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“It feels like an activity, not a test”: Developing and pilot-testing a sticker-based Likert scale for adolescent museum visitors at the Huangmei Opera Museum

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“It feels like an activity, not a test”: Developing and pilot-testing a sticker-based Likert scale for adolescent museum visitors at the Huangmei Opera Museum

Abstract

This paper presents the design and pilot testing of a sticker-based Likert scale for assessing museum experiences among adolescent visitors. Although children and adolescents represent a substantial museum audience, age-appropriate quantitative evaluation tools that are both engaging and suitable for psychometric analysis remain limited. Building on prior work on pictorial and emoji-based rating formats, a one-page sticker questionnaire was developed for visitors aged 8 to 17 at the Anqing Huangmei Opera Museum in China. The instrument operationalises five experience dimensions: enjoyment, cultural awareness, interactivity, technological novelty, and revisit intention. Instead of ticking boxes, respondents place Huangmei Opera-themed face stickers onto a five-point agreement grid; responses are subsequently coded numerically from 1 to 5 according to sticker position. Data were collected using an intercept approach at the museum exit (N = 30). The analysis first examines preliminary evidence on instrument performance, including completion time, missing data, response distributions, and internal consistency for multi-item dimensions. A secondary, illustrative analysis then explores associations among the five experience dimensions to demonstrate how the instrument can support visitor research in an applied museum setting. The findings provide initial evidence that a sticker-based Likert format can serve as a practical and engaging option for quantitative evaluation with adolescent museum visitors.

Keywords: Sticker based Likert scale, adolescent visitors, child centred evaluation, museum experience, Huangmei Opera Museum

1 Introduction

Museums increasingly seek systematic feedback from younger audiences, not only to understand what children and adolescents take from a visit, but also to improve interpretation, interaction design and educational programming [1]. Yet evaluating youth visitor experience remains methodologically challenging. In real museum settings, researchers face tight time windows after a visit, heterogeneous literacy levels, variable attention spans, and contextual influences from family members or school groups. Under these conditions, conventional text-heavy questionnaires can increase response burden and satisficing and may underrepresent younger visitors’ perspectives even when participation rates appear high.

A central difficulty is that experience constructs commonly used in visitor research, such as enjoyment, perceived learning, interactivity and future visit intentions, require respondents to map internal judgments onto ordered response categories. For adolescents, this mapping can be disrupted by comprehension issues, fatigue, or uncertainty about scale direction. Museum learning theory further suggests that what visitors report is shaped by interacting personal, sociocultural and physical contexts over time, meaning that measurement must remain sensitive to both affective engagement and meaning making rather than focusing only on information recall [2]. This creates a practical tension: instruments must be structured enough for quantitative analysis, yet simple and usable enough for consistent completion in situ.

To address similar issues in child-centred evaluation, prior work has developed visually anchored response formats, including smiley-face and icon-based Likert scales, which reduce linguistic demand while preserving graded response structures [3][4] Related research has explored emoji-based rating approaches, showing that familiar facial icons can support rapid affective judgments in short interactions[5]. In museum contexts, pictorial and emoji tools have also been used to document emotional experience as a complement to verbal methods, suggesting that visual anchors can function as practical measurement supports in public settings[6].

Building on this methodological lineage, the present study introduces a sticker-based Likert format in which respondents place themed stickers onto a five-point agreement grid. The approach retains the analytic compatibility of Likert-type data while shifting the response action from ticking or circling to a tangible placement task. The study reports a pilot deployment with visitors aged 8 to 17 at the Huangmei Opera Museum in Anqing, China, using the site as a field test environment to examine how the instrument performs under typical conditions of museum evaluation.

The paper first establishes the experience dimensions targeted by the scale and describes the questionnaire layout and coding scheme. It then reports response-process observations and response-pattern evidence relevant to feasibility and preliminary scale performance, followed by an illustrative analysis demonstrating how the instrument can be used to examine relationships among the measured experience dimensions in an applied museum case.

2 Background

The International Council of Museums (ICOM) defines museums as non-profit permanent institutions serving society, dedicated to the research, acquisition, collection, preservation, interpretation and presentation of tangible and intangible heritage [7]. This definition reflects a shift from object-centred display towards people-centred learning environments, and it provides a broad rationale for evaluating how museums support learning and participation among diverse audiences, including children and adolescents.

Recent museum studies also suggest that engagement is shaped less by the sheer presence of technology than by the quality and contextual relevance of interactive experiences, which can influence adolescents' enjoyment and intentions to return [8]. This highlights the practical importance of evaluation approaches that can capture youth experience in situ, rather than relying solely on adult-oriented feedback instruments.

The Huangmei Opera Museum in Anqing is a performing-arts heritage venue centred on opera, with exhibitions that rely on contextualised interpretation of audiovisual excerpts, historical developments and classic characters and plots [9]. In recent years, the audience has increasingly consisted of families and school-age visitors [10]. With growing emphasis on heritage transmission through education and youth outreach, the need for age-appropriate evaluation approaches for younger museum audiences has become more salient in this context [11]. Internal assessment practices, however, are still dominated by adult-oriented text questionnaires, which limits routine evaluation of visitors aged 8 to 17. In this context, the museum provides a relevant applied setting for piloting a youth-appropriate evaluation instrument under real in situ conditions, while keeping the primary contribution of the present study methodological rather than a comprehensive assessment of the museum itself.

3 Research aims and research questions

Building on this background, the present study focuses primarily on the development and testing of a sticker-based Likert scale tailored to museum visitors aged 8 to 17 years. The main aim is to examine whether this child centred, visually anchored instrument can provide a feasible, engaging and analytically usable way to capture adolescents' evaluations of their museum experience, in a context where conventional text-based questionnaires are often perceived as school like and burdensome. Within this methodological focus, the Huangmei Opera Museum serves as a concrete case that allows the new instrument to be deployed in a real exhibition setting. As a secondary aim, the study uses the resulting data to explore, in an illustrative manner, how perceived interactivity and technological novelty are related to enjoyment, cultural awareness and revisit intention among adolescent visitors.

In line with these aims, the study addresses two research questions:

- RQ1：To what extent does the sticker-based Likert questionnaire provide a feasible and acceptable tool for capturing subjective evaluations of visitors aged 8 to 17 at the Huangmei Opera Museum, and what preliminary internal structure evidence is observed for the multi-item dimensions?

- RQ2：What item-level response patterns emerge across the five experience dimensions in this pilot sample, and what do these patterns suggest for refining the scale and its administration in future deployments?

These questions position the paper as a methodological contribution centred on the design and initial testing of a sticker-based Likert instrument, with the Huangmei Opera Museum functioning as an applied case that demonstrates how the tool can support substantive visitor research.

4 Conceptual Framework

This section establishes the conceptual grounding for the study by clarifying both what is being measured and why the proposed measurement format is appropriate for youth audiences in an in-situ museum context. Museum learning research has long emphasised that learning in museums is not a single cognitive outcome, but an experiential process shaped by interaction with exhibits, social companions, and the visitor's prior knowledge and motivations [12]. From this perspective, evaluation instruments must capture a mixture of affective engagement and perceived meaning-making while remaining practical within the time constraints and environmental distractions of real visits. These demands become more pronounced when the target audience is adolescents, for whom attention, autonomy, and perceived relevance strongly influence participation and the quality of self-reported data. To address these issues, the chapter proceeds in three steps. Section 4.1 positions adolescent visitors as a distinct audience segment and motivates the need for experience constructs that reflect both engagement and learning. Section 4.2 then reviews child-centred response formats and justifies the sticker-based Likert approach as a response-process intervention that maintains analytic compatibility while reducing response burden. Finally, Section 4.3 integrates these strands into a two-layer framework, separating the performance evidence for the measurement device from the illustrative experience-relations model that the instrument is intended to capture.

4.1 Adolescent visitors and key experience dimensions

Adolescents are frequently described as a neglected or hard to reach segment in museum practice. They are no longer satisfied with child-oriented activities, yet they often perceive conventional exhibitions as boring, school like, or not designed for them [13]. Participatory design studies conducted by Cesário and Nisi at the Natural History Museum of Funchal (NHMF) in Portugal show that teenage participants consistently ask for digital interactivity, game like challenges, and opportunities for social sharing, rather than passive and text heavy displays. When story based and game based mobile experiences are offered, adolescents tend to stay longer, explore more exhibits, and report more enjoyable and meaningful visits[8] . Taken together, these findings suggest that adolescent museum experiences are assessed not only in terms of what is learned, but also in terms of how interactive, technology supported, and personally engaging the visit feels.

This view is consistent with Falk and Dierking's contextual model of learning, which conceptualises museum visits as the outcome of interactions between personal,

sociocultural, and physical contexts over time [2]. For adolescent visitors, the personal context includes emerging identity, peer relationships, and a desire for autonomy. The sociocultural context includes family members, classmates, and online communities, while the physical context increasingly combines exhibits, spatial design, and digital interfaces. From this perspective, understanding adolescent museum experiences requires attention to affective responses and meaning construction, as well as to how interaction opportunities and technological features are designed and integrated into the exhibition environment, rather than treating learning outcomes as purely cognitive [14](Fig. 1).

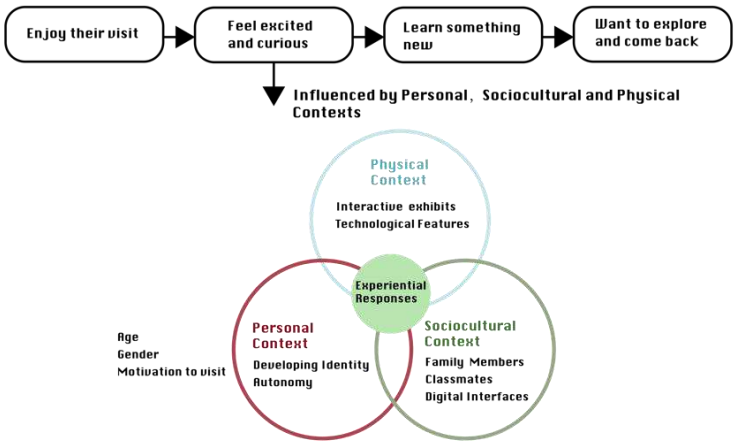


Fig. 1 Model of visitor experience. Source: Falk and Dierking (2000).

On this basis, the present study defines five experience dimensions for adolescent visitors at the Huangmei Opera Museum, which together form the content framework for the sticker-based Likert scale developed and tested in this paper (Fig. 2).

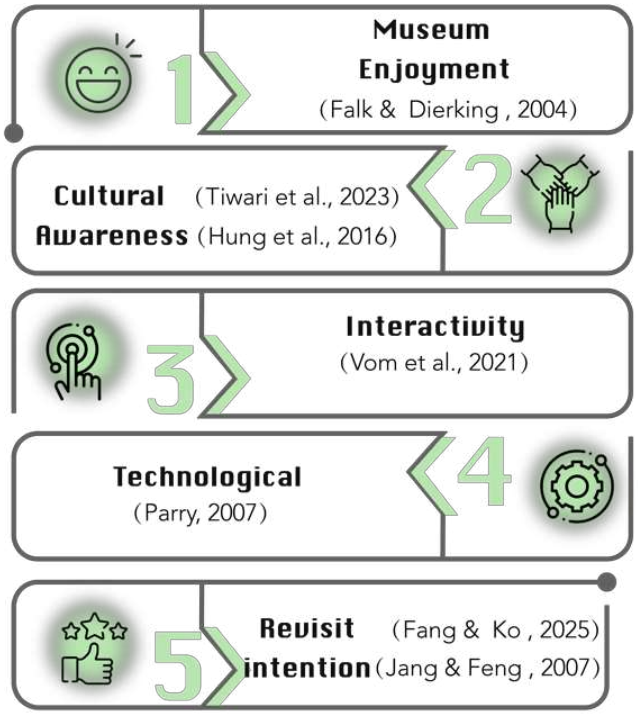


Fig. 2 The Huangmei Opera Museum Experience incorporates five dimensions of concepts. Source: Adapted by the authors based on Falk and Dierking (2004), Tiwari et al. , (2023), and related literature.

Figure 2 summarises the five experience dimensions operationalised in this study and used to structure the sticker-based scale. Enjoyment captures positive affect and playful engagement, which are commonly linked to adolescents' willingness to invest attention and to revisit [14]. Cultural awareness reflects perceived understanding of Huangmei Opera and local heritage and is included because meaningful and memorable cultural experiences have been associated with repeat visitation intentions[15][16]. Interactivity refers to perceived opportunities for active participation and control during the visit, a feature repeatedly emphasised by adolescents in museum design and evaluation contexts [17]. Technological novelty captures how distinctive and up to date the digital elements feel compared with everyday media, and prior research suggests that technologically enhanced engagement can strengthen satisfaction and attachment in museum settings[18] . Finally, revisit intention is treated as a proximal behavioral outcome that summarises whether adolescents would like to return or recommend the museum, and it is widely used as an indicator of longer term value for both visitor studies and museum practice[19][20].



Fig. 3 The five dimensions correspond to the questionnaire questions. Source: Prepared by the authors for this study.

Figure 3 illustrates the five experience dimensions used in this study, highlighting how they collectively structured the questionnaire content for adolescent visitors. These five dimensions form a concise content framework that supports both age-appropriate measurement design and subsequent quantitative analysis.

4.2 Sticker-based Likert scale as a measurement tool

A persistent challenge in visitor studies is the shortage of quantitative evaluation tools that are developmentally appropriate for children and adolescents while still producing data that can be analysed using conventional statistical techniques. Although Likert-type questionnaires are widely used in museum evaluation, they assume fluent reading ability, stable abstract reasoning, and sustained attention to repetitive rating tasks. For younger respondents, these assumptions are often only partially met. Reading speed and comprehension vary considerably, and lengthy text-based questionnaires may be experienced as school-like testing rather than as part of a museum visit. Evidence from child health-related quality of life research similarly indicates that standard verbal instruments can impose a substantial burden on younger respondents and may contribute to discrepancies between adult proxy reports and children's own responses, supporting the need for response formats that better align with children's cognitive and communicative capacities [21](Table 1).

Table 1 Comparison of traditional questionnaires versus pictorial questionnaires.

Questionnaire type	Format of item	Response style	Distribution medium	Visual representation	Accessibility	Abstract concepts	Cognitive load
Traditional questionnaire	Words	Numeric Scale Yes/No	Online/Paper	Participant own visualization	Proxy measures available	Participants own visualization	Read, understand, relate to question (literacy)
Pictorial questionnaire	Pictures	Picture Likert Scale Dichotomous pictures	Online/Paper	Representative scenario visualization	Accessible to individuals with disabilities or impairments	Visual representation aid	Convey items with visual examples resulting in less cognitive load

Source: Tang et al., 2024.

Table 1 summarises the practical differences between traditional text-based questionnaires and pictorial questionnaires, highlighting how pictorial formats can reduce linguistic demand by providing visually anchored response cues and lowering cognitive load during completion [21]. Building on this rationale, a substantial body of work supports pictorial rating formats in which facial icons replace or supplement verbal category labels. Hall, Hume and Tazzyman's "Five Degrees of Happiness" scale demonstrates how carefully designed facial anchors can encourage children to use all five response categories rather than clustering at the most positive end (Fig. 4) [22]. Read and Horton's Smileyometer provides a related five-point pictorial format commonly used in child-focused UX evaluation (Fig. 5). Together, these precedents indicate that pictorial Likert formats can preserve the measurement logic of standard five-point structures while improving usability for younger audiences [23].



Fig. 4 SFL with neutral anchor point. Source: Hall et al., 2016.

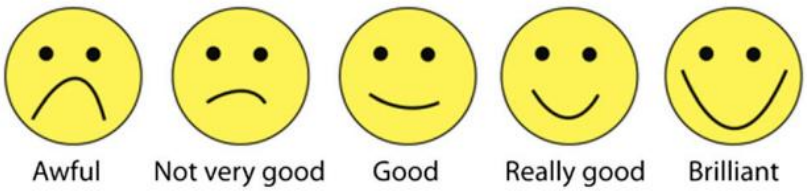


Fig. 5 The Smileyometer. Source: Read and Horton 2025.

Figures 4 and 5 illustrate established pictorial Likert formats designed for child-centred evaluation, where facial icons act as intuitive anchors that help young respondents map their feelings onto a five-point ordered scale. The sticker-based questionnaire in this study follows the same logic by retaining a five-category structure but adapts it to an in-situ museum setting by turning the response into a simple placement task: instead of ticking or circling, adolescents place a themed sticker into the column that best matches their judgement. This preserves the measurement logic of a standard Likert scale while making the response process more concrete and easier to complete within the limited time and attention available after a museum visit.

A parallel line of research has developed emoji-based facial scales for capturing affective responses in contemporary contexts. Swaney-Stueve, Jepsen and Deubler proposed an emoji scale for product testing with children aged 8 to 11, showing that emoji faces can yield emotion ratings comparable to established verbal scales while remaining easy to recognise and apply (Fig. 6) [24]. In museum research, De Angeli, O'Neill and Kelly designed customised emoji to record visitors' emotional experience during an exhibition and showed that emoji ratings can capture nuanced affective states and complement interviews (Fig. 7)[25]. These examples illustrate how visual anchors can support rapid judgement in short interactions by externalising response options and reducing reliance on lengthy textual descriptions.

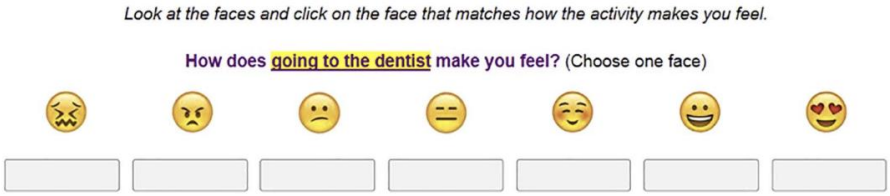


Fig. 6 Example of emotion question format. Source: Swaney et al., 2018.

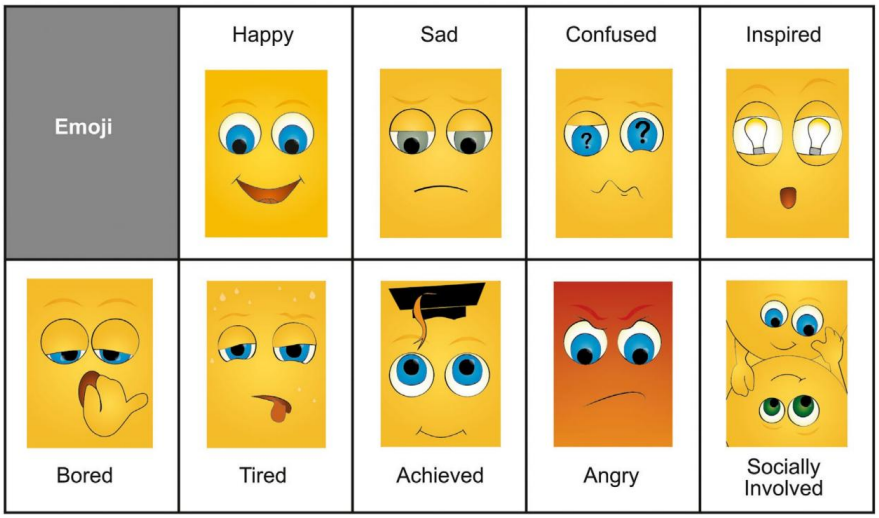


Fig. 7 The emoji icons used to capture visitors' emotional experience. Source: De Angeli et al., 2020.

Figures 6 and 7 illustrate how the image expression scale can be used to quickly elicit emotional judgments by having respondents choose the expression that best reflects their feelings. This format externalizes response options into intuitive visual anchors, reducing reliance on lengthy textual descriptions and helping younger participants transform subjective feelings into ordered categories, laying a practical foundation for applying Likert scales to more child-centered response processes.

Building on this body of work, and on an earlier exploratory sticker-based questionnaire developed for visitors aged 4 to 7 at the Huangmei Opera Museum (previous study, blinded for review), the present study adopts a sticker-based Likert scale as its primary measurement contribution for visitors aged 8 to 17. The instrument retains a five-point agreement structure from "strongly disagree" to "strongly agree" but implements the response process as a tangible sticker-placement task. Respondents receive Huangmei opera character-based face stickers and place one sticker per item in the column that best represents their judgement. Using character-based stickers embeds the response task in the visual language of the visit and helps sustain attention by making completion feel closer to an activity than a conventional test. Cloud-shaped target cells guide placement and keep the layout readable even after the grid is filled with responses (Fig. 8).

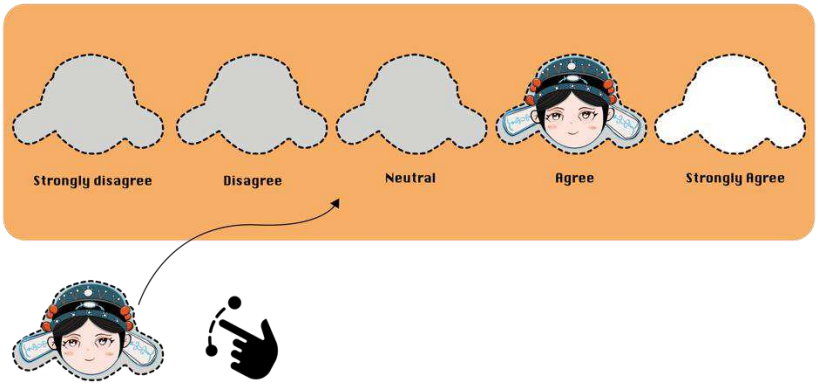


Fig. 8 Huangmei Opera Character Stickers. Source: Prepared by the authors for this study.

From an analytical perspective, the sticker-based format remains compatible with conventional quantitative analysis. Each response position is coded numerically from 1 to 5, enabling item-level statistics, composite indices, and association tests. The innovation lies in the interaction modality rather than in the underlying measurement model. Accordingly, the empirical analysis prioritises initial evidence on instrument performance, including feasibility and acceptability in situ, missing data patterns, response distributions, and internal structure indicators for multi-item dimensions. Substantive relationships among experience dimensions are examined only as an illustrative secondary analysis to demonstrate how the tool can support visitor research when deployed in an applied museum setting.

4.3 Conceptual model

The present study is positioned primarily as a methodological contribution to visitor studies through the development and pilot testing of a sticker-based Likert scale for adolescent museum visitors. Although museum research has increasingly examined how interactive and technology-supported experiences relate to visitor outcomes, an enduring limitation is the availability of age-appropriate quantitative tools for children and adolescents that can be deployed efficiently in situ. Accordingly, the conceptual framework adopts a two-layer structure that separates evidence for the measurement device from the illustrative experience relations that the device is intended to capture (Fig. 9).

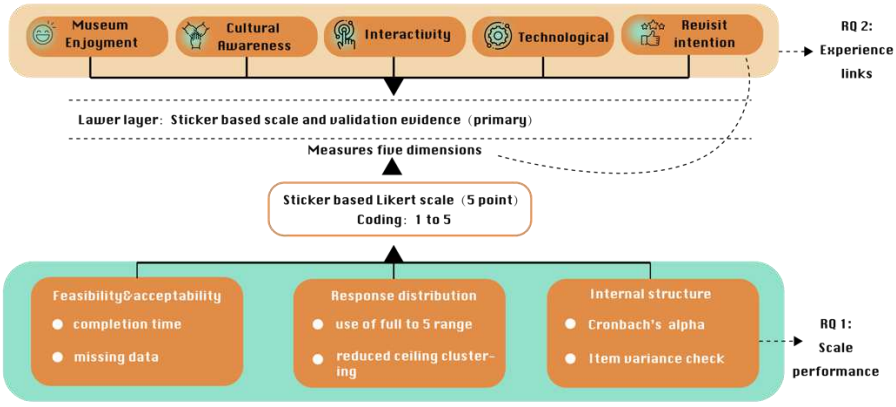


Fig. 9 Double-layer frame. Source: Prepared by the authors for this study.

Figure 9 illustrates the lower layer specifies the sticker-based Likert scale as the measurement device and defines what constitutes initial evidence of its performance. The upper layer specifies a parsimonious experience model that the instrument is designed to measure, and is used in this study as a secondary, illustrative analysis.

In the lower measurement layer, the sticker-based instrument is evaluated using three complementary forms of preliminary evidence appropriate for a field-based pilot. First, feasibility and acceptability are assessed through response completion in situ, including whether participants can complete the sticker task within the museum environment with minimal assistance and whether item nonresponse occurs. Second, response distribution evidence is examined by inspecting whether the full five-point range is used across items and whether responses show differentiation rather than clustering at a single category, a common risk in child and youth surveys. Third, internal structure evidence is explored through internal consistency indicators for multi-item dimensions, with Cronbach's alpha treated as an exploratory metric in this pilot context. This evaluation logic aligns with the broader rationale for pictorial and icon-based scales, which aim to reduce cognitive and linguistic burden while maintaining compatibility with conventional quantitative analysis[26]. The methodological claim is therefore not that the instrument is fully validated, but that it can yield feasible and analytically usable data for adolescent visitor evaluation under real in situ conditions.

In the upper experience layer, the framework specifies a parsimonious set of relations among the experience dimensions operationalized by the scale. Research on interactive and technology-rich exhibitions indicates that features such as technological novelty, sensory stimulation, and opportunities for manipulation can hold visitors' attention and increase engagement, particularly among children and young people[27]. In digital and

immersive museum settings, enjoyment and focused engagement supported by new technologies have been associated with more favorable visitor attitudes and satisfaction, which in turn can strengthen behavioral intentions such as recommending a museum or planning a future visit [28][29]. Studies in heritage and cultural tourism further suggest that memorable and engaging experiences often mediate the relationship between specific experience attributes and revisit intention. Building on this literature, adolescent experience in the present study is operationalized through five dimensions: enjoyment, cultural awareness, interactivity, technological novelty, and revisit intention. Interactivity refers to perceived opportunities to actively participate in or control exhibit engagement. Technological novelty captures the extent to which digital and multimedia elements feel new, surprising, or distinctive. Enjoyment reflects affective responses during the visit, while cultural awareness refers to perceived understanding of Huangmei opera and related heritage content. Revisit intention is treated as a proximal behavioral outcome relevant to museum practice.

The experience relations are specified as exploratory expectations rather than confirmatory hypotheses. Interactivity and technological novelty are treated as experiential drivers that are expected to be positively associated with enjoyment and cultural awareness, because interactive and technology-enhanced exhibits may increase engagement and support perceived understanding when integrated with narrative and interpretation. Enjoyment and cultural awareness are, in turn, expected to be positively associated with revisit intention, consistent with evidence linking positive emotions and meaningful experiences to intentions to return or recommend cultural destinations[30].

In addition, direct associations from interactivity and technological novelty to revisit intention are considered plausible in adolescent audiences, for example when specific installations motivate a desire to return to repeat or share the experience. In the present paper, these relationships are examined only as an illustrative secondary analysis, while the primary focus remains the performance evidence for the sticker-based measurement device.

5 Methodology

This study adopts a field based, instrument-oriented pilot design. The methodological focus is to evaluate the in-situ feasibility and preliminary performance of a sticker-based Likert scale for visitors aged 8 to 17, while using the Huangmei Opera Museum as an applied test setting. Data collection therefore prioritised ecological validity, implementing the questionnaire immediately after the visit under typical museum conditions rather than in a controlled laboratory environment. The methodological logic follows the two-layer framework described earlier. The primary strand addresses RQ1 by documenting response process and scale performance indicators, including completion patterns, completion time, missing data, response differentiation and internal structure evidence. A secondary strand addresses RQ2 through a descriptive analysis of item-level response patterns across the five experience dimensions, using the

pilot results to inform refinement of the scale and its in situ administration. The following subsections describe the study site, participants and instrument, and then detail the procedures for data collection, coding and statistical analysis.

5.1 Study site, participants and instrument

This study was conducted at the Huangmei Opera Museum in Anqing, China. The museum presents the history, performance conventions and contemporary development of Huangmei opera through object displays, archival material and audiovisual interpretation, alongside several interactive and digital installations. In the present paper, the museum serves primarily as an applied test setting in which a child-centred measurement tool can be piloted under real in situ conditions.

Participants were recruited on site during regular opening hours using a convenience intercept approach. Children and adolescents aged 8 to 17 years were approached after completing their visit at a small evaluation table near the exit. Only visitors accompanied by a parent or guardian were invited to participate. The researcher briefly explained the purpose of the study, confirmed the age band and obtained consent from the accompanying adult before administering the questionnaire. Participation was voluntary and no incentives were offered. A total of 30 valid questionnaires were obtained. The sample included respondents across three age bands that broadly correspond to primary, lower secondary and upper secondary school levels (8 to 11 years, 12 to 15 years and 16 to 17 years). Age group, gender and student type were recorded in a short demographic block at the top of the questionnaire.

The core instrument was a one-page sticker questionnaire designed for visitors aged 8 to 17, allowing them to complete it quickly immediately after their visit. The design process employed an iterative approach. An initial layout was created first to test the question wording, grid clarity, and sticker application mechanism (Fig. 10).

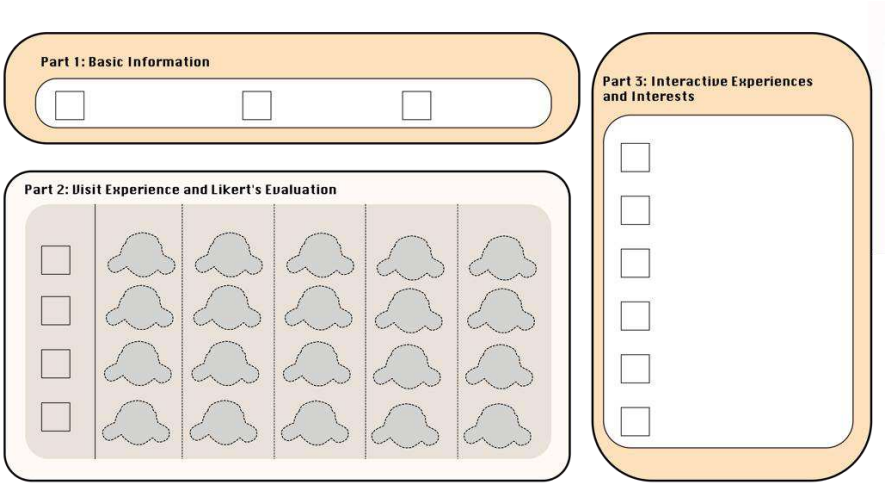


Fig. 10 A preliminary prototype layout for a sticker-based questionnaire. Source: Prepared by the authors for this study.

Figure 10 illustrates the initial low fidelity layout used to prototype the questionnaire structure before final production. The design separates the one page instrument into three functional parts: a basic information strip at the top, a central sticker based Likert evaluation grid where each item is rated by placing a sticker into one of five cloud shaped target cells, and a right hand column of checkbox questions capturing interactive experiences and interests. This prototype was used to check whether the overall information hierarchy was easy to follow, whether the grid could be completed smoothly, and whether the sticker placement targets were sufficiently clear under real museum conditions. Based on on-site piloting and informal feedback from children, guardians and museum staff, the layout was refined to improve the visibility of response anchors, the spacing of the grid and the clarity of sticker target areas. The final version retained a five-point Likert-type agreement structure from “strongly disagree” to “strongly agree” but implemented the response process as a tangible sticker placement task (Fig. 11).



Fig. 11 The final visual effect of the questionnaire. Source: Prepared by the authors for this study.

Figure 11 illustrates that experience statements are presented in a grid format, with five ordered response positions arranged horizontally. Respondents receive a sticker of a Huangmei Opera character's face and based on their own judgment, place the sticker corresponding to each item in the appropriate column. Using character stickers helps to resonate the response task with the visual language of a museum visit and improves attention by making the task feel more like an activity than a traditional test. Cloud-shaped target cells guide the placement of stickers and remain clearly legible after completion.

Scale items were developed from the conceptual framework and organised into five experience dimensions: enjoyment, cultural awareness, interactivity, technological novelty and revisit intention. In addition to the experience grid, the right-hand column of the questionnaire included multiple-choice items capturing visit context and engagement with specific activities or installations. These contextual items were used descriptively and to support interpretation of the scale results, while the primary analytical focus of the paper remains the feasibility and preliminary performance of the sticker-based Likert instrument.



Fig. 12 Questionnaires were filled out on-site at the Huangmei Opera Museum. Source: Prepared by the authors for this study.

Figure 12 illustrates the on-site questionnaire completion at the museum. Participants completed the questionnaire at the assessment table after their visit, while researchers were present to explain the sticker application process and the left-to-right filling direction of the five-point scale through brief practice examples. During the completion process, researchers only provided explanations when participants expressed uncertainty about a particular item or sticker location and ensured that guardians did not answer on behalf of children. Researchers also recorded on-site observations of participants' response behavior, including their ability to complete the questionnaire independently, any hesitation or confusion, and occasional inconsistencies between verbal judgments and sticker locations. These observations were subsequently summarized as evidence of the response process in the "Results" section.

5.2 Data collection, coding and analysis

Data collection employed an on-site intercept method, conducted at assessment points near the museum's exit during normal opening hours. After confirming eligibility (visitors aged 8-17) and obtaining consent from accompanying parents or guardians, researchers explained the research objective to visitors and demonstrated the sticker-based questionnaire process through practice examples. Participants then independently completed the one-page sticker questionnaire, with explanations provided only when questions were unclear. A total of 30 valid questionnaires were collected. The questionnaire data was subsequently entered into a spreadsheet for data management and exported to Excel for analysis. The dataset includes a completion time field. Recorded completion times ranged from 10 minutes 02 seconds to 16 minutes 02 seconds (mean 13 minutes 14 seconds; median 13 minutes 26 seconds; standard deviation 1 minute 43 seconds). All 17 questionnaire items had no missing values.

During encoding, ten sticker-based Likert scale items (items 4 through 13) were converted into numerical scores of 1 through 5, corresponding to ordinal agreement anchors printed on the scale (1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree,

5 = strongly agree). These items were categorized into five constructs defined in the conceptual framework (enjoyment, cultural awareness, interactivity, technological novelty, and willingness to revisit). Construct scores were calculated by averaging the items assigned to each construct. In this pilot study, if a construct was represented by only one item, that item score was used directly. The remaining items were treated as categorical variables. For multiple-choice questions, answers were exported as option strings, separated by a delimiter, and then re-encoded as dichotomous indicators for descriptive reporting.

Data analysis was performed using SPSS, following the two-tiered framework shown in Figure 9. The primary analysis focuses on preliminary performance evidence of the sticker-based Likert scale as a measurement tool. Feasibility and acceptability were assessed through completion patterns, completion times, and missing data. Evidence regarding response distribution was examined by checking whether all five response categories were used in the dataset and whether respondents exhibited differentiated responses across different items (rather than repetitive use of a single category across the entire grid). Evidence regarding internal structure was explored through estimates of internal consistency for multi-item structures. Cronbach's alpha coefficients were calculated for structures with three or more items; inter-item correlations were reported for structures with two items. Given the pilot sample size and the field implementation environment, all psychometric results were considered preliminary.

As a supplementary descriptive analysis, item-level and dimension-level response patterns were examined to illustrate how the sticker-based instrument captures variation across the targeted experience dimensions and to identify skew, clustering, and potential item refinement needs in a real museum setting.

6 Results

6.1 Evidence on Scale Feasibility and Response Process

On-site observations during administration provided additional evidence on the response process for the feasibility of the sticker-based questionnaire. Of the 30 participants, 23 (76.7%) were able to complete the questionnaire independently after a brief presentation, and they generally selected and pasted stickers quickly in the rating task. Five participants (16.7%) showed hesitation or uncertainty in understanding the items and required occasional assistance from guardians or researchers, primarily to clarify the meaning of the items or confirm the expected direction of the answer options. Two participants (6.7%) required ongoing assistance throughout the questionnaire completion process, including reading or repeating most of the items and guidance on the sticker pasting process (Table 2).

Table 2 Observed assistance level during questionnaire completion (N = 30)

Assistance level	n	%
Independent completion	23	76.7
Occasional assistance	5	16.7
Continuous assistance	2	6.7
Total	30	100.0

Source: Prepared by the authors for this study.

In these cases, two recurring issues were observed. First, some participants had difficulty matching verbal judgements with the spatial order of the five-point scale, occasionally pasting stickers in columns opposite to their verbal responses. For example, a participant might verbally express strong agreement but place a sticker in a disagreement position, indicating momentary confusion about the left-to-right orientation of the scale. Second, a small number of stickers were placed outside the pre-set target cells and required correction. These patterns suggest that the sticker-based questionnaire format is generally usable for participants aged 8 to 17, but that a minority of respondents benefit from additional guidance, particularly during the first few items, to ensure consistency between verbal and visual ratings.

6.2 Response patterns and preliminary scale performance

Across the ten sticker-based Likert items (Items 4–13), all five response categories were used, indicating that respondents did not rely on a single option. Aggregating the 300 item ratings (30 respondents × 10 items), the overall distribution was 1 = 4.3%, 2 = 14.7%, 3 = 19.7%, 4 = 37.0% and 5 = 24.3%. At the individual level, respondents used between three and five distinct response categories across the ten items (M = 4.13; 3 categories: n = 6; 4 categories: n = 14; 5 categories: n = 10), suggesting differentiated responding rather than uniform marking across the grid (Table 3).

Table 3 Item level descriptive statistics for the sticker based Likert items (N = 30)

Item (short label)	Mean	SD	% Agree (4-5)	%Disagree (1-2)	%Neutral(3)
I4 Understand Huangmei opera content	3.43	0.68	50.0	3.3	46.7
I5 Like displayed objects (costumes, instruments)	3.87	0.73	73.3	3.3	23.3
I6 Learned a lot about Huangmei opera	3.63	0.72	63.3	6.7	30.0
I7 Exhibits increased sense of importance	4.40	0.72	86.7	0.0	13.3

Item (short label)	Mean	SD	% Agree (4-5)	%Disagree (1-2)	%Neutral(3)
I8 Interesting experience, want to learn more	3.63	0.49	63.3	0.0	36.7
I9 Like interactive experiences	1.93	0.52	0.0	90.0	10.0
I10 Interactive devices are useful	1.90	0.61	0.0	86.7	13.3
I11 Like the overall browsing experience	3.77	0.43	76.7	0.0	23.3
I12 Want more fun experiences	4.90	0.31	100.0	0.0	0.0
I13 Will revisit if new display methods	4.77	0.43	100.0	0.0	0.0

Source: Prepared by the authors for this study.

Table 3 reports item-level descriptive statistics (means and standard deviations) and summarises response direction using the proportions of Disagree (1–2), Neutral (3) and Agree (4–5) for each item. This table highlights substantial variation across items, including floor effects on the interactivity items (I9–I10) and ceiling effects on the items capturing desire for more fun experiences and conditional revisit intention (I12–I13). Together, these patterns suggest that the sticker-based format can capture contrasts between different aspects of the visit while also revealing items that are highly skewed in this pilot sample, which is relevant for interpreting preliminary internal structure evidence and for guiding item refinement.

Item level results show clear variation as well as several floor and ceiling tendencies. Items related to cultural awareness were generally positive, especially Item 7 (M = 4.40, SD = 0.72; 86.7% in the agree or strongly agree range). In contrast, both interactivity items showed strong floor effects. Item 9 and Item 10 had means below 2.0, with 90.0% and 86.7% of responses in the strongly disagree or disagree range, respectively. Two items showed ceiling effects: Item 12 (M = 4.90, SD = 0.31) and Item 13 (M = 4.77, SD = 0.43), both with 100% of responses in agree or strongly agree. These patterns indicate that the scale captured meaningful contrasts across aspects of the visit, but also that some items were highly skewed in this pilot sample, which has implications for reliability estimates and item refinement.

Table 4 Preliminary internal structure indicators for the experience constructs (N = 30)

Construct	Items	k	Mean	SD	Cronbach's alpha	Inter item r (if k=2)
Cultural awareness	I4-I7	4	3.83	0.43	0.43	0.16
Enjoyment	I8, I11	2	3.70	0.34	0.13	0.07
Interactivity	I9, I10	2	1.92	0.40	-0.04	-0.02

Construct	Items	k	Mean	SD	Cronbach's alpha	Inter item r (if k=2)
Technological novelty or innovation (single indicator)	I12	1	4.90	0.31		
Revisit intention (single indicator)	I13	1	4.77	0.43		

Source: Prepared by the authors for this study.

Preliminary internal structure evidence is reported in Table 4. The cultural awareness construct (Items 4 to 7) showed modest internal consistency (Cronbach's alpha = 0.43), consistent with a pilot instrument and with items that may reflect related but not identical facets of understanding and valuing Huangmei opera. For two item constructs, internal consistency estimates were unstable. Enjoyment (Items 8 and 11) showed a low inter item correlation (r = 0.07; alpha = 0.13), and interactivity (Items 9 and 10) showed near zero association (r = -0.02; alpha = -0.04). These results should be interpreted cautiously given the small sample size, the use of two item scales, and the restricted variance observed in several items. Substantively, they suggest that future iterations should expand and refine the item pool, particularly for enjoyment and interactivity, and should consider whether some dimensions function better as indicator sets rather than reflective scales in this context.

7 Discussion

This study set out to develop and pilot test a sticker based Likert scale for museum visitors aged 8 to 17, using the Huangmei Opera Museum as an applied field setting. Overall, the findings provide initial support for the feasibility of the instrument in situ. All questionnaires were completed without missing responses, and recorded completion times clustered within a manageable range for post visit administration. Observational evidence further suggests that most participants could complete the questionnaire independently after a brief demonstration. In this sense, the sticker placement task appears to function as a practical response format that can be implemented within a real museum visit, while still producing data that are compatible with standard quantitative processing.

At the same time, the response process observations are central to interpreting the tool's performance. Although the majority of participants completed the questionnaire independently, a minority required occasional or continuous support, and several recurring issues were documented. The most important issue was temporary confusion in mapping verbal judgement to the spatial direction of the scale, reflected in cases where participants verbally expressed strong agreement but placed a sticker in a disagree position. This pattern does not necessarily indicate random responding, but rather highlights an interface problem at the moment of response, similar to mis clicks in digital surveys. The implication is that the instrument's usability depends not only on

the pictorial format itself but also on clear orientation cues and scaffolding at the start of the task. In practice, this can be addressed by strengthening the visual hierarchy of the scale anchors, adding a prominent left to right arrow, and including a short “check your direction” reminder after the first item.

The response distributions provide further insight into how the instrument functioned in this pilot. Across items, all five response categories were used and most respondents employed multiple categories, suggesting that the sticker format supported differentiated responding rather than simple repetition. However, several items showed strong skew, including floor effects for interactivity items and ceiling effects for items capturing the desire for more fun experiences and willingness to revisit under new exhibition methods. These skews should be interpreted cautiously. In a pilot sample, skew may reflect a genuine feature of the site experience, but it can also be amplified by the phrasing of items and by the tendency of young respondents to gravitate toward extremes when an item is emotionally salient. From a measurement perspective, these results indicate that the instrument can surface strong contrasts between dimensions, but also that future iterations should refine items that trigger extreme clustering, for example by clarifying the object of evaluation and avoiding wording that invites universally positive endorsement.

Internal structure evidence was mixed. The cultural awareness set showed modest internal consistency, while the two item enjoyment and interactivity sets produced low or unstable associations. This does not invalidate the instrument, but it clarifies the current stage of evidence. With small samples, reliability estimates are sensitive to restricted variance and item count, and two item scales are particularly fragile as indicators of a latent construct. Substantively, the low association between the two interactivity items may suggest that they captured different aspects of the experience, such as availability of interactive devices versus perceived usefulness, which may not co vary in a small pilot. Similarly, the enjoyment items may have tapped different affective responses, such as general satisfaction versus curiosity, rather than a single homogeneous construct. The implication is that the next version of the scale should expand the item pool for enjoyment and interactivity and should test whether these dimensions are better modelled as formative indicator sets or as multi item reflective scales. In practical terms, adding at least one or two additional items per dimension, and conducting cognitive interviews with a small subset of respondents to check item interpretation, would strengthen the measurement argument and reduce ambiguity in construct coverage.

Although the museum context is not the primary focus of this paper, the pilot also illustrates how the instrument can be used to generate actionable insights for museum practice. The consistently low ratings on interactivity items align with the observational note that some respondents hesitated during the sticker task and needed guidance, which may reflect broader usability challenges in interactive features or limited opportunities for meaningful interaction. In contrast, the high ratings for wanting more

fun experiences and the strong willingness to revisit if new exhibition methods are introduced suggest a clear demand among adolescents for renewed, playful and technology integrated engagement. These findings should be treated as exploratory given the sample size, but they demonstrate the practical value of a lightweight, child centred evaluation tool that can be deployed iteratively to inform exhibition updates and programme design.

Taken together, the discussion supports the central methodological claim of this paper. A sticker-based Likert format can be feasible for adolescent visitor evaluation in a museum environment and can yield analysable quantitative data. At the same time, the pilot identifies concrete design refinements needed to reduce response direction errors, and it highlights the importance of strengthening the internal structure evidence through item expansion and additional validation steps. Framed in this way, the Huangmei Opera Museum case serves primarily as a realistic test bed that reveals both the strengths and the limitations of the instrument under authentic field conditions.

8 Limitations and Reflections

This study provides initial evidence for the feasibility of a sticker-based Likert scale for adolescent museum visitors, but several limitations constrain interpretation and generalisation. First, the sample size was modest (N = 30) and recruitment relied on a single site convenience intercept approach. As a result, the findings should be interpreted as a pilot demonstration rather than as definitive psychometric validation. The observed response patterns may reflect the specific audience composition, exhibition characteristics and situational factors of the Huangmei Opera Museum during the data collection period.

Second, the present instrument offers only preliminary internal structure evidence. Some constructs were represented by two items or a single indicator in this pilot, which limits reliability estimation and can produce unstable internal consistency results, especially under conditions of restricted variance and skewed responses. The strong floor and ceiling clustering observed in several items further reduces variance and may suppress correlations between items. These patterns highlight a key reflection for scale development: in youth visitor evaluation, the response format can be feasible while the construct measurement still requires iterative refinement through item expansion, wording optimisation and testing across different contexts.

Third, the paper relies on field observations to characterise response processes and assistance needs during completion. While this provides valuable qualitative evidence for feasibility and usability, observational coding may be subject to researcher interpretation and limited standardisation. Future work should consider structured observation sheets, inter rater checks, or brief post completion probes to strengthen response process evidence and reduce bias.

Finally, the study did not include a direct measure of perceived fun or preference for the sticker format, nor did it implement a comparison condition using a conventional tick box questionnaire. Consequently, claims about the sticker format being more enjoyable or superior to text based alternatives cannot be made on the basis of the current dataset. Instead, the present results support a narrower claim: the sticker-based approach is implementable in situ and can yield analysable quantitative data with minimal item nonresponse, while revealing specific usability issues that require design refinement.

9 Conclusion

This paper developed and pilot tested a sticker-based Likert scale for visitors aged 8 to 17 at the Huangmei Opera Museum. The instrument translated a five-point agreement scale into a tangible sticker placement task and produced complete datasets without missing responses under in situ administration. Response distributions indicate that participants used multiple categories and differentiated between items, suggesting that the format can support meaningful variation in youth self report data. At the same time, response process observations identified a small proportion of participants who required assistance, and occasional direction mapping errors where verbal judgements did not match sticker placement. Preliminary internal structure evidence was mixed, particularly for dimensions represented by two items, indicating that further refinement is required before the scale can be treated as a stable multi dimensional psychometric instrument.

Overall, the study's contribution is methodological. It demonstrates a practical, child centred approach to quantitative visitor evaluation that can be deployed in museums and analysed using standard techniques, while also clarifying the design and validation steps needed to strengthen reliability and validity evidence for adolescent audiences.

10 Future Work

Future work will extend validation evidence for the sticker-based Likert scale in four directions. First, the item pool will be expanded, especially for enjoyment and interactivity, to reduce reliance on two item constructs and to better capture the range of adolescent museum experiences. Item wording will be refined through cognitive interviews and short think aloud probes to verify that respondents interpret items as intended and to reduce ambiguity that may contribute to skewed responding.

Second, subsequent studies will recruit larger samples across multiple museums and exhibition types, enabling more robust psychometric testing, including factor structure assessment and tests of measurement stability across age bands and gender groups. This will also help distinguish site specific experience effects from instrument properties.

Third, the response format will be evaluated using comparative designs. A controlled A B study will compare the sticker-based version with an equivalent conventional tick box

Likert questionnaire, using indicators such as completion time, missing data, response differentiation, perceived burden and a direct fun or preference item. Such comparisons would allow stronger claims about the added value of the sticker interaction beyond feasibility alone.

Finally, future deployments will test practical refinements suggested by the present pilot, including stronger visual direction cues, a short direction check after the first item, and clearer target areas for sticker placement. Together, these steps aim to transform the current pilot instrument into a robust, scalable evaluation tool that supports both visitor studies research and evidence informed museum practice.

Declarations

Competing interests

The authors declare that they have no competing interests.

Data availability

We have shared the de-identified raw and processed datasets, the complete sticker questionnaire, the variable coding manual, and the analysis documentation (data processing steps and statistical procedures) for peer review. These materials are available under "Related Documents" in the journal's submission system for editors and reviewers.

Ethical Approval and Informed Consent of Participants

This was a low-risk, non-intrusive questionnaire survey conducted in a public museum setting, involving children and adolescents aged 8 to 17. The Committee on Scientific Research Ethics (CEIC) of the Faculty of Architecture at the University of Lisbon issued a favorable retrospective opinion after reviewing the documents (procedure number: 001/2026). All participants' parents/legal guardians signed written informed consent forms. The questionnaire dataset did not contain any personally identifiable information; signed informed consent forms were stored separately from the questionnaire responses and were not linked to the response data. All procedures complied with the principles of the Declaration of Helsinki and relevant data protection and confidentiality requirements[1].

Informed consent

All participants were informed of the purpose of the study before completing the questionnaire, and informed consent was obtained prior to participation. Participation

[1] The CEIC operates under the Regulation of the Ethics Committee for Scientific Research (CEIC) of the Faculty of Architecture, University of Lisbon, approved by Despacho n.º 503/2026 (Diário da República): https://diariodarepublica.pt/dr/detalhe/despacho/503-2026-1009134422

was entirely voluntary, and all responses were collected anonymously and treated confidentially. The data were used solely for academic research purposes.

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Appendix

Huangmei Opera Museum Visiting Experience Questionnaire

(Students/Children for 8-17years old)

Part 1: Basic Information

1. How old are you? (single choice)

○ 8～11 years old

○ 12～15 years old

○ 16～17 years old

2. What is your gender? (single choice)

○ Male

○ Female

3. What grade are you in school (single choice)?

○ Primary school

○ Middle school

○ High school

○ University

○ Other

Part 2: Experience evaluation Please rate the following statements according to your feelings on a scale of 1-5 (1=strongly disagree, 5=strongly agree).

Question	Strongly Disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly Agree (5)
4. Through the visit, I was able to understand the content of Huangmei Opera very well.					
5. I like the Huangmei Opera items (such as clothing and musical instruments) displayed in the museum.					
6. I learned a lot about Huangmei Opera here.					
7. The exhibits in the museum made me understand the importance of Huangmei Opera even more.					
8. The exhibition here is very interesting and makes me want to learn more about Huangmei Opera.					
9. I really like the interactive experience in Huangmei Opera (such as the headphone device that allows you to play on a touch screen or listen to Huangmei Opera).					
10. The interactive equipment in the Huangmei Opera Museum is very useful and enhances the visitor experience.					
11. I really enjoyed the browsing experience at the Huangmei Opera Museum.					

Question	Strongly Disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly Agree (5)
12. I hope the Huangmei Opera Museum can enhance the fun experience.					
13. If the museum has a new way of displaying exhibits, I will definitely come to visit again.					

Part 3: Interactive experiences and interests

14. How do you mostly come into contact with Huangmei Opera? (You can choose two.)

- ○ My parents told me
- ○ I learned it at school
- ○ I learned it from watching TV, movies or cartoons
- ○ I learned it from chatting with friends or playing games
- ○ I learned it from visiting a museum
- ○ social media
- ○ Other

15. What is your favorite area in the Huangmei Opera Museum? (You can choose two.)

- ○ Area 1 : Where did Huangmei Opera come from?
- ○ Area 2: Where did Huangmei Opera come from?
- ○ Area 3: What makes Huangmei Opera so special?
- ○ Area 4: What is the special flavor of Huangmei Opera?
- ○ Area 5:What is the future of Huangmei Opera?

16. What types of games do you like to play most? (You can choose two.)

- ○ Puzzle games (e.g. jigsaws, solving puzzles or logic games)
- ○ Creative games (e.g. painting, designing or DIY crafts)
- ○ Role-playing games (e.g. pretending to be a doctor, actor or Huangmei opera character)
- ○ Construction games (e.g. building houses or structures with blocks)
- ○ Interactive games (e.g. interacting with animations or characters on the screen)
- ○ Cooperative games (e.g. completing tasks or levels with friends)
- ○ Sports games (e.g. running, jumping rope or outdoor activities)
- ○ Other

17. If the Huangmei Opera Museum added the following experiences, how many points would you give it? (1 point means you dislike it the most, 5 points means you like it the most)

- ○ More interactive mini-games (such as puzzles, spot the difference or touchscreen interaction)
- ○ Animated Huangmei opera stories (explaining the history and stories of Huangmei opera in cartoon form)
- ○ Role-playing experience (try on Huangmei opera costumes and play classic roles)
- ○ Interactive photo area (take photos in costumes or on stage sets to create exclusive commemorative photos)
- ○ Stage performance experience (stand on stage and try the movements or singing of Huangmei opera)
- ○ Virtual reality experience (immersive experience of Huangmei opera performances and scenes through AR/VR technology)
- ○ Interactive musical instrument area (try playing traditional musical instruments in Huangmei opera, such as the huqin or gongs and drums)
- ○ Learn Huangmei opera movements and singing (learn a short and simple performance movement or singing)
- ○ Huangmei opera handicraft area (make Huangmei opera props or masks to take home as souvenirs)

Research Participation Consent Form

Research Title: Enhanced Experience: The Application of Digital Exhibition Design in the Huangmei Opera Museum in China

1. Invitation to Participate

Your child is invited to participate in a research study conducted by ******. The aim of this study is to explore how digital exhibition design can enhance the visitor experience at the Huangmei Opera Museum in China. We aim to understand how children interact with museum exhibits and collect valuable information to improve the Huangmei Opera experience and engagement. Your child will participate in answering questionnaires and have their visit observed during a visit to the Huangmei Opera Museum.

2. Participant Rights

Participation in this study is entirely voluntary.

• Your child has the right to withdraw from the study at any time during the study period without penalty or explanation.

• You and your child may also choose not to answer specific questions or withdraw from the study entirely.

• There are no foreseeable risks, and your child's participation involves completing a brief, minimal-risk questionnaire about their museum visit.

3. Confidentiality

All data collected during this study will be kept strictly confidential.

• Responses and records will be anonymous to ensure your child's privacy.

• All identifiable information will be securely stored and will not be shared with unauthorized personnel.

• The results of this study may be published, but no personally identifiable information will be disclosed.

4. Parental/Guardian Consent Form for Children Under 18

Since your child is under 18 years of age, your consent is required for their participation in this study. By signing this consent form, you acknowledge that:

• You have been informed of the purpose, methods, and confidentiality measures of this study.

• You agree to allow your child to participate in research activities, including answering questions and participating in museum-related tasks.

• You and your child may withdraw at any time without any consequences.

I have read the above information. I voluntarily consent to my child's participation in this study.

Child's Name: _____

Parent/Guardian's Name: _____

Date: _____