Research on the Gamification Design of Museum APP Based on MDA Model

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Abstract. To provide a museum APP gamification process framework and design method, which can play an effective role in better spreading museum culture. Through the study of museum APP gamification design under MDA model, verify the feasibility and necessity of gamification design in museum APP, explore the museum APP gamification design method, provide the museum APP gamification design process relying on MDA model, and guide and carry out the design practice activities of museum APP gamification with the design method process. Gamification design provides a new way of learning, meets the psychological needs of users and has special value. The use of gamification design in museum APP can give excellent play to the role of new media, make it play a greater role in the new era, reach a more youthful and immersive user experience, increase the amount of users, enhance the interest of users in independent learning, form a certain educational significance and social value, so as to promote the development of museum APP gamification and promote the diversified development of museum cultural communication.

Keywords: Gamification theory; MDA model; Museum APP; The user experience

1 Introduction

With the progress of Internet technology and diversification of communication media, it has prompted the cultural communication form of museums to present diversification. APP is an effective way to combine museums and digitalization, integrating the traditional elements of museums with APP communication methods, which can be better popular in today's society, meet the users' psychological expectations, satisfy their emotional needs and increase the efficiency of traditional culture communication. In the face of the huge and diverse APP market, focusing on good user experience attracts more excellent users while enhancing the vitality of APP. The museum itself represents the concentration of the spiritual core of a certain region and a certain nation, and is a position to learn and promote the excellent traditional culture and traditional spirit. Museum APP gamification with "cultural heritage" as a link, is an

important carrier to carry history and inherit culture [1], which helps to spread knowledge, improve skills and solve problems.

2   Gamification theory and MDA model

Gamification thinking is a way of thinking that uses game elements and game design related techniques to engage in problem solving in non-game situations, integrating things that already exist and have value and game mechanics to increase user interest and enhance immersion experiences. Gamification is an approach and can be a way of thinking that can be integrated into various fields. But games and gamification are two different concepts. Games are designed to generate fun, while gamification focuses on the product itself, with the aim of reaching the product its educational, promotional and other goals.

The MDA model, a common design architecture model for gamification design [2], is not only used in game design, but also in application development and education. three elements, based on which three elements of mechanics, dynamics and aesthetics are derived to establish a new model, as shown in Figure 1, that is, the MDA model system. It splits the game into different components and connects design, analysis and technology with a unified theoretical framework. Designers can make all-round consideration of the design process according to this model, and players can also form a correct perception of the game and produce a better understanding through this model. The sum of mechanics, dynamics, and aesthetics constitutes the game itself, and the MDA model provides an effective analysis and guidance framework for gamification design methods by integrating figurative and abstract levels into the design of game components from both micro and macro perspectives.
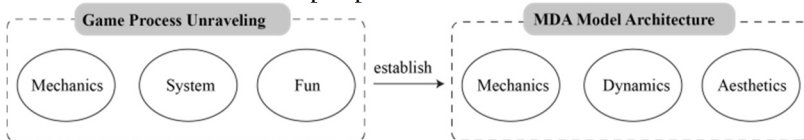

Fig. 1. Analysis of the elements of narrative illustration expression

Each level in the MDA model contains different elements underneath. Therefore, during the design process, the design elements within each panel should be divided in detail.

2.1   Mechanics

A mechanics is a restriction and a guide under interaction design [3]. A mechanics can be a specification of the mode of operation, which sets the user's feasible interaction behavior and has a directional effect on the game process. Mechanics can also be a formulation of game play, such as a reward and punishment mechanism, which evaluates the feasibility of this interaction behavior after the user interaction behavior is performed, and then gives appropriate rewards and punishments. Another example is

the social mechanism, which allows, or must take place in a multi-user cooperative mode at some stage of the game. The game process formulation provides the completed game story line, the reward and punishment mechanism brings the user emotional experience, and the social mechanism provides the user with the option of multiplayer games and increases the interaction between users, all three together form the complete mechanics formulation, which provides the basis and guidance for the next dynamic setting. In the design of mechanics in the MDA model, a general mechanic concerning the overall progress of the game is usually set, and then under the overall planning of the general mechanic, independent game stages are set up in specific stages, and mechanics and dynamics for the independent game stages are formulated. Users must strictly abide by the set mechanics and can only find valid information in the current game episode to unlock new story lines and arrive at the next game session, providing a guarantee for the effectiveness of user participation and experience.

2.2   Dynamics

Dynamics is the interaction between player behavior and the game. The interaction is not only limited to the user's interaction behavior, but also includes the game environment, art, music and the experience brought by multi-user interaction. On the basis of the above mechanic setting, through the interrelationship between users and APP, and between users and users, it can be said that the dynamic setting is subdivided into three types of operation gestures, timely feedback and user interaction. The diverse variations of interaction types can bring different aesthetic experiences. In each independent stage, different dynamics are needed to match the corresponding mechanics to bring diverse experiences to gamification. For example, in different scenes, the interaction behavior of clicking has different meanings. Players can click to select props or control the game character to walk. And too long game overload and dialogue can make users feel tired and lose patience, timely feedback plays a crucial role. Feedback is a promise: the goal is absolutely attainable [4]. Finally, by adding user interaction, it enhances the stickiness between users and the app and promotes the spread and development of the app among users. Dynamics is the way to achieve emotional and sensory experience, and for the dynamic setting can bring the motivation for users to continue playing.

2.3   Aesthetics

Aesthetics is the aesthetic value felt by users in the process of experience, the final goal reached by mechanic setting and dynamic setting and the best game experience provided, mainly divided into two kinds of sensory experience and emotional experience. The sensory experience mainly focuses on the five senses of vision, hearing and touch. Emotional experience can cover rich contents such as fantasy, challenge, narrative, discovery, friendship, expression and leisure. For different gamified APPs, there are different demands for emotional experience categories, and their ultimate purpose is to serve the product itself.

Based on the gamification design of MDA model, mechanics, dynamics and aesthetics echo each other, interact with each other, and are interlocked to achieve aesthetic expectations through mechanic making and dynamic setting. In the model, aesthetics is the basis of mechanic making, mechanic making achieves the purpose of human-computer interaction, dynamic setting brings users emotional experience, and the three cooperate with each other to provide users with a complete game experience. the classification of design elements of MDA model and the connection between the elements are shown in Figure 2.
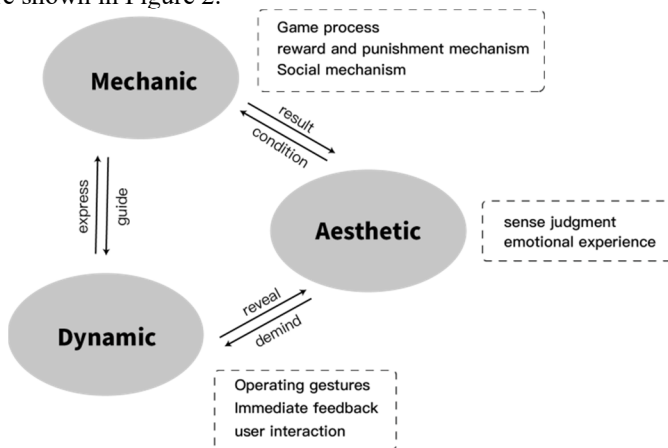

Fig. 2. Analysis of the elements of narrative illustration expression

3 Feasibility of Museum App Gamification Design

3.1 Analysis of the current situation of museum APP

Through the survey, it was found that the existing museum APPs are mostly pure science-based products, of which collection introduction and guided tours are the two most common types. The popularity of electronic products should have allowed museums to provide better educational opportunities for their services. The production and distribution of APPs can create new ways to promote museums. Both have contributed greatly to the dissemination of knowledge, but there are certain problems: first, most APPs are simply guided tours, which do not provide greater value. Secondly, the single product type ignores the multiple needs of users. Again, the lack of fun and interactivity, merely moving physical texts to the Internet platform, without organizing, filtering and extracting cultural contents, has created a fault in the process of integration of content and communication methods [5]. In the context of digitalization, transforming the museum concept from object-based to human-based, gamification into museums is a major opportunity for the transformation of contemporary museums. For example, the story-based design and development of museum gamification APPs that integrate game elements, such as "The Emperor's Day" launched by the Palace Museum allows users to understand how the emperor spends his day in the Forbidden City, and "Eizhen - Myriad Pens of a Thousand Hills" jointly launched with NetEase Games takes users

through the outside and inside of the painting based on the "Thousand Miles of Rivers and Mountains", and "Father and Son" launched by the National Archaeological Museum of Naples, Italy Father and Son" adopts the form of watercolor painting, using the dialogue between the father of an archaeologist and his son as a model to tell the story of the Naples Museum. Although this new direction of gamification APP attracts the attention of various museums, it still lacks a systematic guideline and design ideas [6].

3.2   The value of gamification application in museum app design

The unique advantages of gamification thinking for the purpose of stimulating user participation have extremely rich application value in museum app design, providing cultural experience and information access for the public, focusing on cultural display, appreciation and dissemination [8].

Social communication, application of young people.
    For museums, young people are very important. As the main force of cultural heritage, young people, as the aborigines of the Internet, are scattered with unique network characteristics, and all aspects of life are closely linked to the Internet. They pay more attention to personalized content presentation and interesting interactive experience, love hot spots, in-depth originality and new knowledge, and are willing to take the initiative to contact new things to know, willing to pay for knowledge, and always seeking wider participation, which is where cross-media platforms can help [9]. Gamified APPs are different from traditional museum mobile applications in that entertainment is an advantage in social sharing. The Internet-based APP is the main position of the young population. In museum APP design, different narrative techniques should be tried, and gamification is a good starting point.

Active engagement to provide an immersive experience.
    Traditional museums single mode of information transmission, the audience passive information acceptance, even if the use of new means of communication, museum APP and other Internet platforms have not been able to avoid these shortcomings, just the traditional way of communication copied to the online platform, and no substantial change. Adding gamification thinking to APP design can make the boring knowledge vivid and interesting. The gamification design increases the interaction of APP function, enhances the emotional feedback of users and improves the active participation of users. At the same time, the unique immersive experience of the game also enables users to gain knowledge in the process of immersive game experience, which is conducive to strengthening the understanding and absorption of knowledge.

Combining entertainment and education to improve social value.
    Public interest is one of the main characteristics of museum education. However, people are in awe of traditional culture and cultural relics, which creates a gap between users and museums. Applying gamification thinking in museum app design can be a

good solution to this problem. Gamification is a kind of design thinking and an educational approach, taking the form of digital games and the connotation of games as a carrier, allowing learners to discover problems, explore them and solve them independently, enhancing learning interest and weakening learning pressure. With the packaging of gamification to narrow the gap between museums and the public, gamification can become a powerful tool to promote the dissemination of cultural knowledge and historical civilization, and it can increase the interest of youth viewing and attract youth participation [7], which helps to fulfill the mission of museums and implement their social values.

4   MDA model gamification design process

Based on the MDA model, its theoretical authors analyze the process of gamification design, firstly, it should start from the mechanics to develop a complete and continuous game mechanism to decide the process and development direction of the game, and secondly, it should develop the most reasonable and humanized dynamic interaction behavior to ensure the normal operation of the game mechanism. In turn, through the continuous game process and rich and reasonable human-computer interaction settings to produce a certain aesthetic experience value. From the designer's point of view, mechanic making leads to dynamic settings, which in turn provide a characteristic aesthetic experience; from the user's point of view, aesthetics is the cornerstone of the game, which gives rise to dynamic settings and complete or staged mechanic settings.

Therefore, in the actual design process, designers often put the aesthetic elements before making mechanics, first conceive the sensory and emotional experience that users want to achieve after using the product, as well as the elements needed to build the game and classify them, and then make corresponding mechanics and suitable interaction behaviors according to the anticipation of user experience. Then, it is verified that the set mechanics and dynamics can achieve the desired aesthetic effect. If the aesthetic value brought by the set mechanics and dynamics does not match the expectation, it is necessary to go back to the node where the mechanics were made and adjust the mechanics and dynamics to ensure that the final presentation is close to the initial conception of the aesthetic value. The whole design process is shown in Figure 3.
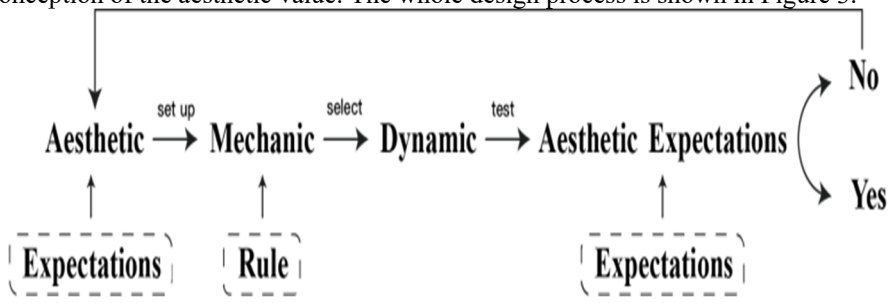

Fig. 3. Analysis of the elements of narrative illustration expression

5   MDA model-based museum app gamification design process

Applying the MDA model theory to the design process of museum APP gamification, a guiding design process framework is derived by refining and analyzing the content of the stage process, and then guiding the design practice process.

First, the purpose as well as value of museum APP gamification should be clarified, and the screening of design elements in aesthetic experience should be carried out. Establishing requirements and establishing good design are the prerequisites of gamification program design. As an official communication platform, museum APP naturally has to have its most basic function, i.e. science learning. Refining the science learning, it can be divided into collection categories, collection uses, background stories, historical figures, and development context. Gamification of museum APP aims to enhance user experience and make science learning interesting, thus increasing user frequency and strengthening and highlighting the social value of museum APP.

Then, the aesthetic experience is screened in the corresponding categories. Based on the generalization of the objectives as well as the roles of the museum APP gamification and the needs of the target group, the emotional experiences in aesthetics are screened, and the emotional experiences that fit with them are extracted, namely challenge, discovery, immersion, and leisure. For narrative, in this stage, the whole process of narrative should be summarized, and the basic design elements of narrative such as the main story line, storyline, subject elements, object elements, and even environment, time, and space should be summarized.

Next, the already summarized narrative part of the aesthetics is extracted, and the narrative is combined into the game design to plan the complete narrative process. A successful game design must first have a reasonable narrative. Corresponding the main story line to the main game line, the storyline is used as a stage independent game, and the items and environment are integrated to form the main mechanics such as collection display and achievement system. And on this basis, the mechanics are expanded and refined. The gamification design of the museum app does not rely so much on common game design elements such as reward and punishment mechanisms, levels and points. The focus is on setting up new levels and new storylines that keep appearing, giving users an immersive experience, convinced that being in the game and looking forward to the next storyline development ensures a complete and smooth game experience. Through the combination of filtered emotional experience and narrative in the game design, a complete and continuous game experience is formed.

Finally, in the design of dynamics, the museum app gamification design should go to consider the dynamics in line with the characteristics of the museum. In terms of operating gestures, it should be simple and convenient, and the simple and easy-to-use interaction design reduces the time for the user to be familiar with the interface not only to optimize the user's behavioral experience, but also to be as rich as possible to meet the user's emotional experience in the process of using, so as to avoid the psychology of boredom or boredom. In terms of picture effects, one should go for traditional element symbols that match the national characteristics of local museums to enhance locality, but not to be noisy or overly decorative. In the music effect, through the distinction of

music, to create a different sense of atmosphere. For example, in the entertainment leisure section should be based on soothing music, in the competition, the game section should be based on compact music. As with the graphics effect, nationalized music genres should be taken into consideration. In terms of user interaction, both cooperation and competition can be considered to establish a social system to facilitate multi-player interaction, increase game play and enhance the game experience. Based on the MDA model museum APP game design process, see Figure 4.
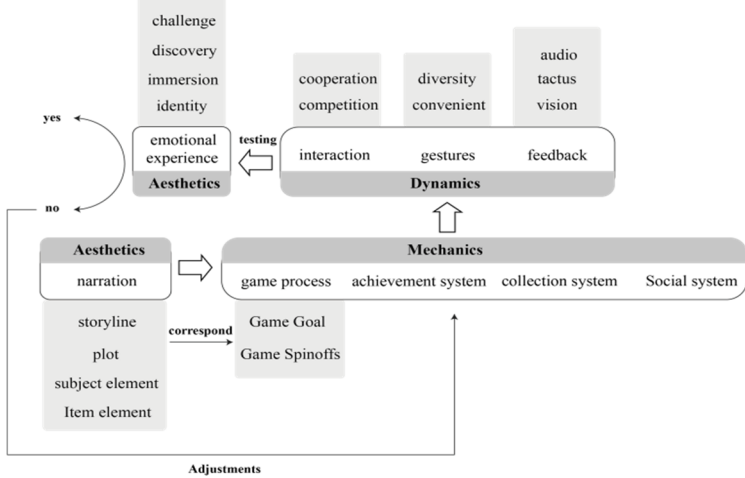
Fig. 4. Analysis of the elements of narrative illustration expression

6   Gamification design practice of Hubei Provincial Museum App based on MDA model

Hubei Provincial Museum is a national comprehensive museum, and has the largest exhibition hall of ancient musical instruments in China. The collection contains nearly 1,000 pieces (sets) of first-class cultural relics. The rich collection of the museum and the important status and value of the collection are enough to provide rich inspiration and reference value for the gamification of the museum app. As one of the "Four Treasures" of Hubei Provincial Museum, Zenghouyi Tomb Chimes were unearthed in 1978, and were a set of large ritual and music instruments cast by the mechanic of Zeng State in the early Warring States on the basis of the bell given by the king of Chu. It is astonishing for its outstanding craftsmanship, exquisite decoration and unique way of sound generation. With many achievements, the Zenghouyi Tomb Chimes represent the highest achievement of Chinese pre-Qin ritual music civilization and bronze casting technology, and can provide a narrative model for the gamification design of Hubei Provincial Museum APP, laying a cultural foundation, meeting the needs of different disciplines and indicating a feasible design direction for the popularization of general science. Therefore, we choose Hubei Provincial Museum Zeng Houyi Chime as the object, take the story of Zeng Houyi and Xiang Fei as the prototype, combine with MDA model, and carry out the app design of "Chime - Unfinished".

6.1   Narrative story building

Story is the soul of the game and objectively determines the breadth and depth of the game carrying the culture of communication. The story of Zeng Houyi and Consort Xiang is chosen as the main line for the game content creation. Legend has it that Zeng Houyi was not only an enlightened monarch, but also a talented man who could make his own musical instruments such as Xiao and flute, and could play and tap out beautiful music. Zeng Houyi also made Xiang Fei acquainted with the chimes because he received a gift from the king of Chu, and finished making a complete set of chimes based on the hao bell. When the complete set of chimes was cast, Zeng Houyi died of the epidemic, and Consort Xiang took the initiative to bring the chimes with him for burial, and Zeng Houyi then had the poignant love myth of Zeng Houyi and Consort Xiang. By summarizing, organizing and refining the story, listing out the detailed storyline, the game branch line corresponds with it. In the process of sorting out the two storylines of "building the whole set of chimes" and "forming the chimes of Zeng Houyi's tomb", the "types of chimes", "chimes casting method" and "chimes casting method" are put together. This not only enhances the fun and playability of the game, but also increases the learning value of the game and improves the user's understanding of chimes as a whole and the various casting methods of ancient bronzes. The narrative story building of the game "Chimes - Unfinished" is shown in Figure 5. Second, in the design of the museum gamification, the common user-NPC cooperation model is used to design the virtual IP image of the chimes. Through the IP image of "Little Chimes" and the interaction with Consort Xiang, users are guided to play the game, complete the required game operations, and explain the story and knowledge.
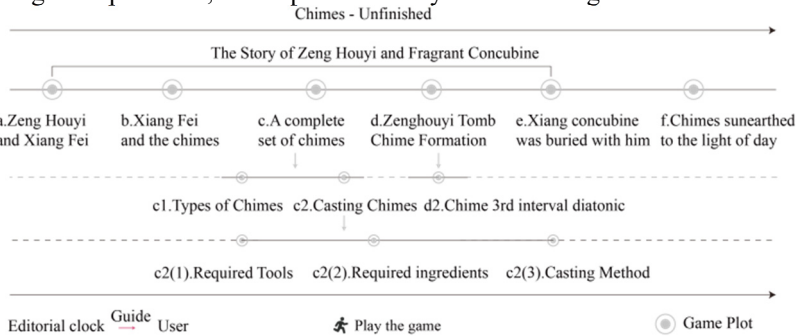

Fig. 5. Analysis of the elements of narrative illustration expression

6.2   Game mechanics making

The game mechanics setting should ensure both the playability of the game plot and the integration of the game plot into the game as a whole. Make the production and achievements about the chimes as the focus of the game plot setting. Firstly, in narrative plot b, let users independently choose the loot that Xiang Fei may choose to guide their immersion experience. Secondly, in narrative episode c, the production of chimes is designed as a story line, and the basic bronze casting method of split-casting is added to the design of the game session to help users understand the method and process of

learning bronze production and the fineness of production. Again, in the narrative plot, the forming of the chimes is not without music, so the game "Play" is added to this plot, and the excellent "third interval double tone" feature of the chimes is incorporated into the game plot design, so that users can further deepen their knowledge and learning of the chimes. and learning. Finally, at the end of the game mechanics, we subjectively add the game plot f "The Chimes of Zenghouyi Tomb are unearthed and seen again", so that players can complete the process from discovery to excavation, and then to polishing, so that the Chimes of Zenghouyi Tomb can be seen again, and at the end of the game, we show the achievements of the Chimes of Zenghouyi Tomb, the complete repertoire of the Chimes, and the history of the events after the unearthing of the Chimes. After the excavation of the bell, the game will show the achievements of the bell. The mechanics of the game "Chimes - Unfinished" are shown in Figure 5.
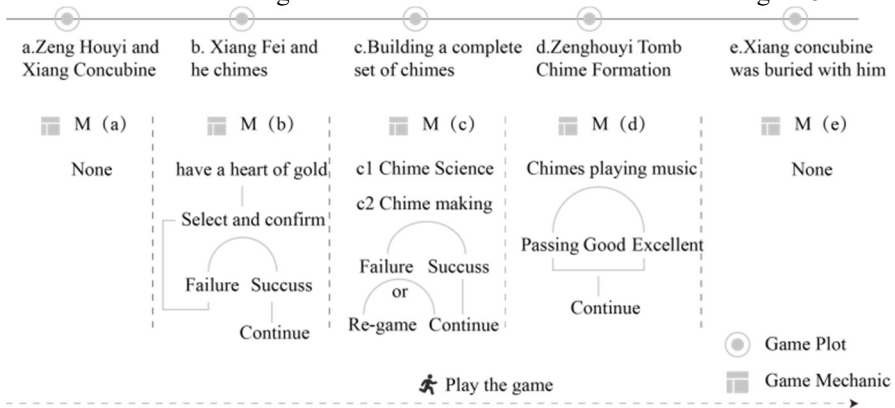
Fig. 6. Analysis of the elements of narrative illustration expression

6.3   Game dynamics setting

Based on the purpose and elements of gamification, the game dynamics are set from the operation gestures and timely feedback elements. In the operation gesture setting, the two most common gestures of interaction, click and swipe, are chosen. However, different dynamic responses to these two basic gestures are made in different game scenarios. In the timely feedback setting, it mainly focuses on the end of the game session, for the feedback of the game result, combining screen, music and vibration to produce different feedback for different game results. And in the process of the game according to the plot needs to adapt different dynamic experience. And through the IP image of small chimes, using voice to strengthen the user's game immersion experience. The dynamic setting and demonstration of the game in "The Chimes - Unfinished" are shown in Figure 6 and Figure 7.

Fig. 7. Analysis of the elements of narrative illustration expression
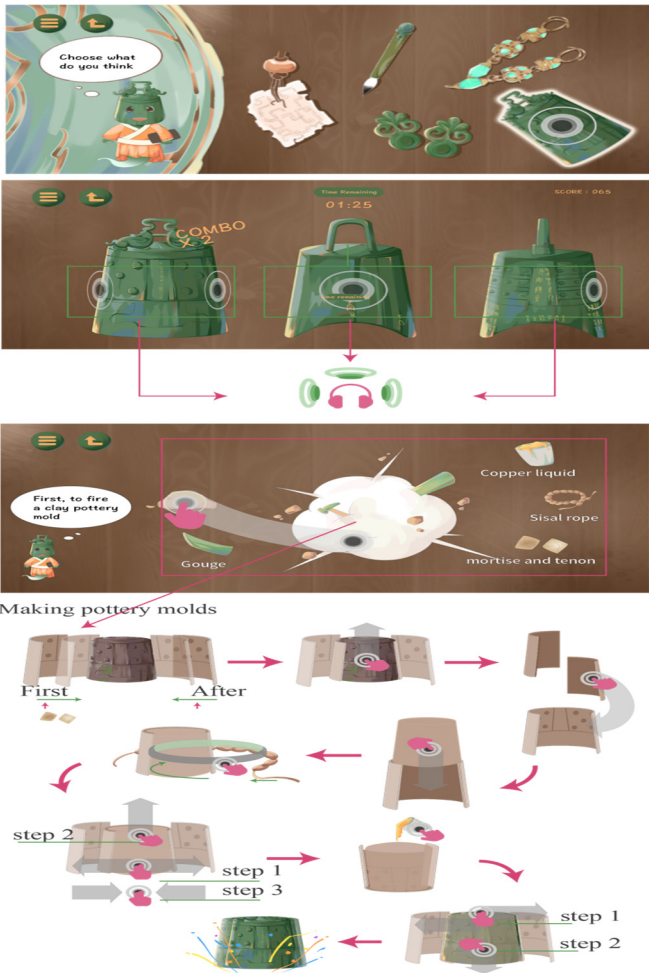

Fig. 8. Analysis of the elements of narrative illustration expression

6.4   Aesthetic presentation of the game

The game aesthetic presentation mainly contains three parts: expected aesthetic narrative, emotional experience and sensory experience. According to the previous analysis of the gamification design process of MDA model, the narrative part is advanced to before the mechanic making, as shown in Figure 7. In the screening of visual and auditory design elements, the main categories of patterns, designs, chime sound effects and music forms are used from traditional elements to constitute a sensory experience in line with the characteristics of the museum. Culture is not only contained in cultural products, but behind every product service there is a rich cultural background. The unique sensory experience brought by these excellent traditional elements can in turn stimulate the user's psychology of identity, including the cultural identity of our excellent traditional culture and the national identity of being proud of the Chinese nation. The specific game aesthetics presented in The Chimes - Unfinished are shown in Figure 9.
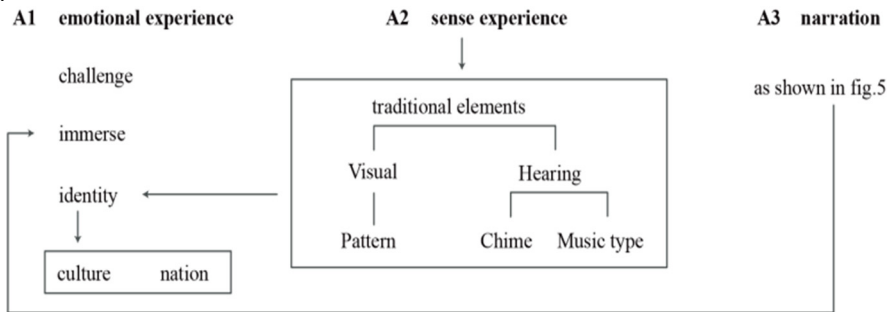

Fig. 9. Analysis of the elements of narrative illustration expression

Gamification through the museum app "Chimes - Unfinished" provides a new way of learning for users and a new way of communication for the museum. With the aid of gamification, an all-round understanding and learning of the chimes will facilitate cultural dissemination and exchange, thus enhancing users' interest in offline exhibition viewing and promoting the development of Hubei Provincial Museum.

In order to verify the effectiveness of the gamification-driven model, the prototype was tested on 9 users again and the conceptual score summary was scored using a Likert scale as shown in Table 1.

The merits of product experience should not only focus on the degree of satisfaction of product functions during use, but also on whether users feel surprised during use. Through the prototype test and scoring, we know that the average score of users is above 3, which means that users are satisfied with the functional points of the product design, and the proposed interesting gamification function is in line with users' learning needs, so the above gamification-driven model can motivate users' learning behavior.

Table 1. Likert Scale scores based on prototype

Design Concept	Narrative Text	Secondary Line	OperationGesture
User 1	4.5	3.9	3.8
User 2	4.1	4	3.8
User 3	3.9	3.7	4
User 4	4	4.5	3.9
User 5	3.9	4.2	3.7
User 6	3.9	3.9	3.5
User 7	3.6	3.7	4
User 8	3.8	4	3.8
User 9	3.7	3.4	3.8
average	3.93	3.91	3.81
Design Concept	**music Effect**	**Visual Effects**	**Cultural Experience**
User 1	4.2	3.5	3.7
User 2	4.5	3.7	4
User 3	4.2	3.8	3.8
User 4	4	4	4.1
User 5	3.6	3.8	3.8
User 6	3.8	4	3.6
User 7	3.4	3.7	3.8
User 8	4	3.8	3.8
User 9	4	3.7	3.6
average	3.97	3.78	3.8

7   Conclusion

People are becoming aware of the importance of museums in education and are beginning to incorporate gamification design thinking into all aspects of education. Gamification has a place in social education. The combination of gamification design and museum education, integrating museum education with gamified learning methods, brings a new way of thinking about museum development, makes up for the lack of space and time, and facilitates local museums to radiate their unique educational values across the country. However, gamification should not take over the main focus, and the design of museum APP gamification should take the cultural and educational purpose as the primary task. Moreover, incorporating the legendary stories into the museum APP gamification design to create a new game cultural environment that is educational and fun, so that the excellent traditional culture is deeply rooted in modern society and embellished into life, is also something that the museum APP gamification design should consider. Gamification has been an unstoppable trend, combined with the specific actual situation, museum APP should find another way to use gamification reasonably as an educational tool to create greater value in today's society.

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