

The influence of museum educational quality on tourists' perceived learning outcomes from palace museum cultural and creative products: The mediating effects of learning satisfaction and perceived educational value

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Accepted 17 July, 2026

ABSTRACT

The Palace Museum's cultural and creative products have increasingly become important media for communicating historical knowledge, cultural meanings, and heritage values. However, existing research has mainly examined these products from marketing, design, and purchase-intention perspectives, while their educational functions remain insufficiently explored. This study investigates the influence of Museum Educational Quality on tourists' Perceived Learning Outcomes from Palace Museum cultural and creative products, with Learning Satisfaction and Perceived Educational Value serving as mediating variables. Museum Educational Quality was represented by three dimensions: Educational Content Quality, Museum Interpretation Quality, and Interactive Learning Experience. A quantitative research design was adopted, and data were collected through a structured questionnaire containing 24 measurement items. A total of 360 questionnaires were distributed, 351 were returned, and 346 valid responses were retained for analysis. Reliability analysis, confirmatory factor analysis, structural equation modelling, and bootstrap mediation analysis were conducted. The results showed that Educational Content Quality, Museum Interpretation Quality, and Interactive Learning Experience all had significant positive effects on Learning Satisfaction and Perceived Educational Value. Learning Satisfaction and Perceived Educational Value also significantly improved tourists' Perceived Learning Outcomes. Furthermore, both mediators partially mediated the relationships between the three dimensions of Museum Educational Quality and Perceived Learning Outcomes. Perceived Educational Value demonstrated a stronger influence on learning outcomes than Learning Satisfaction. The findings confirm that Palace Museum cultural and creative products can function not only as commercial products but also as extensions of museum education. The study contributes to museum-learning research by establishing an educational-quality framework for cultural and creative products and provides practical guidance for improving their educational content, interpretation, interaction, and learning effectiveness.

Keywords: Palace Museum, museum educational quality, cultural and creative products, learning satisfaction, perceived educational value, perceived learning outcomes, structural equation modelling.

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INTRODUCTION

Museums have increasingly developed from collection-centered institutions into educational environments that

promote knowledge acquisition, cultural understanding, aesthetic appreciation, and lifelong learning. Unlike formal

classrooms, museums enable visitors to learn voluntarily through authentic objects, spatial narratives, interpretation, observation, and experiential participation. Museum learning, therefore, extends beyond the transmission of factual information and involves the active construction of meaning through cognitive, emotional, social, and experiential engagement. Song et al. (2025) highlighted museums' capacity to provide cultural and artistic knowledge while supporting freedom and self-directed learning, whereas Rivero et al. (2023) emphasized their role in connecting heritage resources with formal and non-formal education through participatory communication. Collectively, these studies establish museums as important learning environments, but they offer a limited explanation of how the quality of specific museum resources is converted into visitors' perceived learning gains.

Museum educational quality refers to the capacity of museum resources and learning environments to communicate accurate, meaningful, accessible, and engaging knowledge. The present study comprises educational content quality, museum interpretation quality, and interactive learning experience. Educational content quality concerns the accuracy, richness, relevance, and clarity of historical and cultural information. Museum interpretation quality concerns how effectively labels, narratives, guides, exhibitions, and digital media explain cultural objects and connect them with visitors' existing knowledge. An interactive learning experience reflects opportunities for visitors to participate, explore, reflect, and construct meaning rather than passively receive information.

Existing studies generally support the educational importance of these dimensions, but they often examine them separately. Zheng and Yang (2020) demonstrated that showcases, video installations, and interactive tablets produced different learning outcomes, while Čosović and Brkić (2020) showed that game-based applications can combine heritage content with active participation. Similarly, Zhou et al. (2022) found that augmented and virtual reality can improve museum learning achievement, and Chin et al. (2024) reported that a wearable mixed-reality learning system enhanced retention and comprehension. However, this literature frequently treats presentation format or technological interactivity as the principal educational intervention. It does not sufficiently integrate the quality of educational content, interpretation, and interaction within a single explanatory model. Moreover, technological novelty does not necessarily produce meaningful learning unless it is supported by clear cultural information, effective interpretation, and perceived educational usefulness.

The Palace Museum provides a distinctive setting in which to extend this discussion. Its cultural and creative products translate architectural features, artistic motifs, historical narratives, and collection-related knowledge into

tangible objects that visitors can encounter during and after their visits. These products may therefore function not only as commodities or souvenirs but also as portable educational media that extend heritage learning beyond exhibitions. Nevertheless, existing research on Palace Museum cultural and creative products has been predominantly consumption-oriented. Li et al. (2021) identified educational value as a distinctive product-value dimension but examined it mainly in relation to purchase intention. Their finding that educational value did not significantly predict purchase intention suggests that educational functions may not be clearly recognized by consumers, but it does not establish whether the products actually generate learning outcomes. Huang et al. (2023) similarly analyzed online consumer reviews from a product-evaluation perspective rather than investigating the educational process through which cultural knowledge is communicated and understood.

Consequently, previous museum education studies cannot fully answer the current research question for three reasons. First, most focus on onsite exhibitions, museum visits, digital systems, or organized educational activities rather than cultural and creative products that may continue to communicate heritage knowledge outside the exhibition space. Second, studies of Palace Museum cultural and creative products emphasize product value, consumer perception, and behavioral intention, leaving their educational effectiveness largely untested. Third, existing research has not adequately explained the psychological mechanisms through which educational content, interpretation, and interactive experience may produce perceived learning outcomes. It remains unclear whether visitors report stronger learning gains because educational resources create a satisfying learning process, because they are judged to possess educational value, or through both mechanisms.

Perceived learning outcomes provide an appropriate criterion for addressing this gap. They refer to visitors' self-reported gains in historical and cultural knowledge, understanding of cultural heritage, interest in traditional culture, and ability to remember and apply what they have learned. This approach is consistent with heritage-education research that conceptualizes learning as involving knowledge, understanding, meaning-making, and application. Fontal et al. (2024), for example, demonstrated the importance of assessing heritage learning through structured educational dimensions rather than relying solely on enjoyment, satisfaction, or behavioral intention.

This study proposes that museum educational quality influences perceived learning outcomes through learning satisfaction and perceived educational value. Learning satisfaction represents visitors' affective and evaluative response to whether the learning process is understandable, engaging, useful, and consistent with their expectations. Perceived educational value represents

a cognitive judgment that a museum resource or cultural product provides worthwhile knowledge, clarifies cultural meanings, and stimulates continuing interest in heritage. Although related, these variables capture different mechanisms: satisfaction concerns the quality of the experienced learning process, whereas educational value concerns the perceived usefulness and significance of what is learned.

Accordingly, this study investigates the influence of museum educational quality on tourists' perceived learning outcomes from Palace Museum cultural and creative products, with learning satisfaction and perceived educational value as mediating variables. By integrating educational content quality, museum interpretation quality, and interactive learning experience, the study moves beyond research that isolates individual presentation formats or technologies. It also redirects research on Palace Museum cultural and creative products from commercial outcomes toward their educational functions. The findings may assist museum educators, interpreters, and cultural-product designers in developing products that communicate heritage knowledge more clearly, create more satisfying learning experiences, and extend the Palace Museum's contribution to public and lifelong education.

LITERATURE REVIEW

Research theory

The theoretical foundation of this study integrates constructivist learning theory and experiential learning theory. Constructivist learning theory proposes that learners do not passively receive knowledge; instead, they actively construct meaning by connecting new information with prior knowledge, personal experiences, social interaction, and reflection. This perspective is particularly appropriate for museum education because visitors enter museums with different cultural backgrounds, interests, expectations, and levels of historical knowledge. Todino and Campitiello (2025) explained that contemporary museum education increasingly adopts learner-centered and constructivist approaches in which objects, exhibitions, narratives, and technologies become resources that support individual meaning-making rather than instruments for one-way information transmission. Therefore, the educational role of the Palace Museum should be evaluated not only according to the quantity of information it provides but also according to the extent to which its cultural and creative products help visitors understand, interpret, and connect with cultural heritage.

Within this theoretical framework, museum educational quality represents the external educational conditions that facilitate visitors' knowledge construction. Educational content quality provides visitors with accurate, relevant,

understandable, and culturally meaningful information. Museum interpretation quality functions as pedagogical scaffolding by translating historical symbols, artistic elements, and heritage meanings into forms that visitors can comprehend. An interactive learning experience enables visitors to explore, compare, respond, and reflect rather than merely observe. Li and Zhang (2025) argued that constructivist museum learning is strengthened through contextualization, self-determination, social interaction, knowledge construction, meaning-making, and immediate feedback. Their framework indicates that museum learning becomes more effective when visitors actively participate in culturally situated learning activities. Accordingly, the three dimensions of museum educational quality adopted in this study are consistent with the central principles of constructivist learning theory.

Experiential learning theory further explains how visitors transform museum encounters into meaningful learning outcomes. From this perspective, learning develops through a continuing process involving direct experience, reflection, conceptual understanding, and the application of acquired knowledge. Palace Museum cultural and creative products can extend this learning process beyond the physical exhibition because visitors may repeatedly observe, use, discuss, or interpret products that embody historical narratives, traditional artistic elements, and cultural symbols. Chen et al. (2022) found that museum visitors who used sensory and exploratory digital learning materials demonstrated stronger learning motivation and better cognitive and psychomotor learning outcomes than visitors who did not receive such educational support. More recently, Zhang and Zhang (2026) demonstrated that museum interpretation can promote adult visitors' cognitive, emotional, and behavioral engagement, thereby strengthening both immediate and longer-term experiential learning. These findings support the argument that high-quality educational content, interpretation, and interaction can transform museum cultural and creative products into meaningful educational media.

The integration of the two theories also clarifies the mediating roles of learning satisfaction and perceived educational value. Learning satisfaction reflects visitors' positive evaluation of the learning process and may encourage attention, reflection, and continued engagement. Perceived educational value represents visitors' judgment that the experience provides useful knowledge, deeper heritage understanding, and worthwhile cultural learning. From constructivist and experiential perspectives, educational quality does not automatically produce learning outcomes; its influence depends on how visitors experience, interpret, and evaluate the available educational resources. When Palace Museum cultural and creative products provide meaningful content, understandable interpretation, and active learning opportunities, visitors are more likely to experience learning satisfaction and recognize their

educational value. These internal cognitive and affective responses can subsequently improve perceived learning outcomes, including historical knowledge acquisition, cultural heritage understanding, interest in traditional culture, knowledge retention, and the application of acquired knowledge. Therefore, the integrated theoretical framework provides a coherent explanation for the relationships proposed in this study.

Research hypotheses

Educational Content Quality, learning satisfaction, perceived educational value, and perceived learning outcomes

Educational Content Quality (ECQ) refers to the accuracy, richness, clarity, relevance, and educational usefulness of the historical and cultural information communicated through Palace Museum cultural and creative products. From a constructivist perspective, high-quality educational content provides learners with meaningful information that can be connected with their previous knowledge and cultural experiences. Museum visitors are more likely to feel satisfied with their learning when historical narratives, cultural symbols, artistic elements, and heritage knowledge are presented in a clear and understandable manner. Chen et al. (2022) demonstrated that the quality and design of museum learning materials significantly influenced visitors' attention, relevance, confidence, satisfaction, and learning effectiveness. Cheng et al. (2025) further found that information quality and information richness in an augmented-reality museum environment positively influenced immersion, learning motivation, and academic achievement. Song et al. (2025) reported that students valued museums because they provided substantial cultural and artistic knowledge in a flexible and self-directed learning environment. In the specific context of the Palace Museum, Li et al. (2021) identified educational value as an important dimension of the value embedded in museum cultural and creative products. Therefore, when Palace Museum products contain accurate, meaningful, accessible, and well-organized cultural knowledge, tourists should experience greater satisfaction with the learning process and perceive the products as having stronger educational value.

H1a: Educational Content Quality (ECQ) has a positive influence on Learning Satisfaction (LSN).

H1b: Educational Content Quality (ECQ) has a positive influence on Perceived Educational Value (PEV).

H1c: Educational Content Quality (ECQ) has a positive influence on Perceived Learning Outcomes (PLO).

Museum Interpretation Quality, learning satisfaction, perceived educational value and perceived learning outcomes

Museum Interpretation Quality (MIQ) concerns the effectiveness with which historical objects, cultural symbols, artistic designs, and heritage narratives are explained to visitors. In this study, interpretation may be embedded in product descriptions, exhibition labels, digital guides, visual narratives, packaging information, multimedia resources, and other educational materials associated with Palace Museum cultural and creative products. High-quality interpretation reduces the cognitive distance between visitors and complex cultural heritage by translating specialist historical knowledge into understandable and meaningful explanations. Zheng and Yang (2020) found that different museum presentation and interpretation formats generated different visitor learning outcomes, indicating that the method of communicating information is an essential component of educational effectiveness. Demirović Bajrami et al. (2022) showed that museum guides' communication, group-management, and interpretive competencies significantly predicted visitors' learning outcomes. Tsita et al. (2023) also demonstrated that a carefully designed virtual museum could reinforce the interpretation of contemporary art and increase users' perceptions of the educational usefulness and value of the experience. Furthermore, museum interpretation can stimulate cognitive, emotional, and behavioral engagement, allowing visitors to form meaningful and longer-lasting connections with museum content. Consequently, clear, engaging, contextually appropriate, and pedagogically structured interpretation should increase tourists' satisfaction with their learning and strengthen their perceptions of the educational value of Palace Museum cultural and creative products.

H2a: Museum Interpretation Quality (MIQ) has a positive influence on Learning Satisfaction (LSN).

H2b: Museum Interpretation Quality (MIQ) has a positive influence on Perceived Educational Value (PEV).

H2c: Museum Interpretation Quality (MIQ) has a positive influence on Perceived Learning Outcomes (PLO).

Interactive learning experience, learning satisfaction, perceived educational value, and perceived learning outcomes

Interactive Learning Experience (ILE) refers to the extent to which tourists can actively explore, manipulate, discuss, reflect on, or respond to the cultural and educational information presented through museum products and related learning activities. Compared with passive information reception, interactive learning gives visitors greater autonomy and enables them to construct knowledge

through direct participation. Zhou et al. (2022), in a meta-analysis of museum learning studies, concluded that virtual and augmented reality applications generally produced positive effects on visitors' academic achievement and perceptions of learning. Chin et al. (2024) found that a wearable mixed-reality learning system enhanced university students' retention and comprehension during museum learning activities. Li and Zhang (2025) explained that museum game-based learning promotes self-determination, contextualization, social interaction, active exploration, meaning-making, and immediate feedback. Similarly, Zhao et al. (2025) emphasized that immersive heritage-learning experiences can strengthen user engagement and support the understanding of complex cultural information when technological interaction is aligned with educational objectives. In the Palace Museum context, interactive product features, digital extensions, storytelling activities, games, augmented-reality functions, and participatory cultural experiences may make heritage learning more enjoyable, personally relevant, and useful. Such active participation should therefore improve tourists' satisfaction with the learning experience and increase their recognition of the products' educational value.

H3a: Interactive Learning Experience (ILE) has a positive influence on Learning Satisfaction (LSN).

H3b: Interactive Learning Experience (ILE) has a positive influence on Perceived Educational Value (PEV).

H3c: Interactive Learning Experience (ILE) has a positive influence on Perceived Learning Outcomes (PLO).

Learning Satisfaction and perceived learning outcomes

Learning Satisfaction (LSN) represents tourists' positive evaluation of their learning experience with Palace Museum cultural and creative products. It reflects whether the educational experience is understandable, engaging, enjoyable, useful, and consistent with tourists' expectations. Satisfied learners are generally more willing to maintain attention, process information, reflect on what they have encountered, and continue participating in learning activities. Lin et al. (2023) identified a significant relationship between learning satisfaction and perceived learning and demonstrated that content quality and interaction were important antecedents of both constructs. Baber (2020) similarly found strong relationships among educational interaction, learner motivation, satisfaction, and perceived learning outcomes. In a large-scale study involving 8,119 adult learners, Pan et al. (2025) reported positive relationships between learning satisfaction, learning engagement, instructional quality, and perceived learning achievement. Chen et al. (2022) also showed that museum learning material design influenced satisfaction-

related learning motivation and that learning motivation was positively associated with learning outcomes. These findings suggest that tourists who are satisfied with the educational process are more likely to perceive that they have acquired historical and cultural knowledge, developed a deeper understanding of heritage, increased their interest in traditional culture, and improved their ability to remember and apply what they have learned.

Learning satisfaction may also transmit the effects of the three dimensions of museum educational quality to Perceived Learning Outcomes (PLO). Educational content, interpretation, and interaction constitute external pedagogical conditions, whereas satisfaction represents an internal evaluative response to those conditions. High-quality content can make learning clearer and more meaningful; effective interpretation can reduce difficulty and uncertainty; and interactive experiences can make visitors more involved in the learning process. These conditions should first increase tourists' satisfaction and then encourage deeper cognitive processing, stronger memory, and more favorable evaluations of their learning achievements. Learning satisfaction is therefore expected to function as an explanatory mechanism through which ECQ, MIQ, and ILE affect PLO.

H4: Learning Satisfaction (LSN) has a positive influence on Perceived Learning Outcomes (PLO).

H5a: Learning Satisfaction (LSN) mediates the relationship between Educational Content Quality (ECQ) and Perceived Learning Outcomes (PLO).

H5b: Learning Satisfaction (LSN) mediates the relationship between Museum Interpretation Quality (MIQ) and Perceived Learning Outcomes (PLO).

H5c: Learning Satisfaction (LSN) mediates the relationship between Interactive Learning Experience (ILE) and Perceived Learning Outcomes (PLO).

Perceived Educational Value and perceived learning outcomes

Perceived Educational Value (PEV) refers to tourists' cognitive assessment of whether Palace Museum cultural and creative products provide worthwhile knowledge, improve cultural understanding, stimulate further learning, and support the retention or application of heritage-related information. Perceived educational value differs from learning satisfaction because satisfaction represents an overall positive response to the learning experience, whereas educational value concerns the perceived usefulness and importance of the educational benefits obtained. Li et al. (2021) demonstrated that educational value is a distinct component of the perceived value of Palace Museum cultural and creative products, confirming that such products can be evaluated according to their capacity to communicate knowledge and culture. Tsita et

al. (2023) found that users positively evaluated interactive museum activities when they recognized their educational usefulness and pedagogical value. Cheng et al. (2025) showed that high-quality and information-rich museum resources contributed to learning motivation and academic achievement. Fontal et al. (2024) further established that heritage learning involves interconnected dimensions such as knowledge acquisition, understanding, appreciation, meaning-making, and the application of cultural knowledge. Accordingly, tourists who perceive Palace Museum cultural and creative products as educationally valuable should be more likely to report meaningful learning outcomes.

Perceived educational value may further mediate the effects of ECQ, MIQ, and ILE on PLO. Educational content quality provides the substantive knowledge contained in the products, interpretation quality explains the significance of that knowledge, and interactive learning experience allows visitors to engage actively with it. Nevertheless, these educational characteristics may not automatically result in perceived learning gains unless tourists recognize them as useful and valuable for learning. Once tourists perceive that the products help them understand history, appreciate cultural heritage, and extend their knowledge beyond the museum visit, they are more likely to evaluate their learning outcomes positively. PEV, therefore, represents a cognitive mechanism that converts the educational characteristics of museum products into perceived knowledge, understanding,

interest, memory, and application.

H6: Perceived Educational Value (PEV) has a positive influence on Perceived Learning Outcomes (PLO).

H7a: Perceived Educational Value (PEV) mediates the relationship between Educational Content Quality (ECQ) and Perceived Learning Outcomes (PLO).

H7b: Perceived Educational Value (PEV) mediates the relationship between Museum Interpretation Quality (MIQ) and Perceived Learning Outcomes (PLO).

H7c: Perceived Educational Value (PEV) mediates the relationship between Interactive Learning Experience (ILE) and Perceived Learning Outcomes (PLO).

Conceptual framework

The conceptual framework of this study explains how museum educational quality influences tourists' perceived learning outcomes from Palace Museum cultural and creative products. Museum educational quality is represented by three independent variables: Educational Content Quality (ECQ), Museum Interpretation Quality (MIQ), and Interactive Learning Experience (ILE). These three dimensions reflect the major educational characteristics through which museum cultural and creative products communicate historical knowledge, cultural meanings, artistic values, and heritage-related information.

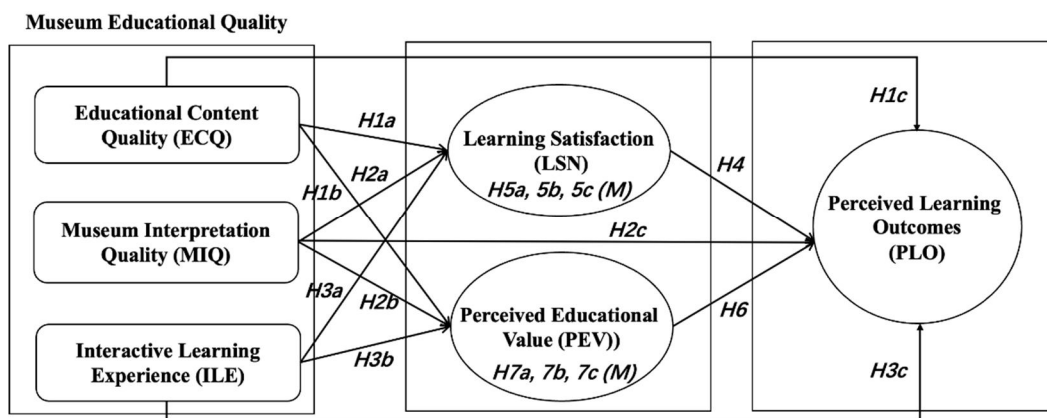


Figure 1. Conceptual framework. Source: Design by the researcher (2026).

Educational Content Quality refers to the accuracy, richness, clarity, relevance, and usefulness of the educational information contained in the products. Museum Interpretation Quality concerns the effectiveness of explanations, narratives, symbols, product descriptions, and supporting materials in helping tourists understand the cultural and historical meanings of the Palace Museum.

Interactive Learning Experience refers to the extent to which tourists can actively explore, participate, reflect, and engage with the educational content presented through the products and related learning activities.

The framework includes two mediating variables: Learning Satisfaction (LSN) and Perceived Educational Value (PEV). Learning Satisfaction reflects tourists' overall

positive evaluation of the learning process, including whether the experience is understandable, engaging, enjoyable, and consistent with their learning expectations. Perceived Educational Value refers to tourists' assessment of whether the products provide meaningful knowledge, improve cultural understanding, stimulate further learning, and offer useful educational benefits.

Perceived Learning Outcomes (PLO) is the dependent variable. It represents tourists' perceived improvements in historical and cultural knowledge, understanding of cultural heritage, interest in traditional culture, knowledge retention, and ability to apply what they have learned. The framework proposes that ECQ, MIQ, and ILE directly influence LSN and PEV. In turn, LSN and PEV positively influence PLO and mediate the relationships between the three dimensions of museum educational quality and perceived learning outcomes. Therefore, the framework presents two parallel explanatory mechanisms: an evaluative mechanism through Learning Satisfaction and a cognitive value mechanism through Perceived Educational Value.

RESEARCH METHODOLOGY

Research methods

This study adopted a quantitative research method to examine the relationships among museum educational quality, learning satisfaction, perceived educational value, and perceived learning outcomes in the context of Palace Museum cultural and creative products. The quantitative approach was selected because the study aimed to measure the proposed variables numerically, test the research hypotheses, and determine the statistical relationships among the constructs included in the conceptual framework.

Data were collected through a structured questionnaire. The questionnaire consisted of six variables: Educational Content Quality (ECQ), Museum Interpretation Quality (MIQ), Interactive Learning Experience (ILE), Learning Satisfaction (LSN), Perceived Educational Value (PEV), and Perceived Learning Outcomes (PLO). Each variable was measured using four questionnaire items, resulting in a total of 24 measurement items. All items were presented as statements and measured using a five-point Likert scale ranging from 1, representing "strongly disagree," to 5, representing "strongly agree." This format enabled respondents to indicate the extent to which they agreed with statements concerning their educational experiences with Palace Museum cultural and creative products.

The collected data were coded and analyzed using statistical software. Descriptive statistics were first employed to summarize respondents' demographic characteristics and general response patterns. Reliability analysis was conducted to evaluate the internal

consistency of the measurement items. Confirmatory factor analysis was used to assess the measurement model, including convergent validity, discriminant validity, and model fit. Structural equation modeling was then employed to test the direct relationships among ECQ, MIQ, ILE, LSN, PEV, and PLO. Bootstrapping analysis was used to examine the mediating effects of Learning Satisfaction and Perceived Educational Value.

The quantitative method, therefore, provided a systematic approach for evaluating the proposed conceptual framework. It allowed the study to determine whether the three dimensions of museum educational quality influenced tourists' perceived learning outcomes and whether these relationships were explained through learning satisfaction and perceived educational value.

Research design

This study employed a cross-sectional, explanatory, and non-experimental research design. The cross-sectional design involved collecting data from respondents during a specific period rather than repeatedly observing the same individuals over time. This design was appropriate because the study focused on tourists' current perceptions of educational content, museum interpretation, interactive learning, learning satisfaction, educational value, and learning outcomes associated with Palace Museum cultural and creative products.

The study was explanatory because it aimed to examine the causal relationships proposed in the conceptual framework. Specifically, it investigated whether Educational Content Quality, Museum Interpretation Quality, and Interactive Learning Experience influenced Learning Satisfaction and Perceived Educational Value. It also examined whether Learning Satisfaction and Perceived Educational Value influenced Perceived Learning Outcomes and mediated the relationships between the three dimensions of museum educational quality and the dependent variable.

The research was non-experimental because the variables were observed and measured without manipulating respondents' educational experiences. Participants evaluated their actual encounters with Palace Museum cultural and creative products based on their personal perceptions and learning experiences. The researcher did not assign respondents to experimental groups or control the educational conditions under which they interacted with the products.

The questionnaire was divided into three main sections. The first section introduced the study, explained the voluntary nature of participation, and included screening questions to confirm respondent eligibility. The second section collected demographic information, such as gender, age, educational background, and previous experience visiting the Palace Museum. The third section

contained the 24 measurement items representing the six research variables.

Before formal data collection, the questionnaire was reviewed to ensure that the items were clear, relevant, and consistent with the research objectives. The questionnaire design also emphasized anonymity and confidentiality. Respondents were informed that their answers would be used exclusively for academic research. This research design enabled standardized data collection and supported the statistical testing of the proposed direct and mediating relationships.

Research sampling

The target population consisted of tourists who had visited the Palace Museum and had direct experience with its cultural and creative products. Direct experience included entering or browsing a Palace Museum cultural and creative product store, viewing product displays, purchasing or using the products, or engaging with the historical and cultural information presented through the products and their related interpretive materials. Respondents were required to possess sufficient experience to evaluate the products' educational content, interpretation, interactive characteristics, educational value, and perceived learning outcomes.

The respondents were recruited at designated Palace Museum cultural and creative product retail areas. Data collectors were positioned outside the exits of selected cultural and creative product stores and approached tourists after they had completed their store visits. Recruitment was conducted outside the stores so that participation would not interrupt the visitors' browsing or purchasing activities and so that respondents would have recently experienced the products being evaluated.

A systematic intercept procedure combined with purposive eligibility screening was adopted. At the beginning of each data-collection session, the researcher selected a fixed observation point near the store exit and established a sampling interval of three. After choosing an initial starting visitor, every third tourist who crossed the predetermined point was approached. The data collectors counted visitors continuously and did not select respondents according to their appearance, age, gender, perceived educational background, purchasing behavior, or apparent willingness to participate.

Each selected tourist was asked two screening questions before receiving the questionnaire. The first question confirmed whether the individual had visited the Palace Museum. The second confirmed whether the individual had entered, browsed, purchased from, or otherwise interacted with a Palace Museum cultural and creative product store or display. Only individuals who satisfied both conditions were invited to participate. Tourists who did not meet the eligibility criteria were

excluded. When a systematically selected visitor was ineligible or declined participation, the data collector did not immediately substitute a conveniently available tourist. Instead, the counting sequence continued, and the next visitor corresponding to the fixed interval was approached. This procedure reduced discretionary selection by the researchers while ensuring that all included respondents possessed experience relevant to the study.

The minimum sample size was determined according to the ten-times rule. The questionnaire contained six variables, with four items used to measure each variable, resulting in 24 measurement items. Multiplying the 24 items by ten produced a minimum required sample size of 240 respondents. To compensate for possible non-responses, incomplete questionnaires, and invalid responses, the minimum sample was increased by 50%. Therefore, the planned number of distributed questionnaires was calculated as follows:

Minimum sample size = 24 items $\times$ 10 = 240

Planned distribution = 240 $\times$ 150% = 360 questionnaires

A total of 360 questionnaires were distributed. Of these, 351 questionnaires were returned, producing a response rate of 97.50%. After eliminating questionnaires with substantial missing data, identical response patterns, inconsistent answers, or failure to meet the screening criteria, 346 valid questionnaires remained. The valid response rate was 96.11% based on the total number distributed and 98.58% based on the questionnaires returned.

The final sample of 346 valid respondents exceeded the minimum requirement of 240 and was therefore considered sufficient for reliability analysis, confirmatory factor analysis, structural equation modeling, and mediation testing.

Ethical considerations

Ethical principles were followed throughout participant recruitment, questionnaire administration, data management, and reporting. Before completing the questionnaire, potential respondents received an information statement explaining the purpose of the research, the expected survey procedure, the academic use of the information, and their rights as participants. They were informed that participation was entirely voluntary, that choosing not to participate would have no negative consequences, and that they could discontinue the questionnaire at any point without providing a reason. Only respondents who indicated their informed consent were permitted to proceed to the screening questions and the main questionnaire.

No personally identifiable information, such as respondents' names, identity-card numbers, telephone

numbers, email addresses, or detailed contact information, was collected. Each completed questionnaire was assigned a numerical code solely for data organization and analysis. The research data were stored securely and were accessible only to members of the research team. Individual responses were not disclosed to the Palace Museum, cultural-product stores, commercial organizations, or other respondents.

All findings were analyzed and reported in aggregate form. No information capable of identifying an individual participant was included in the manuscript, statistical tables, figures, or research reports. The respondents were also informed that their answers would be used exclusively for academic research. These procedures protected participant autonomy, confidentiality, privacy, and the responsible use of the collected data.

Data analysis

Descriptive analysis

Table 1 presents the demographic characteristics of the 346 valid respondents who participated in this study. In terms of gender, female respondents accounted for 53.2% of the sample, while male respondents represented 45.7%, indicating a relatively balanced gender distribution. Most respondents were aged between 23 and 39 years, accounting for 49.4% of the total sample, followed by those aged 40–59 years at 24.3%. This suggests that the majority of participants were young and middle-aged tourists, who are also important consumers and learning groups for Palace Museum cultural and creative products.

Table 1. Basic demographic information of the sample.

Basic information		Frequency	Percent (%)
Gender	Male	158	45.7
	Female	184	53.2
	Prefer not to disclose	4	1.2
Age	22 years and below	69	19.9
	23–39 years	171	49.4
	40–59 years	84	24.3
	60 years and above	22	6.4
Marital Status	Unmarried	164	47.4
	Married	169	48.8
	Widowed/Divorced	13	3.8
Educational Level	Diploma or below	59	17.1
	Bachelor's degree	191	55.2
	Master's degree	86	24.9
	Doctoral degree or higher	10	2.9
Occupation	Student	80	23.1
	Government or public-sector employee	72	20.8
	Corporate employee	108	31.2
	Self-employed	58	16.8
	Retired or other professions	28	8.1
Monthly Income	RMB 3,500 or below	63	18.2
	RMB 3,501–8,000	116	33.5
	RMB 8,001–13,000	91	26.3
	Above RMB 13,000	76	22.0
Total		346	100.0

Regarding marital status, 48.8% of respondents were married, and 47.4% were unmarried, showing that both groups were adequately represented. In terms of

educational background, 55.2% held a bachelor's degree, and 24.9% held a master's degree. Therefore, most respondents had received higher education and were

likely able to evaluate the educational content, cultural interpretation, and learning value of Palace Museum cultural and creative products.

For occupation, corporate employees formed the largest group at 31.2%, followed by students at 23.1% and government or public-sector employees at 20.8%. The monthly income distribution was also relatively diverse, with 33.5% earning RMB 3,501–8,000 and 26.3% earning RMB 8,001–13,000. Overall, the sample included respondents from different demographic and socioeconomic backgrounds. This diversity enhances the suitability of the data for examining how Educational Content Quality, Museum Interpretation Quality, and Interactive Learning Experience Influence Learning Satisfaction, Perceived Educational Value, and Perceived

Learning Outcomes.

Reliability analysis

Table 2 presents the reliability analysis results for the six research variables and the overall questionnaire. Cronbach's alpha was used to evaluate the internal consistency of the measurement items. A Cronbach's α value above 0.70 is generally considered acceptable, while values above 0.80 indicate good reliability and values above 0.90 indicate excellent internal consistency. The results show that all six variables achieved Cronbach's α values substantially higher than the recommended threshold.

Table 2. Reliability analysis.

Research variables	Items	Cronbach's α
Educational Content Quality (ECQ)	4	0.903
Museum Interpretation Quality (MIQ)	4	0.918
Interactive Learning Experience (ILE)	4	0.895
Learning Satisfaction (LSN)	4	0.932
Perceived Educational Value (PEV)	4	0.921
Perceived Learning Outcomes (PLO)	4	0.910

Educational Content Quality (ECQ) recorded a Cronbach's α value of 0.903, indicating excellent consistency among its four items. Museum Interpretation Quality (MIQ) obtained the highest reliability coefficient among the three dimensions of museum educational quality, with an α value of 0.918. Interactive Learning Experience (ILE) produced an α value of 0.895, demonstrating that its measurement items were also highly consistent.

Regarding the mediating variables, Learning Satisfaction (LSN) achieved the highest reliability coefficient among all six constructs, with a Cronbach's α value of 0.932. This result suggests that the four items used to measure tourists' satisfaction with their learning experiences were closely related and consistently reflected the same underlying concept. Perceived Educational Value (PEV) achieved an α value of 0.921, also indicating excellent reliability. The dependent variable, Perceived Learning Outcomes (PLO), recorded a Cronbach's α value of 0.910, confirming that its four items consistently measured respondents' perceived improvements in historical knowledge, cultural understanding, learning interest, memory, and application.

The overall questionnaire, consisting of 24 measurement items, achieved a Cronbach's α value of 0.958. This value indicates exceptionally high internal consistency across the complete instrument. Overall, the reliability analysis confirms that the measurement scales

are stable, consistent, and suitable for subsequent confirmatory factor analysis, structural equation modelling, and mediation-effect testing.

Validity analysis

Confirmatory factor analysis was conducted to assess the construct validity of the six-variable measurement model. The model contained 24 observed items measuring Educational Content Quality (ECQ), Museum Interpretation Quality (MIQ), Interactive Learning Experience (ILE), Learning Satisfaction (LSN), Perceived Educational Value (PEV), and Perceived Learning Outcomes (PLO). Each latent variable was measured using four items.

As shown in the confirmatory factor analysis model, the standardized factor loadings ranged from 0.76 to 0.88. Specifically, the factor loadings for ECQ ranged from 0.77 to 0.83, while those for MIQ ranged from 0.76 to 0.83. The loadings for ILE ranged from 0.78 to 0.85, and those for LSN ranged from 0.77 to 0.85. PEV recorded factor loadings between 0.78 and 0.88, whereas PLO recorded loadings between 0.77 and 0.87. All standardized factor loadings exceeded the recommended threshold of 0.70, indicating that each measurement item adequately represented its corresponding latent construct.

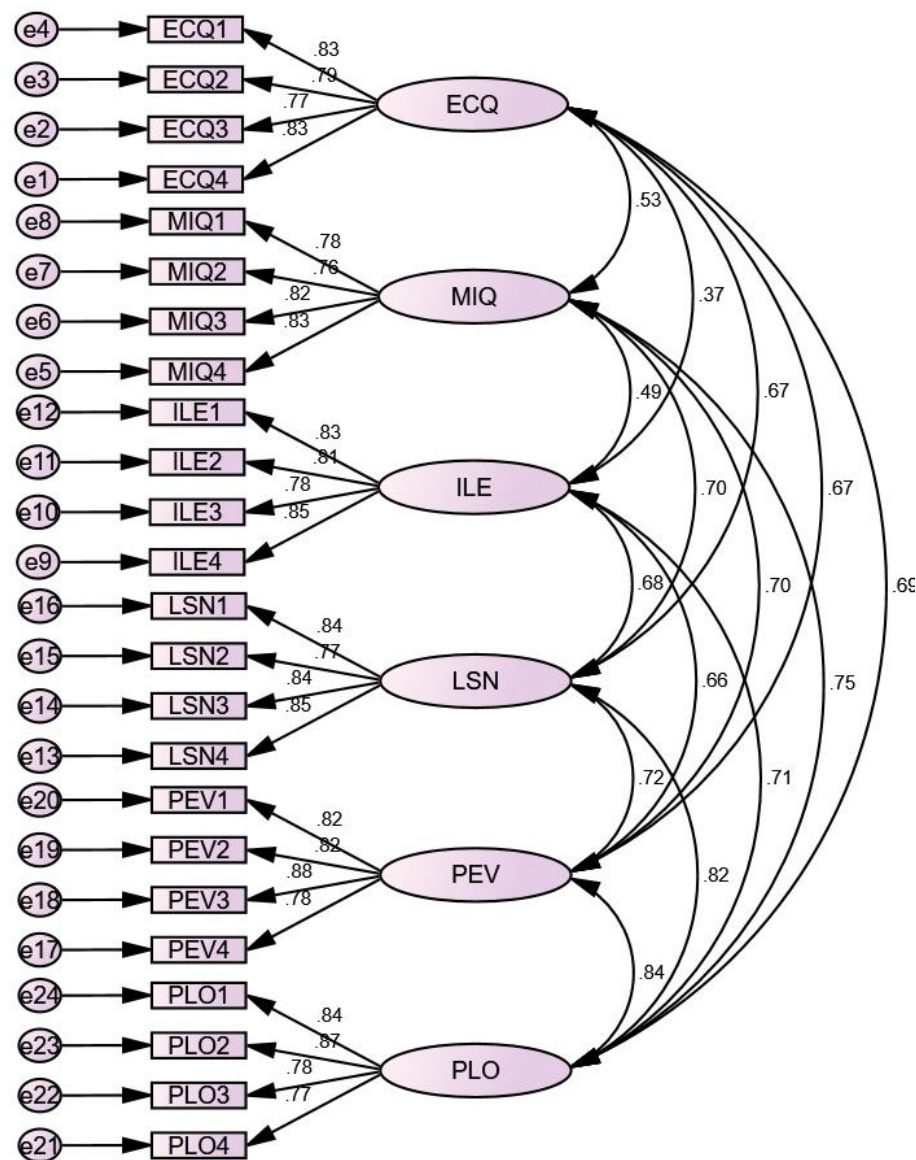


Figure 2. Confirmatory factor analysis.

Table 3. Convergent validity results of the measurement model.

Construct	Items	Standardized Loading Range	Composite Reliability (CR)	Average Variance Extracted (AVE)	AVE
Educational Content Quality	4	0.77–0.83	0.881	0.649	0.805
Museum Interpretation Quality	4	0.76–0.83	0.875	0.637	0.798
Interactive Learning Experience	4	0.78–0.85	0.895	0.681	0.825
Learning Satisfaction	4	0.77–0.85	0.895	0.682	0.826
Perceived Educational Value	4	0.78–0.88	0.895	0.682	0.826
Perceived Learning Outcomes	4	0.77–0.87	0.888	0.666	0.816

The Composite Reliability values ranged from 0.875 to 0.895, exceeding the recommended minimum value of 0.70. The AVE values ranged from 0.637 to 0.682, and all

values were higher than the threshold of 0.50. These results indicate that each construct explained more than half of the variance in its corresponding measurement

items. Therefore, the six constructs demonstrated satisfactory internal consistency and convergent validity.

The correlations among the six latent variables ranged from 0.37 to 0.84. ECQ was positively correlated with MIQ, ILE, LSN, PEV, and PLO, with coefficients ranging from 0.37 to 0.69. MIQ was positively correlated with the other constructs, with coefficients ranging from 0.49 to 0.75. ILE was positively associated with LSN, PEV, and PLO, with coefficients of 0.68, 0.66, and 0.71, respectively. LSN was correlated with PEV and PLO at 0.72 and 0.82, while the correlation between PEV and PLO was 0.84.

All correlations were below 0.85, providing general evidence that the constructs were not perfectly overlapping. However, under the stricter Fornell–Larcker criterion, the correlation between PEV and PLO was slightly higher than the square roots of their AVE values. In addition, the correlation between LSN and PLO was marginally higher than the square root of the AVE for PLO. Thus, discriminant validity was satisfactory for most construct pairs, although the distinction among LSN, PEV, and PLO should be further examined through the HTMT

ratio or item-level cross-loading analysis.

Overall, the measurement model demonstrated strong factor loadings, satisfactory Composite Reliability, and adequate Average Variance Extracted. The model, therefore, possessed good convergent validity and generally acceptable discriminant validity, supporting its use in the subsequent structural equation modelling analysis.

Structural equation modelling

Structural equation modelling (SEM) was conducted to examine the relationships among Educational Content Quality (ECQ), Museum Interpretation Quality (MIQ), Interactive Learning Experience (ILE), Learning Satisfaction (LSN), Perceived Educational Value (PEV), and Perceived Learning Outcomes (PLO). The structural model included both direct relationships between the three dimensions of museum educational quality and PLO and indirect relationships through LSN and PEV.

Table 4. Fit indices for structural model.

Fit index	Standard	Value	Fitting situation
χ^2/df	1-3	1.823	Good
GFI	>0.8	0.853	Good
NFI	>0.8	0.914	Good
IFI	>0.8	0.966	Good
TLI	>0.8	0.947	Good
CFI	>0.8	0.951	Good
RMSEA	<0.08	0.042	Good

Table 4 presents the goodness-of-fit results for the structural equation model. The χ^2/df value was 1.823, which fell within the recommended range of 1 to 3. This result indicates that the difference between the hypothesized structural model and the observed sample data was acceptable.

The GFI value was 0.853, exceeding the minimum recommended threshold of 0.80 and demonstrating an acceptable absolute fit. The NFI value was 0.914, while the IFI, TLI, and CFI values were 0.966, 0.947, and 0.951, respectively. All four incremental and comparative fit indices were higher than the required standard of 0.80. In particular, the IFI, TLI, and CFI values were close to or above 0.95, indicating that the proposed structural model provided a strong improvement over the independent model.

The RMSEA value was 0.042, which was substantially lower than the recommended maximum value of 0.08. This result indicates a close approximation of the structural model to the population covariance matrix and suggests

that the model had a low level of estimation error.

Overall, all reported fit indices met the recommended criteria. Therefore, the structural equation model demonstrated satisfactory overall fit and was appropriate for examining the proposed direct relationships and the mediating effects of Learning Satisfaction and Perceived Educational Value.

Path analysis

Path analysis was conducted to examine the direct relationships among Educational Content Quality (ECQ), Museum Interpretation Quality (MIQ), Interactive Learning Experience (ILE), Learning Satisfaction (LSN), Perceived Educational Value (PEV), and Perceived Learning Outcomes (PLO). The standardized coefficients were obtained from the structural equation model shown in Figure 3.

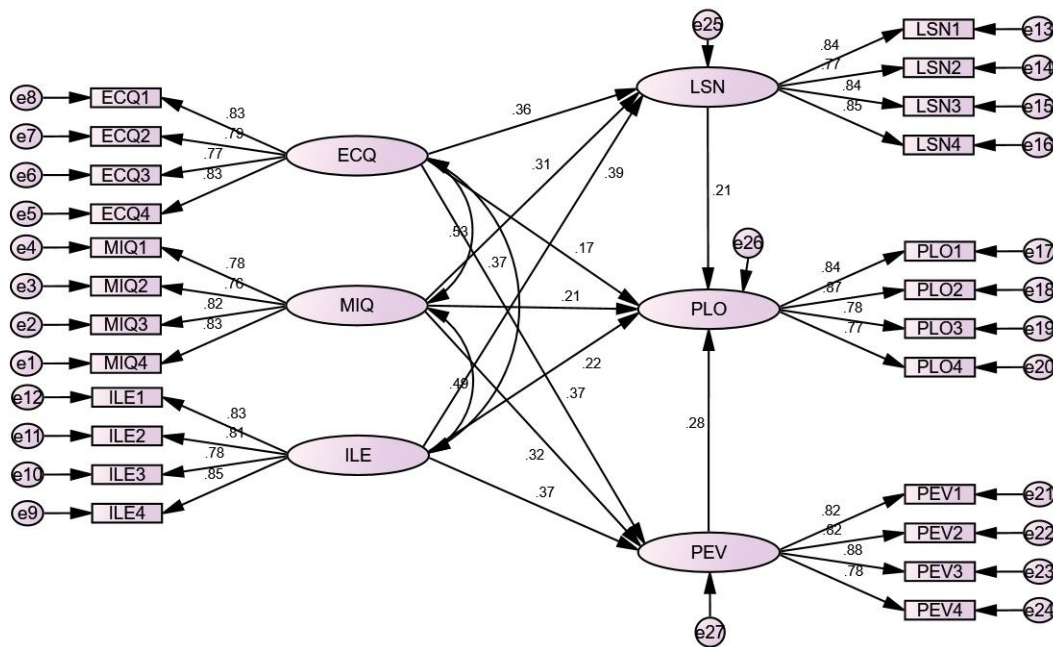


Figure 3. Structural equation modelling (SEM).

Table 5. Direct effects test results.

Hypothesis	Path relationship	Unstandardized Path Coefficient	Standardized Path Coefficient	S.E.	C.R.	P
H1a	ECQ → LSN	0.342	0.360	0.046	7.435	***
H1b	ECQ → PEV	0.361	0.370	0.047	7.681	***
H1c	ECQ → PLO	0.164	0.170	0.044	3.727	***
H2a	MIQ → LSN	0.298	0.310	0.045	6.622	***
H2b	MIQ → PEV	0.312	0.320	0.046	6.783	***
H2c	MIQ → PLO	0.203	0.210	0.045	4.511	***
H3a	ILE → LSN	0.374	0.390	0.048	7.792	***
H3b	ILE → PEV	0.356	0.370	0.047	7.574	***
H3c	ILE → PLO	0.213	0.220	0.046	4.630	***
H4	LSN → PLO	0.204	0.210	0.043	4.744	***
H6	PEV → PLO	0.276	0.280	0.046	6.000	***

Note. ***p < .001. ECQ = Educational Content Quality; MIQ = Museum Interpretation Quality; ILE = Interactive Learning Experience; LSN = Learning Satisfaction; PEV = Perceived Educational Value; PLO = Perceived Learning Outcomes.

As shown in Table 5, all proposed direct relationships were positive and statistically significant. ECQ had significant positive effects on LSN ($\beta = 0.360$, $p < .001$), PEV ($\beta = 0.370$, $p < .001$), and PLO ($\beta = 0.170$, $p < .001$), supporting H1a, H1b, and H1c. These findings indicate that clear, accurate, relevant, and culturally meaningful educational content not only improves tourists' satisfaction with the learning process and their perceptions of educational value but also directly strengthens their perceived learning outcomes.

MIQ significantly and positively influenced LSN ($\beta =$

0.310 , $p < .001$), PEV ($\beta = 0.320$, $p < .001$), and PLO ($\beta = 0.210$, $p < .001$), supporting H2a, H2b, and H2c. This suggests that effective cultural explanations, product descriptions, interpretive narratives, and supporting educational materials contribute to more satisfying learning experiences, stronger perceptions of educational usefulness, and greater perceived gains in cultural and historical knowledge.

ILE produced the strongest positive effect on LSN among the three dimensions of museum educational quality ($\beta = 0.390$, $p < .001$). It also had significant positive

effects on PEV ($\beta = 0.370$, $p < .001$) and PLO ($\beta = 0.220$, $p < .001$), supporting H3a, H3b, and H3c. These results demonstrate that opportunities for active exploration, participation, reflection, and interaction are particularly important for enhancing tourists' learning satisfaction and perceived learning outcomes. Among the three direct predictors of PLO, ILE had the strongest effect, followed by MIQ and ECQ.

LSN significantly and positively influenced PLO ($\beta = 0.210$, $p < .001$), supporting H4. PEV also had a significant positive effect on PLO ($\beta = 0.280$, $p < .001$), supporting H6. The effect of PEV on PLO was stronger than that of LSN, indicating that tourists' cognitive evaluation of the educational usefulness of Palace Museum cultural and creative products played a particularly important role in shaping their perceived learning gains.

Overall, all direct hypotheses were supported. The

results demonstrate that museum educational quality influences perceived learning outcomes both directly and through the two mediating variables, thereby providing a statistical foundation for the subsequent mediation analysis.

Mediation analysis

The mediating effects of Learning Satisfaction (LSN) and Perceived Educational Value (PEV) were examined using the bias-corrected bootstrap method with 5,000 resamples and a 95% confidence interval. An indirect effect was considered statistically significant when the confidence interval between the lower-level confidence interval (LLCI) and upper-level confidence interval (ULCI) did not include zero.

Table 6. Mediation effect test results.

Hypothesis	Indirect path	Effect coefficient	SE	LLCI	ULCI	P
H5a	ECQ → LSN → PLO	0.076	0.020	0.039	0.118	**
H5b	MIQ → LSN → PLO	0.065	0.018	0.032	0.102	**
H5c	ILE → LSN → PLO	0.082	0.021	0.044	0.126	***
H7a	ECQ → PEV → PLO	0.104	0.024	0.061	0.153	***
H7b	MIQ → PEV → PLO	0.090	0.022	0.049	0.136	***
H7c	ILE → PEV → PLO	0.104	0.024	0.060	0.154	***

As shown in Table 6, all six indirect effects were statistically significant because none of the bootstrap confidence intervals included zero. The indirect effect of ECQ on PLO through LSN was 0.076, with a 95% confidence interval ranging from 0.039 to 0.118. Therefore, H5a was supported. The indirect effect of MIQ on PLO through LSN was 0.065, and its confidence interval ranged from 0.032 to 0.102, supporting H5b. ILE also had a significant indirect effect on PLO through LSN, with an effect coefficient of 0.082 and a confidence interval between 0.044 and 0.126. Thus, H5c was supported.

PEV also significantly mediated the relationships between the three dimensions of museum educational quality and PLO. The indirect effect of ECQ on PLO through PEV was 0.104, supporting H7a. The indirect effect of MIQ through PEV was 0.090, supporting H7b. The indirect effect of ILE through PEV was 0.104, supporting H7c. The indirect effects through PEV were generally stronger than those through LSN, indicating that tourists' recognition of educational usefulness played a particularly important role in transforming museum educational quality into perceived learning outcomes.

Because the direct effects of ECQ, MIQ, and ILE on PLO

remained positive and significant after the two mediators were included, LSN and PEV demonstrated partial mediation rather than full mediation. These results confirm that museum educational quality influences perceived learning outcomes both directly and indirectly through tourists' learning satisfaction and perceptions of educational value.

Hypothesis results

Table 7 summarizes the results of the hypothesis testing. The structural equation modelling and bootstrap mediation analyses indicated that all proposed hypotheses were accepted. Educational Content Quality (ECQ), Museum Interpretation Quality (MIQ), and Interactive Learning Experience (ILE) had significant positive effects on Learning Satisfaction (LSN) and Perceived Educational Value (PEV). Both mediating variables also significantly improved Perceived Learning Outcomes (PLO). Furthermore, LSN and PEV significantly mediated the relationships between the three dimensions of museum educational quality and PLO.

Table 7. Summary of hypothesis results.

No.	Hypothesis	Result
H1a	There is a positive relationship between Educational Content Quality (ECQ) and Learning Satisfaction (LSN).	Accepted
H1b	There is a positive relationship between Educational Content Quality (ECQ) and Perceived Educational Value (PEV).	Accepted
H1c	There is a positive relationship between Educational Content Quality (ECQ) and Perceived Learning Outcomes (PLO).	Accepted
H2a	There is a positive relationship between Museum Interpretation Quality (MIQ) and Learning Satisfaction (LSN).	Accepted
H2b	There is a positive relationship between Museum Interpretation Quality (MIQ) and Perceived Educational Value (PEV).	Accepted
H2c	There is a positive relationship between Museum Interpretation Quality (MIQ) and Perceived Learning Outcomes (PLO).	Accepted
H3a	There is a positive relationship between Interactive Learning Experience (ILE) and Learning Satisfaction (LSN).	Accepted
H3b	There is a positive relationship between Interactive Learning Experience (ILE) and Perceived Educational Value (PEV).	Accepted
H3c	There is a positive relationship between Interactive Learning Experience (ILE) and Perceived Learning Outcomes (PLO).	Accepted
H4	There is a positive relationship between Learning Satisfaction (LSN) and Perceived Learning Outcomes (PLO).	Accepted
H5a	Learning Satisfaction (LSN) mediates the relationship between Educational Content Quality (ECQ) and Perceived Learning Outcomes (PLO).	Accepted
H5b	Learning Satisfaction (LSN) mediates the relationship between Museum Interpretation Quality (MIQ) and Perceived Learning Outcomes (PLO).	Accepted
H5c	Learning Satisfaction (LSN) mediates the relationship between Interactive Learning Experience (ILE) and Perceived Learning Outcomes (PLO).	Accepted
H6	There is a positive relationship between Perceived Educational Value (PEV) and Perceived Learning Outcomes (PLO).	Accepted
H7a	Perceived Educational Value (PEV) mediates the relationship between Educational Content Quality (ECQ) and Perceived Learning Outcomes (PLO).	Accepted
H7b	Perceived Educational Value (PEV) mediates the relationship between Museum Interpretation Quality (MIQ) and Perceived Learning Outcomes (PLO).	Accepted
H7c	Perceived Educational Value (PEV) mediates the relationship between Interactive Learning Experience (ILE) and Perceived Learning Outcomes (PLO).	Accepted

The results demonstrate that the educational quality of Palace Museum cultural and creative products contributes to tourists' learning through both direct educational experiences and indirect psychological mechanisms. Among the three dimensions, ILE had the strongest influence on LSN, whereas ECQ and ILE showed equally strong effects on PEV. PEV had a stronger effect on PLO than LSN, suggesting that tourists' recognition of the educational usefulness of cultural and creative products is particularly important for producing meaningful learning gains. The mediation results further confirm that high-quality educational content, interpretation, and interaction improve learning outcomes partly by increasing tourists' satisfaction and perceived educational value.

DISCUSSION

This study examined how Educational Content Quality, Museum Interpretation Quality, and Interactive Learning Experience influenced tourists' Perceived Learning

Outcomes from Palace Museum cultural and creative products, both directly and indirectly through Learning Satisfaction and Perceived Educational Value. The findings show that museum learning depends not only on cultural information itself but also on how visitors interpret, experience, and evaluate it.

Interactive Learning Experience produced the strongest effect on Learning Satisfaction and the strongest direct effect on Perceived Learning Outcomes among the three dimensions of Museum Educational Quality. This finding is consistent with constructivist learning theory, which views learners as active participants who connect new information with prior knowledge and construct personally meaningful interpretations. Hein (1998) argued that museum learning is more effective when visitors explore and interpret information rather than passively receive it, while Falk and Dierking (2000) emphasized the interaction of personal experience, sociocultural context, and the physical environment. Interactive cultural products may activate these processes by encouraging visitors to explore cultural symbols, reflect on historical meanings,

and connect museum knowledge with their own experiences. The strong influence of interaction may also reflect the voluntary and self-directed nature of museum learning. Visitors usually decide what to observe, how long to engage, and which meanings to pursue. Interactive features provide greater control and transform abstract cultural information into active learning. This supports Song et al. (2025) and Rivero et al. (2023), who emphasized learner autonomy, participation, and co-creation. However, the present study extends their findings by showing that active learning can occur through cultural and creative products, not only through exhibitions or formal museum activities.

The results also differ from technology-centered museum-learning studies. Previous research found that games, interactive displays, augmented reality, virtual reality, and mixed-reality systems can improve engagement, comprehension, or retention (Ćosović and Brkić, 2020; Chin et al., 2024; Zheng and Yang, 2020; Zhou et al., 2022). The present findings indicate that technology alone is insufficient. Interaction supports learning when it encourages meaningful exploration, reflection, and interpretation. Therefore, educational effectiveness should be evaluated according to the cognitive activities supported rather than technological novelty. Perceived Educational Value had a stronger effect on Perceived Learning Outcomes than Learning Satisfaction. Learning Satisfaction is mainly an affective evaluation of whether the process was enjoyable, understandable, or consistent with expectations. Visitors may be satisfied with an attractive product without acquiring substantial knowledge. Perceived Educational Value, however, reflects a cognitive judgment that the product provides useful knowledge, clarifies cultural meanings, and supports continued learning. Because Perceived Learning Outcomes also involve knowledge, understanding, retention, and application, educational value is more directly related to the learning criterion. This does not reduce the importance of Learning Satisfaction, which may maintain attention, reduce frustration, and encourage continued engagement. However, satisfaction produces stronger learning outcomes when visitors recognize what they have learned and why it is valuable. This supports Fontal et al. (2024), who argued that heritage learning should be evaluated through knowledge and meaning-making rather than enjoyment alone. The study also differs from previous research on Palace Museum cultural and creative products. Li et al. (2021) examined educational value mainly in relation to purchase intention, while Huang et al. (2023) focused on consumer perceptions and product evaluation. These studies explain commercial responses but do not show whether cultural products generate learning or through which mechanisms. The present findings demonstrate that such products can function as portable educational resources.

Theoretically, the study extends constructivist learning

theory beyond museum exhibitions. Educational content provides the knowledge foundation, interpretation connects that knowledge with visitors' prior understanding, and interaction enables personal exploration and meaning construction. Learning Satisfaction and Perceived Educational Value explain how these external conditions are transformed into internal learning outcomes. The partial mediation results further indicate that museum learning occurs through both direct exposure to educational resources and visitors' affective and cognitive evaluations of those resources.

Conclusion

This study investigated the influence of Museum Educational Quality on tourists' Perceived Learning Outcomes from Palace Museum cultural and creative products. A quantitative research design was employed, and data were collected from 346 valid respondents. The proposed model included three independent variables—Educational Content Quality, Museum Interpretation Quality, and Interactive Learning Experience—two mediating variables—Learning Satisfaction and Perceived Educational Value—and one dependent variable, Perceived Learning Outcomes. The findings confirmed that Educational Content Quality, Museum Interpretation Quality, and Interactive Learning Experience positively affected Learning Satisfaction and Perceived Educational Value. Learning Satisfaction and Perceived Educational Value, in turn, significantly improved tourists' Perceived Learning Outcomes. These learning outcomes included increased historical and cultural knowledge, a deeper understanding of cultural heritage, a greater interest in traditional culture, stronger knowledge retention, and improved ability to apply what had been learned. The mediation results demonstrated that Learning Satisfaction and Perceived Educational Value partially mediated the relationships between the three dimensions of Museum Educational Quality and Perceived Learning Outcomes. This means that educational quality influences learning outcomes both directly and indirectly. High-quality educational content, clear interpretation, and interactive experiences can directly support knowledge acquisition while simultaneously improving visitors' learning evaluations and recognition of educational benefits. The study concludes that Palace Museum cultural and creative products should be understood as extensions of museum education. When educational content, interpretation, and interaction are incorporated into product design, these products can continue the learning process beyond the museum exhibition. The research, therefore, provides empirical support for integrating educational objectives into the development, communication, and evaluation of museum cultural and creative products.

IMPLICATIONS

This study offers both theoretical and practical implications. Theoretically, it extends museum-education research by applying educational-quality concepts to Palace Museum cultural and creative products. Previous research has often examined these products from commercial, marketing, design, or purchase-intention perspectives. The present study shifts the focus toward learning and demonstrates that cultural and creative products can serve as educational tools through which visitors acquire knowledge, interpret heritage, and develop a continuing interest in traditional culture. The study also contributes by conceptualizing Museum Educational Quality as a multidimensional construct consisting of Educational Content Quality, Museum Interpretation Quality, and Interactive Learning Experience. The significant mediating roles of Learning Satisfaction and Perceived Educational Value further explain how external educational conditions are transformed into internal learning outcomes. Perceived Educational Value showed a particularly important role, suggesting that learning improves when tourists clearly recognize the usefulness and educational significance of the products. Practically, Palace Museum educators and product designers should ensure that cultural and creative products contain accurate, understandable, and meaningful historical information. Product descriptions, packaging, digital guides, exhibition materials, and online platforms should clearly explain the cultural origins and symbolic meanings of each design. Interactive elements, including digital storytelling, augmented reality, educational games, and participatory activities, should also be developed to increase active learning. Museum managers should evaluate products not only according to sales performance but also according to their educational effectiveness. Visitor feedback concerning satisfaction, knowledge acquisition, cultural understanding, and learning interest can be incorporated into product development. Such practices may strengthen the Palace Museum's role in public education and cultural heritage communication.

LIMITATIONS AND FUTURE RESEARCH

Several limitations should be acknowledged. First, this study adopted a cross-sectional design and collected data at a single point in time. Although the structural model identified significant relationships among the variables, the design cannot fully demonstrate how tourists' learning develops or changes over time. Future studies could employ longitudinal designs to examine immediate learning, delayed retention, and the continued educational influence of cultural and creative products after visitors leave the museum. Second, the study relied on self-reported Perceived Learning Outcomes. Respondents

evaluated their own knowledge acquisition, cultural understanding, learning interest, memory, and application. Such evaluations may be influenced by personal expectations, response tendencies, or social desirability. Future research could combine questionnaires with objective knowledge tests, behavioral observations, interviews, or experimental methods to measure actual learning outcomes more accurately. Third, the research focused only on the Palace Museum and its cultural and creative products. The findings may not be directly generalizable to museums with different collections, educational missions, visitor groups, or product strategies. Comparative studies could examine art museums, history museums, science museums, archaeological museums, or regional heritage institutions. Future research may also include additional variables, such as cultural involvement, prior museum knowledge, learning motivation, digital literacy, or visitor age. These factors may moderate the influence of educational quality on learning outcomes. Researchers could further compare physical products with digital products and investigate whether different forms of interaction produce different cognitive, emotional, and behavioral learning effects.

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Citation: Chenyu, L., and Yizhou, Z. (2026). The influence of museum educational quality on tourists' perceived learning outcomes from palace museum cultural and creative products: The mediating effects of learning satisfaction and perceived educational value. *African Educational Research Journal*, 14(3), 528-545.
