of elementary school students.

Eight out of 18 parents thought playing games between players and virtual characters helps elementary school students to independently remember the key points of traffic safety. Seventeen out of 18 parents believed that guiding elementary school students to cooperate in games will also help them cooperate with each other when facing danger.

Evaluation Game Demo02-03 Application

The evaluation of game Demo02-03 reveals that the virtual context in the gamification can effectively simulate the dissemination of community and traffic safety information to students. The virtual feedback based on game variables can provide clear reference values for students to master safety skills. The game effectively reproduces the safety hazards in Shanghai communities.

P1 said, "*Quantifying game feedback through global variables in the game is very effective for students to grasp their own learning progress*." P5 said, "*Game Demo02 &03 help prompt students to actively participate in learning about urban safety information, especially in Demo02, the game scenes are very characteristic of the Shanghai community*."

Evaluation Game Demo 04-05 Application

The evaluation of game Demo04-05 shows that the virtual scenarios in the game can simulate the dissemination of home safety information and fire evacuation safety information to a certain extent. The openness of the game module helps to incorporate current hot crises into the existing game mode, completing the dissemination of sudden information, such as COVID-19 prevention. P6 stated, "*The Game Demo04 posed interactive operations related to kitchen electrical safety and toilet slip risk, which is closer to the probability of accidents occurring at home in Shanghai*." P9 said, "*Game Demo 04 turns avoiding the COVID-19 into a parkour game, which is very challenging*." P10 said, "*Game Demo05 feedback in the scene still needs further improvement, and the perspective presented in the scene may not fully shape the fire situation.*"

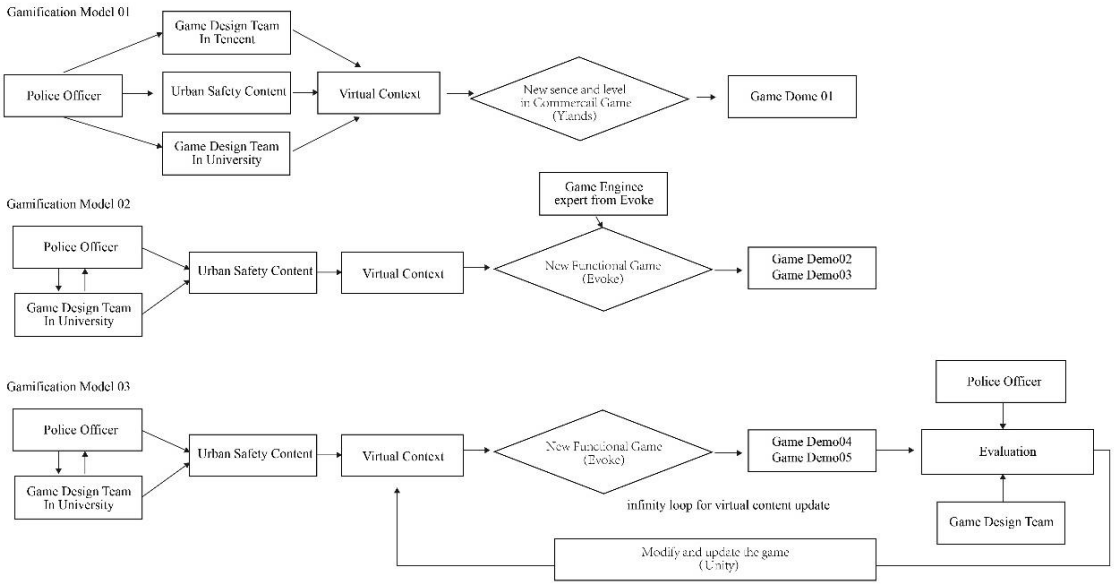
Discussion and Conclusion

Conclusion of Comparison with Three Different Gamification Models

Although the virtual context in the games has the ability to efficiently disseminate necessary safety information to primary school students, due to the fact that urban safety information comes from multiple aspects of society, game production teams cannot be separated from safety education experts, police, and audiences and cannot independently build a game-based communication context with the game team as the core. This is the foundation for building gamification-based communication. In addition, over time, even highly completed game products may encounter timeliness issues and become outdated due to various new environmental safety issues, changes in student cognitive habits, and the acquisition of new security technologies by urban safety departments. It is necessary to have a convenient and timely long-term maintenance and operation mechanism that incorporates the latest information into the game.

In this study, five Game Demos were developed using three different gamification modes (see Figure 5).

Figure 5: Comparison of Gamification Models



Gamification Model 01 applying a tripartite collaboration was used, with police, university game design teams, and commercial game companies (*Tencent Game*) working together to provide security information content, while university game design teams and commercial game companies worked together to place the content in already running commercial games. The advantage of this approach is that the allowed commercial games already have a certain customer base that can quickly promote the dissemination of gamification strategies, with mature commercial game teams providing technical support and very high production efficiency. The disadvantage is that all commercial games have a lifecycle and are not suitable for the dissemination of urban safety information that needs to be normalized. The level of urban safety content cannot bring profits to commercial game companies, so long-term cooperation is not possible. On already running games, adding levels is limited by the existing game world architecture and cannot be designed with urban safety as the core objective. Some university development teams cannot incorporate game content into existing games, which limits the development of gamification for urban safety content. Commercial games already have a certain target audience, which does not fully match the Shanghai primary school students needed by the research institute. Therefore, it is necessary to consider the needs of non-target audiences, which will also limit the effectiveness of urban safety information dissemination.

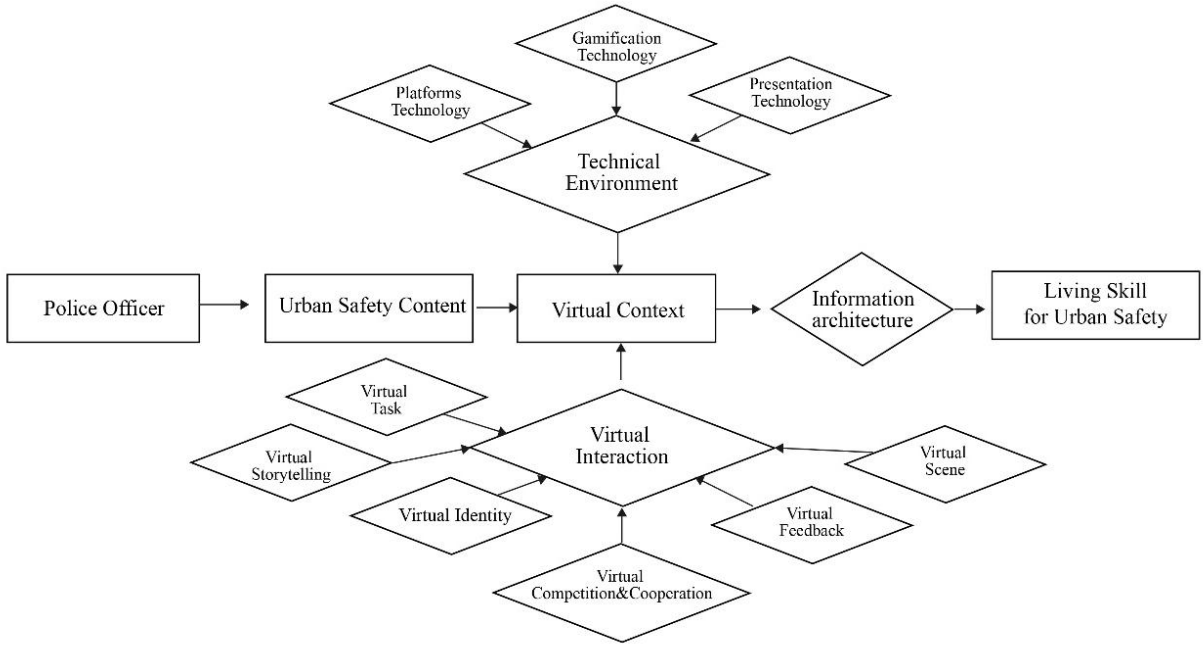
Gamification Model 02 applies the non-programming design game engine Evoke, developed by the *Evoke-Gaming* company. The game features an interactive module based on commonly used gameplay, enabling police officers to participate in the design and development of the game together. Due to the free use of the game engine and modular design of interactive behavior, this gamification approach reduces the capital and time costs of game development, and can quickly output games for testing on multiple platforms such as mobile phones and computers. The disadvantage is that this game engine is only suitable for developing 2D games and has few users in professional fields, so it cannot be operated and used for a long time in the future, and is not suitable for the development of urban safety communication game strategies that require continuous updates.

In the Gamification Model 03, we will replace the Evoke engine with the commonly used Unity engine in the professional field during the later stages of game development based on the second model. Because this engine has the advantage of cross platform dissemination in the future, as well as high technological resource advantages and future scalability, it will help the game to continuously update and modify existing gamified dissemination content in subsequent communication with the police.

The Virtual Context Design in Gamification for Urban Safety

In this research, the construction of information in virtual contexts in gamification is mainly influenced by the technological environment and virtual interaction. In the technological environment, it is influenced by three variables: the development of platform technology, gamification technology, and the impact of presentation platform technology. (Figure 04)

Figure 6: The Virtual Context Model in Gamification for Urban Safety



Visually Quantify for Virtual Feedback

The virtual context in games is often built on the basis of the quantified results of the game, such as the Scoring System (SS: quantification of the behavioral effects of player operations), Experience Points (XP: quantification of the player's current comprehensive ability evaluation), Player Level system (PL: quantification of the player's future ability improvement space), and Inventory Data (ID: quantification of the player's current collection of items and available contextual resources). Let's use the game that promotes cardiopulmonary resuscitation (CPR) skills at the Shanghai Youth Outdoor Training Base as an example. Each player will have a silicone mannequin in front of them. The dummy's body has a pressure detector installed. Players need to perform cardiopulmonary resuscitation compressions on the dummy within the specified time. In real-life situations, it is difficult to convey information about the correct level of pressure to personnel performing safe operations. However, once gamification takes place, the player will see the "force" they exert on the screen, and the game's "points" will determine if their actions are "correct". This allows players to improve their operations immediately based on the information the game conveys (see Figure 7).

Figure 7: Gamification-based Communication for CPR

Source: The Ambulance Training Laboratory of the Oriental Oasis Youth Outdoor Training Base in Shanghai, April 19, 2023

Visually Task Led to Proactively Explore is Conduce to Adjacent Possible Skills

Setting up multiple proximity problems in the virtual context of the game can help elementary school students use adjacent possible thought skills to find solutions to overcome difficulties. In the Game Demo01, players need to simulate the dangers that primary school students encounter when going to the park in spring. When a classmate falls into the water, lifebuoys are often not found by the lake in the park, players need to find a "replacement plan". One hidden alternative plan is for the player to collect six packs of potato chips from their fellow NPCs, stuff them into a backpack, and then throw the backpack to their drowning companions. The Shanghai police conducted a real experiment that inspired the virtual context tasks in this game. Six packs of potato chips can make an adult weighing less than 200 pounds float on the water surface for about 30 minutes. This approach of using near possibility thinking to solve problems is precisely the unique ability of game virtual context dissemination and the unique demand for urban safety information dissemination. The purpose of disseminating urban safety information is not to rigidly tell others what they should do, but to tell them how to think and evaluate the environment quickly. The testing of this sample has proven that designing information dissemination in virtual game scenarios can guide primary school students to quickly and effectively establish their own thinking patterns for safety measures.

The use of virtual contexts to construct an "adjacent possibility" thinking approach can help primary school students better understand the possibility of imminent safety incidents and make more informed decisions when facing safety issues. For instance, we can create an intelligent communication ecosystem that combines virtual reality symbiosis and human-machine interaction. Spreading urban safety information through gamification is beneficial for expanding the spatial scope and time span of situational dissemination of safety information, allowing information recipients to personally experience and respond to various safety risks in the game. At the same time, virtual scenarios can also set various tasks and challenges to motivate them to actively learn and improve their safety skills.

Virtual Storytelling is Helpful to Established Meaningful Content

Urban safety information must be endowed with "meaning" in order to be remembered. Narrative in virtual contexts adds concrete causal logic, spatial and temporal information to the occurrence of dangerous situations, making information easier to remember. Sid Meier, the designer of the game "Civilization," once likened games to a collection of choices endowed with meaning. Narrative in games is achieved through symbols such as words, actions, objects, artifacts, signals, and texts, and completes the shaping connection with past experiences. Without the external conditions created by narrative, no matter how clear the explicit knowledge is explained, students cannot effectively understand it (Gee, 2018).

Virtual Identity can Build Urban Safety Awareness

In the game Demo02, we assume that the player is a "community investigator" who needs to investigate safety hazards in the community where her grandmother lives Community investigator "is a unique community system in Shanghai, where people can spontaneously submit their community safety hazards to Shanghai TV. After the evening news every day, there will be a program called" Audience Come," which will report various problems encountered by citizens and urge the government to improve. In our research, we found that when primary school students are given a" sense of mission "identity, they are very willing to actively participate in the task of" saving this community "in the game. The sense of mission that virtual identity gives players is the core driving factor for trend players to participate in challenges (Yu-kai, 2014). In Game Demo01 players can not only play as the student in danger, but also play as the person who saves others, like teachers or parents, which creates multiple perspectives for students when facing the danger situation. Because detachment from the dangerous environment in reality can be seen as a cooperation between the rescued and the rescuer, jointly facing challenges from the situation. If one can have empathy and anticipate the behavior of collaborators, it has a positive impact on escaping danger. When players successfully deal with disasters or protect city safety in the game, they will feel a sense of achievement, which can be translated into attention and participation in urban safety issues in real life.

Virtual Competition & Cooperation

In game design, competition and challenge mechanisms are not only key elements to enhance player engagement and entertainment, but can also serve as an effective means to disseminate urban safety information. The competition and challenges in the game can stimulate players' intrinsic motivation, making them more actively participate in the game. By setting tasks and challenges related to urban safety, players will naturally come into contact with safety knowledge while pursuing victory. For example, in Game Dome05, players need to deal with unexpected events such as fires and earthquakes. This challenge not only increases the

fun of the game, but also allows players to learn the correct methods for dealing with disasters while solving these problems.

Virtual Feedback is Foundation of Interactive Behavior in Virtual Context

Feedback is the foundation of game interaction mechanism and the basis for evaluating game results. Virtual situational feedback can provide players with real-time and visual results, helping them understand the consequences of specific behaviors. In Game Demo 03, when players take the correct safety measures in traffic, the game can reinforce these behaviors through virtual situational feedback (such as successfully avoiding blind spots in cars and earning coins or medals). On the contrary, if players ignore traffic rules, they may encounter negative consequences in the game, such as virtual character injuries or property damage. This instant feedback mechanism can help players learn and remember safety knowledge faster.

Victual Scene

Victual Scene is the carrier of the remaining virtual variables in this study, which takes place in a visualized scene, including virtual challenges, virtual stories, interactive behaviors, etc. Virtual scenes are also a part of storytelling, but unlike animation, virtual scenes in games are also an important basis for giving emotional value to games. Mild danger, moderate danger, and urgent danger all require the shaping of the scene. Therefore, virtual scenes also affect the emotional experience of players during gaming. Victual Scene is the carrier of the remaining virtual variables in this study, which takes place in a visualized scene, including virtual challenges, virtual stories, interactive behaviors, etc. Virtual scenes are also a part of storytelling, but unlike animation, virtual scenes in games are also an important basis for giving emotional value to games. Mild danger, moderate danger, and urgent danger all require the shaping of the scene. Virtual scenes can enhance players' memory of urban safety information through emotional resonance. When players experience tense or dangerous situations in the game, they may experience strong emotional reactions such as tension, anxiety, or a sense of achievement. These emotional experiences can help players better remember relevant safety knowledge and coping strategies. Virtual scenes also play an important role in transforming virtual knowledge into skills.

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