Supplementary Material S1: Public Understanding and Experience of Text-Bearing Bamboo and Wooden Slips in Museum Settings

Part 1. Demographic Information

1. What is your age?
2. What is your gender?
   - Male
   - Female
3. What is your educational background?
   - College diploma or below
   - Bachelor's degree
   - Master's student or master's degree
   - Doctoral student, doctoral degree, or postdoctoral researcher
4. What is your disciplinary or professional field?

Part 2. Museum-visiting Experience

5. Do you regularly visit museums or history-related exhibitions?
   - Yes
   - No
6. When visiting museums, how much attention do you pay to bamboo and wooden slip artifacts?
   - Very much
   - Fairly
   - Moderately
   - Not at all
7. (Multiple choice) When visiting the museum, which aspects of the bamboo and wooden slip artifacts interest you?
   - Historical background
   - Production techniques
   - Inscribed textual content
   - State of preservation
8. (Single choice)How do you rate the museum's display and interpretation of bamboo and wooden slip artifacts?
   - Very good
   - Good
   - Average

- Poor

9. (Multiple choice) What improvements would you like the museum to make regarding the display and interpretation of bamboo and wooden slip artifacts?
   - Provide more historical background information
   - Strengthen the interpretation of production techniques
   - Display more bamboo and wooden slip artifacts
   - Improve the presentation of preservation conditions

Part 3. Scene Understanding and Cognitive Impact of Bamboo and Wooden Slip Artifacts

In the following questions,1=Strongly disagree, 5=Strongly agree.

10. Textual explanations alone allow me to gain a general understanding of the content of bamboo and wooden slip artifacts.
11. Images, diagrams, or reconstructions help me understand the meaning of the texts inscribed on bamboo and wooden slips.
12. Videos or moving images help me understand historical information more easily than static text.
13. Combining multiple forms of presentation, such as text, images, and video, makes the content of bamboo and wooden slips clearer to me.

Part 4. Understanding of the textual content and historical background

In the following questions,1=Strongly disagree, 5=Strongly agree.

14. I am more interested in the specific historical events or activities reflected in the texts on bamboo and wooden slips.
15. Understanding the historical background or contexts in which the texts on bamboo and wooden slips were produced and used would make their content easier for me to understand.
16. Without contextual background, the texts on bamboo and wooden slips often seem abstract or difficult for me to understand.
17. Linking textual content to specific people, actions, or spatial settings helps me form an integrated understanding.

Part 5. Clarity and perceived credibility of the displayed content

In the following questions,1=Strongly disagree, 5=Strongly agree.

18. It is necessary to include explanatory or supplementary content in displays of bamboo and wooden slips.
19. I pay attention to whether displayed content is supported by clearly identified sources or evidence.

20. If displayed content lacks supporting explanations, I question its accuracy.
21. I am concerned that excessive interpretation of historical content may affect my understanding of the artifacts themselves.

Part 6. The Impact of Modes of Experience on Understanding and Memory

In the following questions,1=Strongly disagree, 5=Strongly agree.

22. I would be more willing to participate if I could learn about the content of bamboo and wooden slips in a more immersive way.
23. Obtaining information through spatial, action-based, or interactive means would strengthen my impression of the historical content.
24. Compared with reading explanatory text alone, I find information acquired through experience easier to remember.

Part 7. Open question

25. Do you have any other suggestions or comments regarding the museum's display and interpretation of bamboo and wooden slip artifacts?

Supplementary Material S2: Experience questionnaire

Part 1. Participant Information

1. What is your name?
2. What is your gender?
   - Male
   - Female
3. What is your disciplinary background?
   - Cultural heritage and museum studies
   - Design
   - Non-specialist field
4. What is your highest level of education?
   - Associate degree
   - Bachelor's degree
   - Master's degree or above

Part 2. Prior Experience, Knowledge, and Interest

5. Have you previously visited a museum?
   - Yes
   - No
6. How many times had you used a VR device before this study?
   - Never
   - 1-2 times
   - 3-5 times
   - More than 5 times
7. Before this experience, how familiar were you with the Liye Qin slips?
   - Not at all familiar
   - I had heard of them
   - I had some knowledge of them
   - Fairly familiar
8. Before this experience, how familiar were you with bamboo and wooden slip artifacts?
   - Not at all familiar
   - I had heard of them
   - I had some knowledge of them
   - Fairly familiar
9. How interested are you in ancient writing, bamboo and wooden slips, or Qin history? (1 = Not at all interested, 5 = Very interested)
   - 1

- 2
- 3
- 4
- 5

Part 3. Perceived Accessibility

In the following questions,1=Strongly disagree, 7=Strongly agree.

10. I could easily view the bamboo slips presented in the experience.
11. When examining the bamboo slips, I could clearly see their inscriptions and physical details.
12. Information about the bamboo slips was presented clearly, allowing me to easily identify important content.

Part 4. Authenticity

In the following questions,1=Strongly disagree, 7=Strongly agree.

13. The appearance and details of the bamboo slips gave me the impression that the artifacts had been faithfully reconstructed.
14. The environments, characters, and objects in the experience gave me a sense of the living conditions of that historical period.
15. The explanations and information about the bamboo slips appeared to be based on relevant historical sources.

Part 5. Engagement

In the following questions,1=Strongly disagree, 7=Strongly agree.

16. I was able to participate in the experience through my own interactions.
17. The tasks in the experience made me feel that my actions were part of the overall experience.
18. While performing interactions and tasks, I could perceive a direct connection between my actions and the content of the experience.

Part 6. Immersion

In the following questions,1=Strongly disagree, 7=Strongly agree.

19. During the experience, I felt as though I had entered a historical environment.
20. The scenes and events made me feel as though I was present at the historical events being portrayed.
21. During the experience, I was able to temporarily ignore my real-world surroundings and focus on the scenes and events.

Part 7. Perceived Knowledge Gain

In the following questions,1=Strongly disagree, 7=Strongly agree.

22. Through this experience, I gained a better understanding of the Liye Qin Slips and the information recorded on them.
23. Through this experience, I learned more about how bamboo slips were produced, written on, and used.
24. Through this experience, I gained a better understanding of the relationship between the textual content of the bamboo slips and social life during the Qin dynasty.

Part 8. Emotion

In the following questions,1=Strongly disagree, 7=Strongly agree.

25. The characters and stories in the experience helped me better appreciate the living conditions of people at that time.
26. During the experience, I was able to imagine the lives and experiences of historical characters from their perspectives.
27. This experience strengthened my emotional connection with the Liye Qin Slips and their historical and cultural significance.

Part 9. Revisit Intention

In the following questions,1=Strongly disagree, 7=Strongly agree.

28. After the experience, I would like to learn more about the Liye Qin Slips and their related history.
29. I would be willing to participate in similar cultural heritage experiences in the future.
30. I would be willing to introduce or share the content of this experience with others.

Supplementary Material S3: Post-Experience Open-Ended Questions

1. During the VR experience, did the use of 3D models, close-up viewing, and video interpretation help you observe and access bamboo and wooden slip artifacts more clearly? Please explain how.
2. Did you find the models of the slips, the reconstructed scenes of Qin-era Liye, the character dialogues, artifacts, and task design in the VR experience credible? Were there any elements that seemed unclear or insufficiently authentic?
3. Did embodied activities such as producing slips, writing on them, and distributing grain encourage you to participate more actively in understanding bamboo and wooden slip artifacts? Please explain.
4. During the experience, which scenes, sounds, characters, or tasks most strongly made you feel that you had entered the historical environment of Qin-era Liye? Why?
5. After the experience, what new understanding did you gain of the functions, uses, historical context, or cultural value of the Liye Qin slips and other bamboo and wooden slip artifacts? Which parts of the experience contributed most to this understanding?
6. Among the artifact display, historical narrative scenes, and grain-distribution game, which form of presentation was most helpful in understanding the content of the multiplication-table slip? Why?
7. Which character, narrative episode, or scene produced the strongest sense of involvement or emotional response? Did it change the way you perceived bamboo and wooden slip artifacts? Please explain.
8. After the experience, were you more willing to continue learning about the Liye Qin slips, visit related exhibitions, or introduce these artifacts to others? Would you be willing to recommend this experience, and could you explain the reasons for your recommendation?

Supplementary Material S4: RAG Evaluation Questions and Ground Truth Criteria

S4.1 Evaluation Questions

ID	Question type	Test question
Q1	Specific factual question	What does the “Debt Recovery Case” (追讨欠款案) documented in the Liye Qin Slips mainly record?
Q2	Specific factual question	What is mainly recorded on Liye Qin slip 8-458?
Q3	Specific factual question	What is mainly recorded in the Nine-Nine Multiplication Table among the Liye Qin Slips?
Q4	Comprehensive knowledge question	What practical functions did the common administrative documents among the Liye Qin Slips serve?
Q5	Comprehensive knowledge question	What characteristics of local administrative operations during the Qin dynasty are reflected in the Liye Qin Slips?
Q6	Comprehensive knowledge question	What aspects of military administration and material management are documented in the Liye Qin Slips?
Q7	Comprehensive knowledge question	What do the records concerning taxation, corvée labor, and military service in the Liye Qin Slips reveal about the functioning of grassroots society during the Qin dynasty?
Q8	Comprehensive knowledge question	Why are the Liye Qin Slips important for studying grassroots society and local governance during the Qin dynasty?
Q9	Incorrect historical premise	What characteristics of local administration during the Tang dynasty are reflected in the Liye Qin Slips?
Q10	Unsupported information	Who were the specific scribes of these Liye Qin Slips, and what were their respective ages and personal histories?

S4.2 Ground Truth Information Points (Q1–Q8)

Each GT item was scored as 1 when the generated answer clearly and correctly covered the corresponding information point, and 0 otherwise. Q9 and Q10 were assessed separately for their handling of an incorrect historical premise and unsupported information, respectively, and were excluded from GT coverage calculations.

Q1. What does the "Debt Recovery Case" (追讨欠款案) documented in the Liye Qin Slips mainly record?

GT1	Xiao Ke (小欬) was from Yangling County.
GT2	He was sentenced to a monetary fine of 11,211 cash (qian).
GT3	He was unable to repay the fine.
GT4	He was sent to Qianling County.
GT5	He served as a garrison soldier to fulfill his obligation through service.

Q2. What is mainly recorded on Liye Qin slip 8-458?

GT1	The document concerns the official armory or military arsenal of Qianling County.
GT2	It records weapons or military supplies.
GT3	It includes protective equipment such as armor and helmets.
GT4	It includes weapons or components such as crossbows, crossbow stocks, bowstrings, arrows, and halberds.
GT5	It records inventory quantities for stocktaking or verification.

Q3. What is mainly recorded in the Nine-Nine Multiplication Table among the Liye Qin Slips?

GT1	The text consists of the Nine-Nine multiplication formulas.
GT2	It begins with "nine times nine is eighty-one" (九九八十一).
GT3	It includes the expression "二半而一" (two multiplied by one-half equals one).
GT4	It indicates the inclusion of fractional arithmetic.
GT5	The table concludes with "凡千一百一十三字", conventionally interpreted as indicating that the sum of the multiplication products is 1,113.

Q4. What practical functions did the common administrative documents among the Liye Qin Slips serve?

GT1	They recorded personnel, legal cases, debts, or penalties.
GT2	They supported the administrative execution of corvée labor and garrison

	service.
GT3	They recorded quantities of weapons or supplies.
GT4	They supported the transfer, stocktaking, and accounting or write-off of supplies.
GT5	They served as documentation and evidence for administrative coordination across institutions or regions.

Q5. What characteristics of local administrative operations during the Qin dynasty are reflected in the Liye Qin Slips?

GT1	Document-based administration: administrative activities relied on records written on bamboo or wooden slips.
GT2	Quantitative management: monetary amounts, service terms, and weapon quantities were expressed numerically.
GT3	Institutionalized and standardized procedures governed penalties, transfers, and verification.
GT4	Interregional coordination involved official correspondence between counties and between commanderies and counties.
GT5	State administration extended into grassroots society and individuals' everyday lives.

Q6. What aspects of military administration and material management are documented in the Liye Qin Slips?

GT1	Qianling County had an official armory.
GT2	Weapons and military equipment were stored by category.
GT3	Quantities of different types of military equipment were recorded.
GT4	Supplies were transferred or allocated.
GT5	Stocktaking and reconciliation between records and actual stock were conducted.

Q7. What do the records concerning taxation, corvée labor, and military service in the Liye Qin Slips reveal about the functioning of grassroots society during the Qin dynasty?

GT1	The state governed grassroots society through laws and administrative orders.

GT2	Monetary penalties could be converted into corvée labor or garrison service.
GT3	Individuals' obligations were documented and managed by the administrative system.
GT4	Military, economic, and administrative activities were interconnected.
GT5	Social operations were characterized by quantification, institutionalization, and written documentation.

Q8. Why are the Liye Qin Slips important for studying grassroots society and local governance during the Qin dynasty?

GT1	They are primary historical sources on grassroots society during the Qin dynasty.
GT2	They provide evidence of how local administration operated in practice.
GT3	They support the study of law, labor obligations, military affairs, and supply management.
GT4	They illuminate ordinary people's social lives and obligations to the state.
GT5	They provide evidence concerning knowledge, calculation, and socioeconomic activities.

S4.3. Questions Testing Response Boundaries (Q9–Q10)

Q9 includes an incorrect historical premise by treating Qin-period slips as evidence for Tang-dynasty administration. The intended evaluation focus was whether a response identifies and corrects the premise rather than accepting it.

Q10 asks for specific scribes' identities, ages, and personal histories. The intended evaluation focus was whether a response refrains from asserting personal details that cannot be established from the available sources.

S4.4. Calculation of Retrieval Evaluation Metrics (Q1–Q8)

To evaluate retrieval performance, Precision@3 and Mean Reciprocal Rank (MRR) were calculated for Q1–Q8. Each of the top three retrieved knowledge chunks was assigned a binary relevance score: 1 if the chunk contained information directly relevant to the question, and 0 otherwise.

Precision@3 measures the proportion of relevant knowledge chunks among the top three retrieved results. When three, two, one, or no relevant chunks were retrieved, the

corresponding scores were 1.000, 0.667, 0.333, and 0, respectively. If fewer than three chunks were returned, the missing positions were treated as irrelevant. The final Precision@3 was calculated as the average across the eight questions.

Mean Reciprocal Rank (MRR) measures the ranking position of the first relevant knowledge chunk. If the first relevant chunk appeared at rank 1, 2, or 3, the reciprocal rank was 1.000, 0.500, or 0.333, respectively. If no relevant chunk appeared among the top three results, the reciprocal rank was set to 0. The final MRR was calculated as the average reciprocal rank across the eight questions.

For example, relevance scores of (1, 1, 0) yielded a Precision@3 of 0.667 and a reciprocal rank of 1.000, whereas (0, 1, 1) yielded a Precision@3 of 0.667 and a reciprocal rank of 0.500. These two metrics were used to assess retrieval relevance and ranking quality, respectively.