

## Enhancing Cognitive Learning: The Role of Map Exhibits in Museum Education

Jing Wang, Jasni Dolah

School of Arts, Universiti Sains Malaysia, Malaysia

Email: [winniewang@student.usm.my](mailto:winniewang@student.usm.my)

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### Abstract

This study explores the role of map exhibits in enhancing cognitive education in museums, focusing on the Henan Museum, situated within the broader context of cultural heritage preservation. It addresses the gap in understanding the educational potential of various map exhibits. The methodology centers on a qualitative approach, primarily involving the observational examination of map exhibits at the Henan Museum. This includes detailed observations of diverse exhibit types such as display panels, sand tables, models, and multimedia applications. The research uncovers that diverse map exhibits notably impact visitor cognitive learning and engagement, with different exhibit types catering to various learning preferences. Display panels provide clear, concise information, whereas 3D models and multimedia exhibits offer more interactive and immersive experiences. These findings align with theories of visual and experiential learning. This research contributes to museum education by highlighting how integrating cognitive science principles can enhance the educational impact of map exhibits, catering to various visitor learning styles and improving the overall museum experience.

**Keywords:** Map Exhibits, Museum Education, Cognitive Learning, Visitor Engagement, Experiential Learning

### Introduction

In the evolving landscape of cultural heritage preservation, museums play an increasingly significant role in public education as pivotal institutions for displaying and protecting human historical and cultural legacies (Martin et al., 2016). This research addresses the underexplored domain of map exhibits within museum education, aiming to illuminate their potential to enhance cognitive learning. Despite the essential role of museums in showcasing achievements and serving as cultural symbols, the specific contributions of different types of map exhibits to cognitive education, such as display panel maps, model maps, and multimedia maps, remain inadequately examined. Against this backdrop, the study seeks to fill this gap, exploring how map exhibits can effectively contribute to museums' interpretative and educational missions.

Museum maps extend beyond mere exhibition elements; they are crucial educational tools. These exhibits, categorized into comprehensive content maps, natural maps, and human maps, play a vital role in interpreting artifacts and historical events (Ress et al., 2018). Their significance lies in enhancing museum exhibits' interpretative and narrative capacity, thus supplementing artifact information and elevating the overall educational experience.

However, the challenge arises in the inherent limitations of maps as two-dimensional representations. While they effectively capture textual, color, and state information, a gap remains between these representations and the objective world (Niu et al., 2014). Additionally, the viewer's personal experiences and knowledge significantly influence their interpretation of these maps, potentially limiting the depth of understanding (Lu, 2018).

This study is guided by two fundamental questions that seek to deepen the understanding of the educational role of map exhibits in museums. The first question explores the distinct impacts of various types of museum map exhibits, such as display panel maps, model maps, and multimedia maps, on visitors' cognitive education. This inquiry examines how each type of map exhibit uniquely influences cognitive learning and interpretative skills among museum visitors. The second question investigates the role cognitive science can play in enhancing the educational effectiveness of these map exhibits. By integrating cognitive science principles, the study seeks to uncover methodologies that render map exhibits more engaging and informative, thus facilitating a richer understanding of cultural and historical contexts for museum visitors.

## **Literature Review**

### ***Cognitive Education in Museums***

Museum education, traditionally seen as supplementary to the core functions of museums, has evolved significantly, positioning museums as key educational institutions. This evolution reflects a shift from museums being mere repositories to dynamic learning environments where visitors engage actively with exhibits (Falk & Dierking, 2016). This shift is underpinned by educational theories such as Constructivism and Experiential Learning. Constructivism suggests that learners construct knowledge through experiences, a concept that aligns well with museums' hands-on and immersive nature (Hein, 2002). Similarly, experiential Learning Theory emphasizes learning through direct experience and reflection, a process readily facilitated by modern museum exhibits' interactive and participatory nature (Kolb & Kolb, 2009).

Applying these theories in museum settings has led to innovative educational practices. Interactive exhibits and storytelling are just a few examples of museums' integration of educational theories into practice (Hooper-Greenhill, 2007). These practices not only make learning more engaging but also effectively enhance the visitors' understanding and retention of information. Through these approaches, museums offer a unique form of cognitive education that differs significantly from traditional classroom settings. They provide a more flexible, learner-centered approach, allowing visitors to explore and interact with exhibits at their own pace, leading to a deeper and more personal understanding of the content.

The role of museums in cognitive education is further emphasized by their ability to cater to diverse audiences. Unlike formal education environments, museums offer practical, real-

world experiences that foster curiosity and provide experiential learning opportunities. This distinctive approach to learning not only complements formal education but also enriches it, making museums invaluable resources in the landscape of contemporary education.

### ***Spatial Cognition in Map Understanding***

The study of spatial cognition, a key area within cognitive science, delves into how people comprehend their environment, including the positioning, spatial distribution, and interrelations of objects within it. This aspect of cognition is crucial for understanding how humans perceive and process the objective world around them. It encompasses how individuals gather, process, and utilize information about their surroundings (Liben & Downs, 1993). Specifically, spatial cognition in the context of map reading involves using cartographic methods to comprehend geographical spaces (Dong et al., 2022). It is a process where individuals recognize and understand the geographical environment, including the positions and distributions of various elements within that space.

Map-based spatial cognition research has undergone two primary phases: focusing on the mapmaker's perspective and the user's perspective. The initial phase, centering around the mapmaker, emphasized how cartographers cognitively perceive the objective world and effectively communicate this information. This phase is represented by theories such as map information transmission theory. The latter phase shifts the focus to the map reader's understanding and interpretation, encompassing theories like map cognition theory, map deconstruction theory, and map interpretation theory (Keates, 2014).

Further, the cognitive process of understanding spatial information through maps is divided into four fundamental stages: perception, representation, memory, and thinking (Wang et al., 2000). This cognitive process involves how individuals use maps to acquire spatial information, comprehend and memorize this information, identify problems, make decisions, and guide external actions. The map user's cognitive process mirrors the general cognitive process of perceiving the objective world, including perception, representation, memory, and thinking phases. During the perception phase, the brain interprets maps as symbolic representations of geographical space, with map symbols stimulating the visual cortex and forming a basic understanding of individual attributes of items. In the representation phase, the brain, building upon sensory perception, recreates these images, forming mental or cognitive maps. The memory phase involves reinforcing these cognitive maps in the brain through repeated examination of the physical map, linking them with existing information, and forming a dynamic, continuous understanding of the geographical space. Finally, the thinking process represents a higher stage of map-based spatial cognition (Miller, 2003). It involves abstracting and generalizing objects' essential properties and spatial relationships, allowing for a deeper understanding of their characteristics, distribution patterns, and internal connections, facilitated through concepts, judgments, and reasoning.

This exploration of spatial cognition in map reading reveals its critical role in how individuals interpret and interact with maps. By examining both mapmakers' and map users' perspectives, it becomes clear that understanding maps goes beyond mere visual interpretation to involve complex cognitive processes. These insights suggest that spatial cognition is an essential, practical aspect of map usage, emphasizing the need for focused research in this area to improve our engagement with geographical information.

### ***Enhancing Cognitive Learning through Map Utilization in Museums***

The integration of map-based learning in museum education offers a unique avenue for enhancing the cognitive experiences of visitors. Museums, evolving as interactive educational spaces, hold the potential to leverage maps not just as static displays but as dynamic tools for learning and exploration (Yan, 2019). The focus on map usage aligns with the principles of spatial cognition, particularly enhancing visitors' understanding of geographical, historical, and cultural contexts through interactive and immersive map experiences. However, there appears to be a limited focus in current research on how museums utilize maps beyond traditional exhibition formats, indicating a gap in understanding their full educational potential (Liu, 2022).

Interactive map displays and augmented reality experiences involving maps can significantly deepen visitors' engagement, offering a more hands-on approach to learning. However, the literature review reveals a need for more studies that thoroughly investigate the impact of different map representations in museums on visitors' cognitive processing and spatial understanding. This presents an opportunity for future research to explore the effectiveness of various map formats, such as digital interfaces, interactive GIS maps, and physical map models, in enhancing cognitive learning within museum environments (Nikolakopoulou et al., 2022).

Moreover, existing studies tend to segregate the concepts of museum education and map-based spatial cognition, underscoring the need for more integrated research in this area. Future investigations could explore how different forms of map usage in museums contribute to cognitive development, spatial literacy, and overall educational outcomes. This research is crucial for understanding how museum educators can effectively implement map-based learning strategies, thereby enriching the educational experience for visitors.

## **Methodology**

### ***Study Design***

This study adopts a qualitative research approach to explore the impact of map-related auxiliary exhibits on cognitive learning at the Henan Museum. The focus is on understanding the educational contribution of these exhibits, particularly in how they enhance visitor comprehension and engagement with historical and geographical content.

### ***Data Collection Method***

**Observational Visits:** The primary data collection will involve observational visits to the Henan Museum. During these visits, detailed observations of the various map exhibits will be conducted, including display panels, sand tables, models, and multimedia applications. The observations will focus on the exhibits' layout, content presentation, and interactive elements.

**Review of Museum Documentation:** Secondary data collection will include reviewing existing museum documentation. This may encompass exhibit descriptions, curator notes, or any available material that provides insights into the design and thematic intent of the exhibits.

### Data Analysis Strategy

**Qualitative Analysis:** The observational data and museum documentation information will be analyzed qualitatively. This analysis will focus on how the exhibits are designed to convey historical and geographical information, their thematic representation, and the way they engage visitors.

**Thematic Interpretation:** The study will employ thematic interpretation to understand the educational features of the exhibits. This involves identifying key themes, such as design principles, interpretive strategies, and visitor engagement tactics, and how these contribute to the museum's educational objectives.

**Case Studies of Selected Exhibits:** Selected exhibits will be analyzed as case studies to provide a deeper understanding of their specific contributions to cognitive learning. This analysis will consider the unique features of each exhibit and their role in enhancing visitor interaction and understanding.

### Results

In its permanent exhibition, the Henan Museum showcases a comprehensive range of map-related auxiliary exhibits that are pivotal in depicting the region's rich historical and geographical narratives. The museum employs various exhibit types, including display panels, sand tables, models, and multimedia applications, collectively amounting to 94 map samples. This variety in exhibit styles not only caters to different learning preferences but also enhances the overall interpretive and educational value of the museum's offerings. The following sections detail each exhibit type's distinct characteristics and contributions, starting with display panels, which form the majority of the map exhibits.

#### Display Panels as Primary Exhibits

Among the map-related exhibits at the Henan Museum, display panels are a prominent feature, making up 78 out of 94 map samples. As the primary presentation mode, these panels effectively convey the region's historical and geographical essence, highlighting their importance in the museum's exhibit design. Map design focuses on clarity, aiding in enhancing visitor understanding.



Figure 1: A Drawing illustrating the distribution of Yangshao, Qujialing, and Dawenkou cultures in Henan



Figure 2: Drawing illustrating the scope of Central Plain Longshan culture and its city sites

In the case of Figure 1 and Figure 2, the focus is primarily on the geographical outline of Henan Province, outlining the distribution of various cultural sites. Moreover, these panels intentionally reduce other map details, a strategy that lightens the interpretative burden on viewers. This method facilitates a quick, clear understanding of site distribution, resulting in an immediately recognizable impact.

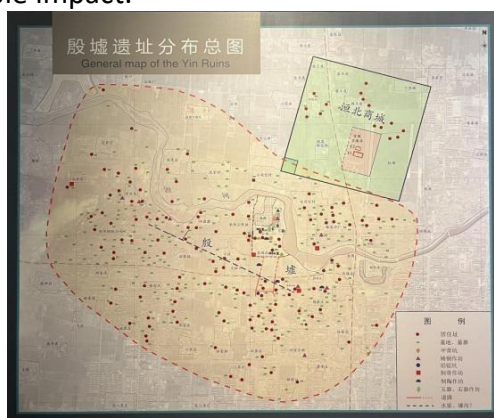


Figure 3: General map of the Yin Ruins

Figure 3 describes the spatial distribution of archaeological sites within the Yin Ruins. The map employs color coding to differentiate areas of significant archaeological interest and strategically places various symbols to indicate notable features such as habitation zones, burial sites, and metallurgical workshops.



Figure 4: Major city sites from the era of Longshan culture

Figure 4 expands the view to include multiple locations within Henan Province, each marked by a red symbol and supplemented with rich visual aids—photographs or sketches—and accompanying narrative boxes. These sites are closely linked to the Late Neolithic epoch of the Longshan culture, a cornerstone of Chinese civilization. The map's design serves an instructive purpose: to illustrate the geographic dispersion and impact of the Longshan culture through its urban remnants. The interactive layout of the map supports pedagogical interaction, encouraging observers to link the pictorial representations with their geographical counterparts.

### ***Three-Dimensional Models and Sand Tables***

While display panels are a staple within the museum's exhibition design, other types of displays offer irreplaceable advantages. Specifically, the museum's sand table and model maps bring forth a tangible dimension to the representation of topography and terrain. Such exhibits replicate geographic features at a certain scale, allowing for a microcosmic yet vivid reflection of the natural and constructed landscapes. Figure 5: "The Ancient Heluo Kingdom" utilizes a sand table to present topographical data in a more dynamic form, enhancing the viewer's perception of landscape contours. Figure 6 "The Model of Eastern Capital of Northern Song Dynasty" vividly demonstrates the urban layout and architectural styles, going beyond mere visual depiction to recreate the city's historical ambiance. These exhibits offer a multi-sensory engagement, translating spatial relationships and historical contexts into tangible forms, thereby providing an immersive learning environment.



Figure 5: The Ancient Heluo Kingdom



Figure 6: The Model of Eastern Capital of the Northern Song Dynasty

### ***Integration with Multimedia***

The museum also integrates multimedia technologies to enhance the exhibit experience, exemplified by "Figure 7: Model of the Grand Canal." This exhibit is based on a wooden sand

table featuring elements such as boats, arched bridges, and buildings along the banks. It combines the physical model with elements from film and television productions about the Grand Canal and a display panel titled "Schematic of the Grand Canal during the Sui and Tang Dynasties" for an in-depth interpretation. Such an approach not only illustrates the canal's physical attributes but also its socio-cultural and architectural significance. This method of presentation partially reconstructs the overall scope of the Grand Canal and the historical ambiance of its surroundings, enhancing the viewer's cognitive efficiency and depth of understanding. The multimedia elements add a more decadent layer to the narrative, deepening the viewer's engagement with the site's history. The multimedia elements bring additional depth to the map's narrative, intensifying the audience's engagement with the historical context.



Figure 7: Model of the Grand Canal

As the primary type of map-related auxiliary exhibits in the Henan Museum, display panels highlight their effectiveness in educational communication. Their clear and concise presentation of geographical and historical information facilitates a quick and comprehensive understanding among viewers. This emphasizes the crucial role of display panels in enhancing cognitive learning within the museum environment, aligning with the museum's goal of providing easily understandable and meaningful historical and cultural insights.

## Discussion

### *The Role of Diverse Map Exhibits in Enhancing Museum Learning*

In the context of the Henan Museum, the effectiveness of various types of map exhibits, such as display panels, 3D models, and multimedia presentations, in enhancing cognitive learning is evident. The findings from the study underscore the diverse approaches to information presentation and visitor engagement. Display panels, for instance, provide clear and concise historical and geographical information, supporting theories in visual learning and information processing. These panels align with cognitive psychology principles, suggesting that simplifying complex data enhances understanding and recall.

On the other hand, 3D models and multimedia exhibits offer a more interactive and immersive experience. These exhibit types effectively engage visitors more deeply, as they appeal to multiple senses and encourage exploration and discovery. This aligns with experiential learning theories, which suggest that engaging multiple senses can enhance understanding and memory retention. These innovative exhibit types in the museum setting also reflect contemporary trends in museum education, where interactive and engaging



experiences are increasingly valued. By offering a range of exhibit types, museums can cater to various learning preferences and styles, thus broadening their educational impact. This approach not only aligns with current educational theories but also demonstrates a practical application of these theories in a real-world setting.

### **Strategies for Enhancing Museum Map Exhibits**

The study's findings on the Henan Museum's map exhibits highlight the importance of diversifying exhibit types to enhance cognitive learning and visitor engagement. Museums can cater to diverse learning styles by integrating display panels, 3D models, and multimedia exhibits, each offering unique educational benefits. Display panels provide clear and concise information, appealing to visual learners, while interactive 3D models and multimedia exhibits engage kinesthetic and auditory learners through immersive experiences. Enhancing visitor engagement involves integrating interactive elements like touch screens and virtual reality. Museums can also improve understanding by contextualizing map exhibits with background information, offered through guided tours or digital aids. The application of augmented reality and digital displays can further transform traditional map exhibits into dynamic and engaging learning experiences. To complement these approaches, educational programs and workshops centered around map exhibits can deepen the educational impact. Continuous visitor feedback is essential for improving exhibit design and content. By adopting these strategies, museums can significantly enrich the visitor experience, making map exhibits more effective and engaging, thus fostering a deeper understanding of historical and geographical content.

### ***Museum Visitors' Cognitive Characteristics in Map Learning***

When visitors encounter map exhibits, their initial perception is shaped not by the objective reality these maps represent but by the visual stimuli provided by the exhibits. In this cognitive model, maps first form a vague mental image in the viewers' minds. The symbols and data within the maps require transformation to be comprehensible. Visitors rely on their personal experiences and knowledge to extract and process the information from the maps, leading to a subjective reconstruction of the objective world.

The study reveals the critical factor in this process is the individual's experience and background. Different types of visitors, with varied cultural and educational backgrounds, interpret map information differently—this variance in information extraction results in diverse reconstructions of the world depicted by the maps. Recognizing the differences in cognitive processes between map creators and visitors is crucial. While map creators must present comprehensive and expertly curated exhibits, the general audience benefits from building mental maps to aid in spatial cognition.

Museums can bridge the gap between professional knowledge and general audience understanding by reconstructing the knowledge background of map exhibits, transforming related academic achievements, or connecting intrinsic map information to the visitors' real lives. This helps visitors build mental maps, enhancing their map reading experience. The study also suggests that museums can adopt educational methods that cater to this cognitive process, making it more efficient for the audience. For example, highlighting key geographical elements in map exhibits and elaborating on symbolic features can guide visitors to engage

in a bottom-up cognitive approach. This method can significantly improve the educational impact of map exhibits on museum visitors.

### ***Limitations of Traditional Map Exhibits***

The current approach to displaying museum maps primarily relies on two-dimensional representations, focusing mainly on extracting essential information. While traditional methods often stimulate visitors' visual senses through the maps' physical appearance, a more profound understanding requires moving beyond this direct form of presentation. This straightforward and tangible exhibition style can sometimes lead to fragmented narratives, which may hinder the depth of visitors' comprehension. Therefore, there is a need for a more abstract and expansive educational approach that transcends mere physicality, delving into the intrinsic value of maps from a spatial cognition perspective.

Additionally, museum map exhibits tend to be scattered and presented independently, often embedded within broader thematic exhibitions as auxiliary elements. This results in a lack of comprehensive explanation and diminishes the potential educational impact of the maps. The need to connect the maps with their omnipresent contexts with adequate interpretative support leads to a superficial understanding of their content and value. There is a pressing need for more integrated and interpretative approaches in museum map displays to enhance their educational effectiveness and reveal their more profound historical and geographical significance.

### ***Advancing Museum Map Education: Trends and Methods***

Traditional map display methods in museums have typically relied on two-dimensional representations, limiting the depth of interpretation and engagement. The current trend in museum education is moving towards more dynamic, multi-dimensional exhibits that offer a richer, more interactive experience. This shift is driven by the need to cater to visitors' diverse cognitive styles and present complex spatial information more effectively. The advent of multimedia technologies has expanded the possibilities for map displays, enabling the incorporation of various sensory elements like sound, animation, and even virtual reality. These advancements provide opportunities for museums to present maps in ways that are not only visually compelling but also more intuitive and engaging, allowing for a deeper understanding and appreciation of the maps' content. To fully realize this potential, museums should integrate theories and methodologies from cognitive science and cartography, ensuring that map exhibits are both educational and accessible. This approach can significantly enhance the level of cognitive learning in museum settings, pushing the boundaries of traditional map education.

### **Conclusion**

This research underscores the pivotal role of map exhibits in cognitive education within museums, highlighting their effectiveness in enhancing cognitive recognition and visitor experiences through multimedia integration. By tailoring exhibit design and educational strategies to map spatial cognition and audience cognition characteristics, the study bridges the cognitive gap between exhibits and visitors, fostering a sustained and expansive learning effect. The application of map cognition theory not only grounds the cognitive learning effects of exhibits in scientific theory but also promotes a deeper understanding of maps' intrinsic information and knowledge, suggesting that multi-sensory perception and organic

interpretation of map exhibits can expand educational content and introduce new methods and innovative exhibition concepts.

The findings reveal the significant benefits of integrating cognitive science principles into map exhibit design, which enriches visitor experiences by accommodating diverse learning styles and enhancing cognitive engagement. This approach not only caters to technologically savvy audiences but also deepens the understanding of geographical and historical narratives, marking a substantial contribution to museum education by providing evidence-based strategies for exhibit design that bolster cognitive learning.

In summary, this study highlights the vital importance of map exhibits in museum education, advocating for the integration of technological advancements to create more interactive and informative displays. Acknowledging the study's modest contribution, it points towards the potential for further research in achieving a balance between technological innovation and educational efficacy, suggesting that future work could explore this equilibrium to enrich visitor experiences and broaden the educational scope of museums, in line with contemporary educational needs.

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