

Game-design Workshops with Co-creation Toolkit to Support Game-based Learning for Heritage Museum

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Abstract: In the context of heritage museums, the integration of game-based learning and gamification has garnered significant interest from academia and educational stakeholders. However, barriers such as high costs and lengthy development cycles hinder wider adoption of game-based learning, particularly among educators who lack of software development skills. This paper introduces a series of game design workshops supported by a card-based toolkit aimed at simplifying the process of creating location-based games. These workshops serve a dual purpose: providing educators and museum stakeholders with an accessible toolkit for data collection and offering engaging game-based learning activities for young museum visitors aged 15-30. To achieve this goal, a pilot study was conducted in collaboration with the Guangzhou Maritime Museum, focusing on 48 university students aged 18-26 and 10 museum staff members visiting the Sea God Temple, a heritage site with a 1400-year history. Qualitative and quantitative data collected from this study indicated positive feedback on the value of co-creation toolkit acting as the instructional scaffolding to support informal learning. Insights gained from this research informed the refinement of the toolkit design, while the game ideas from workshops served as a foundation for mobile game development tailored to young museum visitors.

Keyword: Game-based Learning, Heritage Museum Learning, Co-creation, Card-based Design Toolkit

1. Introduction

Gamification in learning has been a prominent topic at educational conferences for many years, akin to the current discussions surrounding AI in learning. Renowned for its significant advantages in enhancing learners' motivation and engagement, gamification has garnered considerable attention from researchers and educators, leading to numerous studies and initiatives. However, despite the initial enthusiasm, the application of gamification in education has not become as widespread as anticipated. This limited adoption can be attributed to three primary challenges.

First, game design is inherently complex, requiring substantial investment in both time and financial resources. Educational games often generate less profit compared to other types of games, making it difficult to achieve a return on investment from a commercial perspective. Second, game designers typically possess expertise in interaction design or software programming but lack sufficient knowledge of educational principles. Conversely, educators, who are key stakeholders in this field, often show interest in integrating game-based learning methods but face obstacles due to their limited skills in game design and software development. Consequently, the creation of educational games frequently relies on funding from universities or government bodies, which often demand extensive learning data to justify and support game development projects.

Drawing from these insights, I have investigated and compared various types of games within informal learning environments, such as museums and heritage sites. This research has informed the development of key research questions aimed at identifying potential solutions to broaden the adoption of gamification in learning.]

Research Question (RQ): Is it possible to develop an easy-to-use design tool for educators that serves three purposes?

1. A tool that allows educators to develop game-based learning activities tailored to specific educational needs.
2. A tool that enables the design of educational games with minimal cost and time investment.
3. A tool that facilitates the collection of learning data to test game design concepts, thereby increasing the likelihood of successful implementation.

To ensure that this research adheres to the principles of usability and practicality, I conducted a comprehensive literature review across multiple disciplines, including museum learning, game-based learning, and game design. This review served as the foundation for developing a card-based design toolkit, which integrates several conceptual and theoretical frameworks. A pilot study was subsequently carried out in collaboration with a historical museum in China. Both qualitative and quantitative data were collected and subjected to constant comparative analysis. The overall findings of this research indicate very positive outcomes, highlighting significant potential for enhancing heritage education and developing social skills.

2. Background

The integration of game-based learning and gamification in heritage museums has garnered significant interest in recent years. Museums have sought to create more inclusive and engaging spaces by embracing new technologies, interactive exhibits, and participatory approaches. These strategies aim to enhance visitor engagement and learning, incorporating digital games as mainstream entertainment mediums.

In exploring gamification within the museum context, a notable trend is the creation of location-based games, which are mobile games with pedagogic purposes prominently featured role-playing elements (Avouris & Yiannoutsou, 2012). These games allowed users to immerse themselves in realistic roles, particularly within cultural heritage sites such as museums and historical cities. A notable example is 'Intrigue at the Museum', a game-based mobile application designed for children aged 7-13 visiting Palazzo Madama-Museo Civico d'Arte Antica in Turin, Italy (Xhembulla et al., 2014). Such locations, with their tangible objects and physical spaces, provided rich grounds for developing location-based games with significant learning potential. This aligns with the concept of 'Meaningful Gamification' introduced by Nicholson (2012), which integrates play elements into real-life settings like museums and historical sites. This approach creates spaces for participants to explore, engage in play, discover personal meaning, and reflect on their experiences, ultimately fostering transformation.

Despite the benefits, Ribeiro et al. (2021) highlighted several challenges in the development of location-based games. They called for the creation of easier-to-use frameworks for such games. Educators have shown interest in incorporating game-based learning with new technologies, such as virtual reality (VR), mobile technology, and programming. However, the high costs and lengthy development cycles associated with full game development, along with educators' potential lack of software development skills, act as significant barriers to wider adoption. As illustrated by Olesen, Holdgaard, and Laursen (2018), there is a tendency towards tech-driven development that sometimes overshadows the educational, participatory, and engagement purposes.

A low-tech solution with tool-support and guidance for practical application, as suggested by Tahir and Wang (2020), may offer a viable compromise. In fact, it is quite common to use physical objects such as cards, maps, dice, and other props in gamification. These objects help support focus shifts, make arguments tangible in a dialogue (Hornecker, 2010), and frame collaboration by improving idea generation and easing communication. They introduce a playful thinking mode and encourage participants to take risks within the game's framework (Brandt & Messeter, 2004).

3. Methodology

This section details the research methods employed in this study. Participatory action research served as the primary approach to achieving comprehensive results. Initially, a prototype of a card-based game design toolkit was developed, drawing upon theoretical frameworks identified in the literature review. Subsequently, a pilot study, in collaboration with a historical museum, was conducted. Five workshops, involving 48 university students and 8 museum staff, were held to test the usability of the design tool. The development of the game design tool followed an iterative process, guided by feedback from each workshop. The research team, acting as participants, was fully engaged in the process, co-creating and co-learning to generate new knowledge. A mix research method was employed to gather both qualitative and quantitative data.

3.1 Game Design Tool Development

The card-based toolkit guided participants through the learning process, transforming abstract theoretical frameworks into tangible references. The idea of using a card-based toolkit to transform the abstract theoretical framework was introduced by Tahir & Wang (2020). They presented a ten-step process for transforming the LEAGUE framework into the GBL ideation cards toolkit. The use of card-based toolsets for gamification design is quite common, which previously employed by researchers to gather knowledge or ideas from diverse stakeholders in a tangible and accessible form.

The genesis of designing this card-based toolkit is rooted in the three fundamental elements of the location-based game setup framework (Avouris & Yiannoutsou, 2012): the player, physical space, and virtual space. This framework, intersecting with Amory's (2007) Game Object Model, expands to convey more profound meanings. The player, beyond merely identifying themselves in the game space, embodies roles as a role-player, an actor immersed in the story space, and a learner in the real world. The physical space represents the real world, encompassing museums, heritage sites, cultural relics, and physical objects, providing a rich context and primary

material for multifaceted learning, with a focus on cultural learning in this paper. The virtual space encompasses the game space dominated by game mechanics and the story space where storytelling takes precedence.

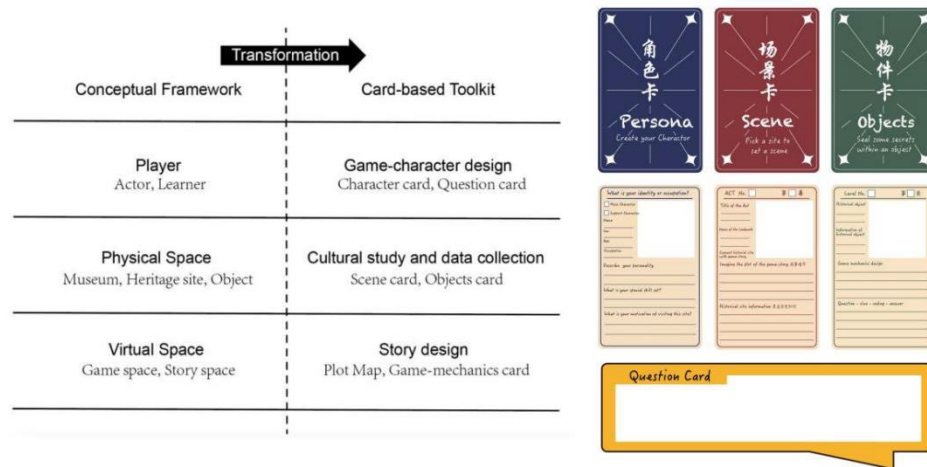


Figure 1: Transformation framework: from location-based game conceptual framework to card-based toolkit

The dimensions, factors, and relations extracted were translated into a set of ideation cards, featuring five distinct types: Character Card, Scene Card, Object card, and Mechanics card, Question card. Additionally, a plot map incorporates a co-creation board was created to collective ideas and formula the conceptual game.

Character Cards: the primary focus on the initial step of game character creation, considering the character as the participant's avatar throughout the entire process. Participants were prompted to provide four layers of information to shape their characters with detailed information, including images, basic details, descriptions, and optional hidden identities.

Scene Cards: designed to craft scenes using real-world landmarks, descriptions, and events. These cards align with Robert McKee's (2014) the five-act narrative structure 'Setup, Catalyst, Crisis, Climax, and Resolution', effectively addressing logical inconsistencies and chaotic storytelling. Serving as a bridge between storytelling and the physical world, Scene Cards require participants to select a landmark for each scene, shaping the environment and context in which the story unfolds.

Object Cards: drawn from 'Object-based Learning,' a pedagogical approach that encourages direct engagement with tangible artifacts to deepen the connection to the subject matter (Lainie Schultz, 2018). In gaming and storytelling, objects often function as the Object of Desire, serving as triggers to reveal secrets or solve problems. Object Cards bridge learning and gaming by prompting participants to capture real-world images and descriptions to design game puzzles.

Mechanics Cards: encompasses four primary types of mechanics design, including coding table, conditions, procedures, and AR recognition, providing examples from existing games to assist in game design.

Question Cards: encourage participants to document insights and questions throughout the workshop, fostering critical thinking and group discussions.

Co-creation Story Board: served as a prototype, helping teams visualize and discuss the game's structure. Made with simple materials, it was accessible to all participants, encouraging diverse input and iterative improvement. The board aligned with the design tasks and card toolkit, presenting the game design clearly and organized.

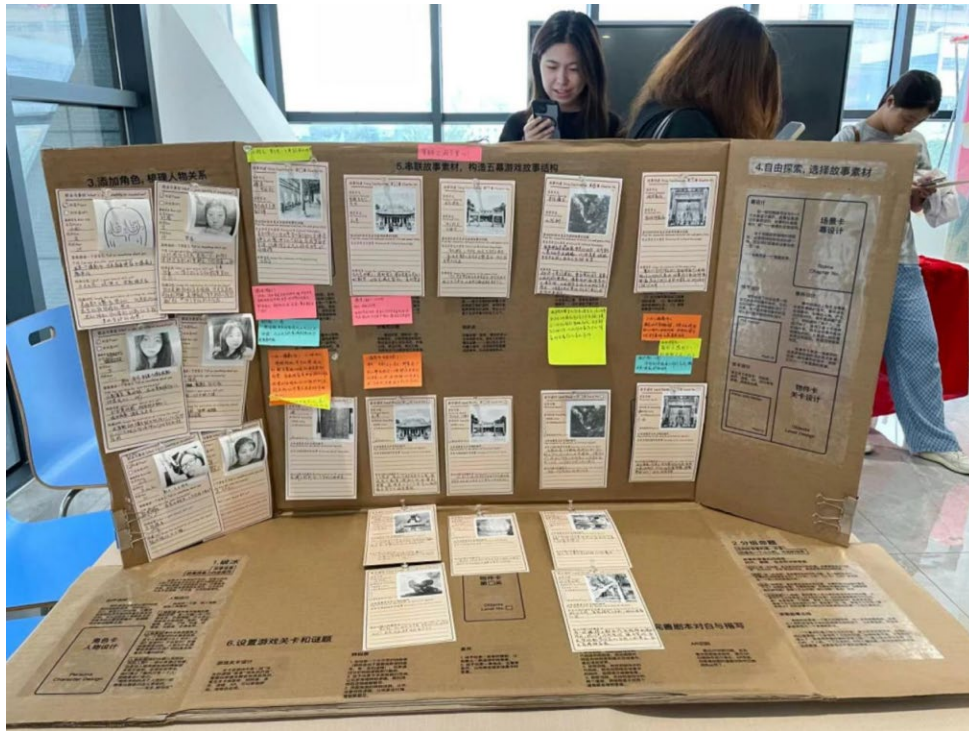


Figure 2: An example of a game-story prototype in a co-creation board form

Design Handbook: Feedback from initial workshops indicated a need for more systematic teaching materials. In response, the researchers developed a Design Tasks Handbook, breaking down the game design process into seven tasks, such as character design, backstory design, character relationship design, plot design and level design. Each task included knowledge points, reference cases, and design tasks to aid participants learning journey.

3.2 A Pilot Study Setting

A pilot study was conducted in the South Sea God Temple, part of the Guangzhou Maritime Museum in China. The temple, a key point along the ancient Maritime Silk Road, has a 1,400-year legacy. Despite its rich history, visitors often find the narrative fragmented and less engaging. The game design workshop set a mission to apply gamification and storytelling approaches to enhance museum learning experiences.

3.2.1 Duration and Workshop Layout

The duration of the game design workshop lasted for six hours. Three hours in the morning, students experienced two times field exploration of the heritage site. One was guided, and the other was a free-choices exploration based on participants' stories. Game-design knowledge was embedded into seven tasks design, such as character design, game backstory design, 5-acts story structure plot design and game level design. In the afternoon, students collected all the information they needed and returned to the museum education room. A complete game prototype needed to be built up within the next 3 hours. In the end, a round-table focus group discussion was conducted to provide the opportunity for participants to reflect on their learning experience and to feedback on the workshop design and toolkit.

3.2.2 Participants Composition

The participants in the game-design workshops were divided into two primary groups. The first group consisted of a research team made up of three individuals. One member acted as the moderator, usually a workshop designer or an experienced teacher, responsible for organizing and guiding the workshop, fostering a conducive atmosphere, and managing participant expectations. The other two members were research assistants with experience in game design. These assistants supported group activities and received pre-training for the research. They functioned both as participants and researchers, with the moderator addressing broader issues from an objective perspective and the research assistants providing empirical insights due to their active

involvement.

The second group comprised recruited participants, typically numbering 10-12 co-creators per workshop. These participants were divided into two teams to complete tasks within specific game mechanisms. Participants were selected based on their prior gaming experience, including familiarity with escape rooms, scripted quests, or narrative-driven computer games.

3.3 Data Collection and Evaluation

As we know, there is considerable debate in the educational world about the possibility of measuring learning, especially in relation to informal learning or what are sometimes called the "soft outcomes" (attitudes, key skills, learning skills, etc.) In this research, I employed a conceptual framework - Generic Learning Outcomes (Hooper-Greenhill, 2008), which identified five categories of learning outcomes covering (1) knowledge and understanding, (2) skills, (3) attitudes and values, (4) activity behaviour and progression, and (5) enjoyment, inspiration and creativity. GLOs help researchers develop research questions, design research tools, and analyze and interpret research findings that are particularly appropriate to the multi-dimensional, creative, and open-ended learning environment of the museum and other cultural organizations.

The data collected in these co-creation workshops mainly focused on three aspects:

First, the research assistants observed and recorded the entire learning process. They specifically recorded the participants' utilization of the game-design toolkit at different stages, their involvement in each learning segment, the difficulties they encountered, and how they resolved those difficulties.

The last 30 minutes of the workshop consisted of a retrospective session for all members, where three topics were discussed in a focus group. First, participants described their overall learning experience in the game design workshop. Then, they discussed the advantages and disadvantages of the traditional tour and the workshop. Finally, suggestions for improving the game-design toolkit were collected.

The above two types of data are qualitative, derived from both researchers and participants and are inherently subjective. Therefore, on the 14th day after the workshop, additional feedback was collected from participants through questionnaires. This "14-day-later" timeframe was chosen to allow participants a cooling-off period, enabling more objective feedback on the learning experience. The questionnaire consisted of 9 questions, all of which were multiple-choice and rating questions, allowing for the collection of quantitative data through statistical analysis. By using a mixture of quantitative and qualitative research methods, data from the three sources was repeatedly compared to obtain objective conclusions.

4. Findings

4.1 Game Concepts from Workshop

Within the support of the game design toolkit, ten game design prototypes were produced during the research (table 1). It was surprised to see that all of the games presented in a state of wholeness, which consists of three basic elements as characters design, plots design, and levels design. Take the game ***the Lost Stone*** for example, six main characters (table 2) created by the participants gave a strong sense of dramatic intense.

Table 1: 10 games created in workshops

1. Nanhai Treasure Hunting: Wonderful world	6. The Old Man and The Sea
2. The Riddle of Nanhai: A girl disappeared	7. The Crazy Magic Chicken
3. Time Travel: I am not 007	8. Forbidden Tree
4. Pavilion Quest	9. One day Poet
5. <i>The Lost Stone</i>	10. A Gate to Reborn

Table 2: Six main characters in example game: The Lost Stone

1. <i>The Retired Fisherman</i> : A mysterious figure with an unknown past.
2. <i>The Street Food Shop Owner</i> : Descendant of an imperial chef, running a humble food stall.
3. <i>The Eldest son</i> : Heir apparent involved in the violent scramble for inheritance within an overseas royal family.

4. *The Second Son*: Younger brother caught in the same struggle for the royal inheritance.
5. *The Real Estate Developer*: Ambitious and shrewd, always looking for the next big opportunity.
6. *The Fortune Teller*: A liar who manipulates others by pretending to have mystical insights.

At the same time, all the game presented in a quite complex level, but with a logical structure that includes climactic moments and engaging twists. In the level design, participants heavily referenced historical artifacts from the South Sea God Temple. Both the research team and the participants remarked, 'It is hard to imagine that a six-hour workshop could have allowed participants with no experience in game design to achieve such creative outcomes.'

4.2 Feedback from Participants: Learning Experience in the Workshop

There were 48 participants in the workshop, and 45 valid questionnaires were received. The ages of the participants were concentrated among first-year students between 18-19 years old (47%), with the rest being senior students (27%) and post-graduate students (20%). Participants came from various professional backgrounds, including product design, interaction design, art management, art history, architectural design, and fashion design. The age-group statistics indicated that participants had no theoretical knowledge or practical experience in game-design. Their diverse majors and academic levels also showed that this workshop was based on a teamwork experiment involving strangers.

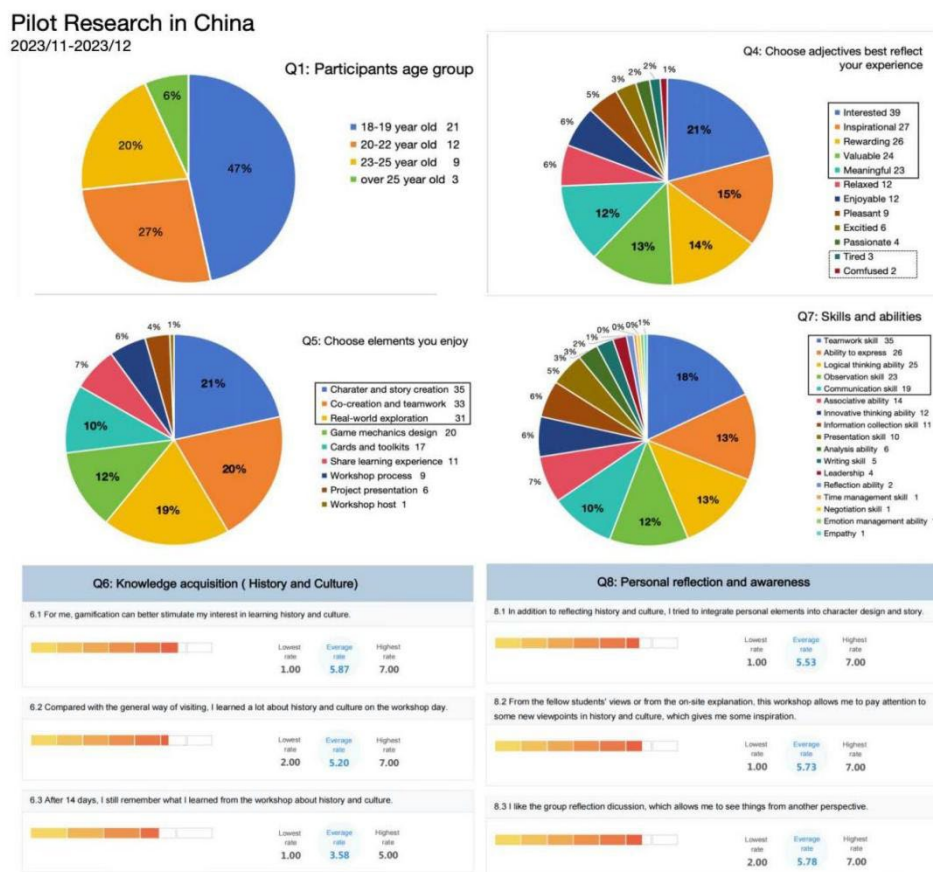


Figure 3: Data collected from Pilot study

In focus groups, participants often described their learning experience as 'happy' and 'very happy', frequently mentioning 'fun' and 'good experience'. Due to limited Chinese vocabulary and students' tendency to hide personal feelings, I expanded the questionnaire's keywords for better expression. Students could choose 3-5 words reflecting their experience. Positive options included interested, meaningful, valuable, exciting, pleasant, relaxing, enjoyable, passionate, inspirational, and rewarding, while negative ones included 'boring', 'waste of time', 'frustrating', 'tired, confused', and 'negative'.

Most participants had a positive experience, with five keywords standing out: interesting (39), inspirational (27),

rewarding (26), valuable (24), and meaningful (23). These accounted for 75% of the feedback. Some participants mentioned the learning experience exceeded their expectations and was different from typical historical museum learning. One participant stated, 'I thought the teaching process would be very tedious and serious, and I was worried that I would fall asleep. However, the workshop was very relaxing and fun, and I was able to participate in the whole process.'

Q5 focuses on feedback regarding the process of workshop and the usage of the game-design toolkit. After reviewing the feedback from the first two workshops, significant adjustments were made to the toolkit, and some game-specific items were added, resulting in stronger positive feedback from participants in the third and fourth sessions. Participants felt that the learning sessions were 'interlinked' and the process was smooth. Three learning sessions received particularly high praise.

The first was the character-design as icebreaker. The toolkit offers 24 occupations for participants to choose from, as well as dice items to add randomness to the game. Character cards provide a writing outline for character development. The detailed design of the toolkit 'instantly put me in character and created a strong sense of immersion'. The second highly praised component was the Co-creation Story Board. Participants felt that it allowed them to 'clearly understand the whole framework of game creation'. Finally, the workshop included two real scene explorations. The project-based learning method, which involved 'collecting information and inspiration from real historical relics and then applying it to game design', was well received by participants.

The feedback aligned with the questionnaire statistics, showing that 21% of participants highlighted the character design, 20% mentioned the co-creation story board, and 19% pointed out the reality exploration as significant sections. The questionnaire also included a special option regarding the level of attention paid to the workshop facilitator, and only one participant selected this option. This result is noteworthy because an important goal of this study was to guide the learning process through the Game-Design Toolkit, diminish the teacher's dominant role, and achieve a decentralized, student-centered learning model. One participant remarked, 'I found the toolkit to be friendly to a novice and even to some of the more professional game designers. The Design Tasks Handbook, in particular, very helpful to me.'

4.3 Assessment of Participants' Learning Outcomes

In addition to the discussion around the 'feelings and experiences' of the participants, a self-assessment of the learning outcomes from the workshop followed. This assessment referred to the General Learning Outcomes (GLOs) framework used in museums and evaluated the learning effect from five aspects: knowledge, skills, personal development, creativity, and environment & society.

In the interview, participants discussed the value of game-based learning in historical and cultural contexts. Most participants did not deny the value of traditional guide in museums, acknowledging several advantages. Firstly, guided tours can objectively and systematically present real historical knowledge. Secondly, they cater to a broad audience, being suitable for people of all ages, from the elderly to children. Lastly, this form of learning is straightforward and simple, requiring neither a significant time investment nor intensive cognitive effort.

When participants were asked to objectively and independently rate the questionnaire, their opinions were fully expressed. Questionnaire Q6 specifically focuses on the role of gamification in historical and cultural learning and divides it into three subdivisions. Participants rate their agreement or disagreement on a scale from 1 to 7, with 1 indicating complete disagreement and 7 indicating strong agreement.

Q6.1: In my opinion, gamification enhances my interest in learning about history and culture. Overall, this viewpoint received a score of 5.87. Eleven participants strongly agreed with this perspective, rating it 7 points. Conversely, one participant gave a rating of 1 point, indicating complete disagreement. However, this participant chose to remain anonymous and did not provide further feedback during the discussion.

Q6.2: Compared to traditional methods of exploration, I gained significant insights into history and culture during the workshop. The overall score for this perspective is 5.2. Nine participants strongly agreed, assigning a rating of 7 points.

Q6.3: Even after 14 days, I retain what I learned about history and culture during the workshop. The comprehensive score for this viewpoint is 3.82, comparatively lower than the other scores. The highest rating received was 5, with 10 participants giving this score. On the contrary, 3 participants rated it 1 point.

In summary, it is evident that game-based learning plays a significant role in acquiring historical and cultural knowledge. This is primarily seen in the shift from passive to active learning, and the clear learning goal (game

design) makes the learning tasks more specific and in-depth. However, based on a 6-hour learning activity, the effectiveness of achieving systematic learning and enhancing knowledge retention is not significant.

In terms of assessing learning skills, the most frequently mentioned keyword by participants in the interviews was 'teamwork'. Related words included 'together', 'clear division of team roles', 'brainstorming', 'high efficiency', and 'high involvement'. Another set of keywords focused on 'creativity and imagination' with related expressions such as 'out-of-the-box thinking', 'inspirational', 'enlightening', and 'novelty'. These feedbacks thoroughly illustrate the participants' sense of achievement in teamwork and the significant learning outcomes facilitated by the co-creation approach for the first time.

In Q7, 17 skills were included in the questionnaire, and participants were asked to select 3-5 skills that they used and developed during the workshop. These skills included: Teamwork, communication, presentation, writing, logical thinking, negotiation, reporting, leadership, observation, information gathering, analysis, time management, emotion management, association, innovative thinking, reflection, and empathy. The top five skills mentioned were teamwork (18%), presentation (13%), logical thinking (13%), observation (12%), and communication (10%). From a statistical perspective, all skills were mentioned, highlighting the significant potential of game-based learning in cultivating students' comprehensive abilities. Compared to merely acquiring specific knowledge, developing students' capacity to acquire knowledge is deemed more crucial in assessing learning outcomes.

In the real world, imagination and creativity require nourishment; they cannot simply arise from nothing. In the final part of the evaluation, I delved into some deeply personal questions with the participants: Did they incorporate elements of themselves into the character creation or story setting? Some participants affirmed this perspective. For instance, one student named his character after his idol, imagining the character possessing the star's appearance and temperament. Another participant crafted a character who excelled in math because she struggled with the subject herself, using the character to fulfill a wish she couldn't achieve.

Regrettably, due to concerns surrounding personal privacy, this aspect of the discussion remains incomplete, as only certain participants with distinct personalities have been willing to share their experiences. Consequently, questionnaire Q8 has been formulated to delve deeper into participants' self-reflective tendencies within this informal learning context and gauge their awareness of this reflective behavior. Likewise, three statements have been presented, inviting participants to rate their agreement level on a scale from 1 to 7. Following the scoring, participants are encouraged to provide additional insights or ratings of their own.

Q8.1: Apart from reflecting on history and culture, I endeavored to infuse personal elements into character design and narratives. The overall score for this viewpoint is 5.53. Thirteen participants strongly agree with this statement, awarding it 7 points, while one participant completely disagrees, granting it 1 point. Surpassing our initial expectations, this rating even exceeded the feedback received during the focus group.

Q8.2: Through interactions with peers and guided explanations during the workshop, I found myself drawn to fresh perspectives on history and culture, sparking inspiration. The overall score for this viewpoint is 5.73. Fourteen participants strongly agree with this statement, assigning it 7 points, while one participant completely disagrees, assigning it 1 point. In their additional comments, some participants shared profound insights: 'I sensed the transformation of values through story creation and exploration of history and culture', 'It encouraged me to boldly enjoy and engage in courageous practice', 'I've become more subjectively attentive to historical sites.'

Q8.3: I value the group reflection discussions, as they provide me with alternative viewpoints. The overall score for this viewpoint is 5.78. Fourteen participants strongly agree, giving it 7 points. One participant's comment left a lasting impression: 'Indeed, allowing ideas to flow freely without constraints often leads to rich outcomes. Whether in work or life, embracing diverse possibilities and employing critical thinking enhances our perception and experiences.' This feedback transcends mere commentary on teaching activities; it serves as personal encouragement and reinforces individual beliefs. Another participant questioned, 'The story crafted by another group was vastly different from ours. The facilitator noted that this disparity stemmed from differing modes of thinking. This raises my curiosity about the distinctions between these thinking processes and what specific differences led to such divergent final outcomes.'

These learning reflections align closely with my expectations when designing gamified teaching activities. Despite being students, the participants are young adults aged between 18 and 25 years old. They exhibit a profound capacity for self-reflection within game-based learning, demonstrating a depth of thought that exceeds my initial anticipations. This highlights the considerable potential of game-based learning, particularly within young

groups.

5. Discussion and Conclusion

This section will discuss the implications of the research findings and further evaluate the potential of the game design workshop and co-creation toolkit to address the research question posed at the beginning of this study.

5.1 Game Design Assists Personal Meaning Generation in Heritage Learning

In heritage learning, young visitors often face challenges in connecting with historical artifacts and deriving meaningful experiences from them (Piscitelli & Weier, 2002). Motivational theories suggest that effective learning in museums is driven by several factors: the opportunity to construct personal meaning, the ability to make choices, the willingness to accept challenges, the capacity to take control of one's learning, the opportunity to collaborate with others, and the presence of positive consequences or benefits for actions (Paris, 1997).

The use of game design as a bridge to create a meaningful context between history and visitors has proven to be effective in this research. One participant remarked in a focus group, 'By immersing myself in the game through the character, I established a weak connection with the museum, which makes me feel like a part of the museum and less sense of foreignness.' This highlighted the potential of game design to enhance personal engagement and reduce the sense of alienation often felt by visitors in heritage learning environments.

5.2 Game Design Workshop Supports Active Learning

Furthermore, the game design workshops supported active learning in a very natural way. Active learning, rooted in constructivist learning theory, posits that learners are active participants in their own learning process rather than passive recipients of information. Learners construct their own understanding and knowledge of the world through experiences and interactions with their environment, and by reflecting on those experiences. This process involves assimilation (integrating new information into existing schemas) and accommodation (modifying schemas in response to new information) (Pardjono, 2016). The observations and findings of this study are fully consistent with this description.

There was a noticeable difference between the participants' engagement during two field explorations in the workshop. During the initial visit, participants displayed a sense of blandness, daze, and even boredom. However, once they formed teams and began the story creation process, they became deeply engaged and excited. They actively explored and discovered creative materials at the site, enthusiastically rushing around the scenic spots of the temple, examining the patterns on cultural relics, and looking up historical information on the Internet.

One participant noted that game-based learning could serve as an extended learning opportunity, complementing the museum's traditional guided tours, making them more 'targeted and interesting' for young people. Another participant used an intriguing metaphor to compare the two learning styles: 'The traditional guide is a bit like a sponge; the guide squeezes out a little information, and then I absorb a little. In the workshop, my subjective initiative became stronger, a bit like panning for gold. I would take the initiative to seek and acquire knowledge, and incorporate my interests, hobbies, or academic abilities into our game story.'

5.3 Game Design Workshop Breaks the Boundaries of Social Group

After more than three years of online education during the COVID-19 epidemic, students' social and communication skills showed a significant decline. It was exciting to find that the game design workshop played a significant role in enhancing these skills through the co-creation process.

Vygotsky's theory (1978) of social context highlights the role of social interaction and cultural context in learning, emphasizing the importance of collaborative learning activities. Learning in activity has become a new approach differing from traditional education (Engeström, 2022). Learning studies are no longer focused solely on the individual but expand to the context of larger collective formations, such as small groups, classrooms, communities, or social groups.

Compared to formal learning, playing in a social group provides the freedom and low-risk environment to explore 'the possibilities inherent in things and events' (Rennie and McClafferty, 2002). Play is pleasurable and enjoyable, intrinsically motivated, spontaneous and voluntary, and involves the player in active engagement (Garvey, 1990).

At the beginning of the workshop, all participants were perfect strangers to each other and showed some initial

caution. However, after the ice-breaker session where they created their characters as avatars for the game, everyone relaxed. Discussions related to the story and conversations about personal interests flowed naturally in the museum study room. Participants took great pride in creating imaginative stories comparable to TV series, which seemed effortless to generate. One participant noted, 'I felt like I was playing a script-kill game rather than learning.' This indicates that the game design workshop not only facilitated social interaction but also made learning an enjoyable and engaging experience.

5.4 Limitation

This study faces several limitations. Firstly, the game design toolkit was tested with a narrow demographic of undergraduate and graduate students aged 18-25 from the Guangzhou Academy of Fine Arts in China. Consequently, due to the constraints of age, location, and educational background, the study data can only offer insights into the effectiveness of the toolkit within a specific region. Future research could aim to recruit young participants from diverse regions and countries, as well as individuals from various disciplinary backgrounds, to provide a broader perspective.

Secondly, the testing site was confined to the South Sea God Temple, a historical site with cultural relics and specific geographical features. This limitation significantly influenced the co-creation outcomes, resulting in a predominance of stories revolving around themes such as sea gods, time travel, and treasure hunting. Future iterations of the study could explore different theme museums, such as science museums or industrial museums, to broaden the application scope of game-based learning activities.

Finally, the main result of this research, game design co-creation toolkit, has certain limitations in its application. One participant said in an interview that the toolkit 'did not succeed in guiding us to a great story.' This suggests that the primary goal of the toolkit is not to train professional game designers but to guide young people in learning about history and culture through game design. The next stage of this research will involve further developing the online game design tool and extending the teaching time to achieve deeper learning outcomes.

Funding

Higher Education Project of Education Science Planning of Guangdong Province in 2022 (2022GXJK234)

References

- Amory, A. (2007). Game object model version II: A theoretical framework for educational game development. *Educational technology research and development* 55:1, pp 51-77.
- Avouris N., & Yannoutsou, N. (2012). A review of mobile location-based games for learning across physical and virtual spaces, *Journal of Universal Computer Science*, vol 18.
- Brandt, E., & Messeter, J. (2004). Facilitating collaboration through design games. Proceedings of the 8th Conference on Participatory Design: Artful Integration: Interweaving Media, Materials and Practices - Volume 1, 121-131. doi:10.1145/1011870.1011885
- Engeström, Y. (2022) *Learning in Activity*. In Sawyer, R. K. (ed.) *The Cambridge Handbook of the Learning Sciences (3rd ed.)* Cambridge: Cambridge University Press. p134, doi:ezproxy.uwtsd.ac.uk/10.1017/9781108888295
- Garvey, C. (1990). *Play*. Cambridge, MA: Harvard University Press. P4.
- Hooper-Greenhill, E. (2008). *Museums and Education: Purpose, Pedagogy, Performance*. London: Routledge, pp 46-57.
- Hornecker, E. (2010) Creative idea exploration within the structure of a guiding framework: the card brainstorming game, Proceedings of the 4th international conference on Tangible, embedded, and embodied interaction (TEI '10). New York, USA: Association for Computing Machinery, pp. 101-108. doi: 10.1145/1709886.1709905
- Schultz, L. (2018), Object-based learning, or learning from objects in the anthropology museum, *Review of Education, Pedagogy, and Cultural Studies*, 40:4, pp 282-304
- McKee, R. (1999). *Story : substance, structure, style, and the principles of screenwriting*. London: Methuen.
- Nicholson, S. (2012). Strategies for Meaningful Gamification: Concepts behind Transformative Play and Participatory Museums. Presented at *Meaningful Play 2012*. Lansing, Michigan.
- Olesen, A. R., Holdgaard, N. and Laursen, D. (2018) Challenges of practicing digital imaginaires in collaborative museum design, *CoDesign*, 16(3), pp. 189-201. doi: 10.1080/15710882.2018.1539109.
- Paris, S. G. (1997). Situated Motivation and Informal Learning. *Journal of Museum Education*, 22(2-3), 22-27. doi:10.1080/10598650.1997.11510356
- Pardjono (2016). Active Learning: The Dewey, Piaget, Vygotsky, and Constructivist Theory Perspectives, *JURNAL ILMU PENDIDIKAN*, 3(9), pp. 166-167. doi:10.17977/jip.v9i3.487
- Piscitelli, B. & Weier, K. (2002). Learning With, Through and About Art: The Role of Social Interactions, in Paris, S.(ed.) *Perspectives on Object-Centred Learning in Museums*, Muhwah, USA: Lawrence Erlbaum, pp. 121-151.

- Rennie, L. & McClafferty, T. (2002) Objects and Learning: Understanding Young Children's Interaction with Science Exhibits, in Paris, S. (ed.) *Perspectives on Object-Centred Learning in Museums*, Mahwah, USA: Lawrence Erlbaum, pp. 191-214.
- Ribeiro, F. R., Silva, A. P., & Metrôlho, J. (2021). Literature review of location-based mobile games in education: challenges, impacts and opportunities. *Informatics*. 8, 43.
- Xhembulla, J., et al. (2014). Intrigue at the Museum: Facilitating Engagement and Learning through a Location-based Mobile Game. *Proceedings of the 10th International Conference on Mobile Learning*.
- Tahir, R. & Wang, A. I. (2020). Transforming a theoretical framework to design cards: league ideation toolkit for game-based learning design. *Sustainability*, 12.
- Vygotsky, L. S. (1978). *Mind in Society: Development of Higher Psychological Processes* (M. Cole, V. Jolm-Steiner, S. Scribner, & E. Souberman, eds.). Harvard University Press. Doi:10.2307/j.ctvjf9vz4