Educational Practice Journal
ISSN: 2997-6235 |
Volume 11 Issue 1, January-March, 2023
Journal Homepage: https://ethanpub.online/Journals/index.php/E1
Official Journal of Ethan Publication

MULTIMEDIA MAVERICKS: PIONEERING INNOVATION IN MUSEUM EDUCATION THROUGH DIGITAL TECHNOLOGIES

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Abstract
Modern learning is evolving beyond the confines of traditional educational settings, encompassing a broad spectrum of learners and diverse learning environments. Museums, traditionally regarded as cultural repositories, are now at the forefront of this evolution. They serve as dynamic hubs for interaction, cultural memory preservation, inspiration, education, information dissemination, and research. In this context, multimedia learning materials and advanced information technology have emerged as catalysts for transformative museum education. Multimedia learning transcends traditional boundaries, offering a multitude of formats, from computer-based courses with animations and narratives to textbooks enriched with illustrations and texts. Concurrently, the rapid advancement of information and communication technologies (ICT) is revolutionizing museum operations, elevating accessibility, transparency, and the overall visitor experience. Digital museums, empowered by ICT, are surmounting geographic and temporal constraints, fostering increased visitation, and enhancing the quality of each visitor's encounter. This study delves into the integration of multimedia technology in contemporary museums, focusing on Manchester, UK. Through on-site visits and interviews with museum staff, it seeks to gauge the impact and utilization of multimedia learning materials. The People's History Museum in Manchester serves as a primary source for original multimedia materials, enriching our understanding of the evolving landscape of museum education.

Keywords: Museum education, Multimedia learning, Information technology, Digital museums
Cultural enrichment

Introduction

The concept of modern learning is inclusive enough that learners should not be limited to students, nor should educational environments be confined to traditional offline platforms, classrooms, or video platforms limited to online courses. Museums serve multiple functions, including interaction with objects, cultural memory, inspiration, education, information dissemination, and research [1]. Nowadays, multimedia learning materials and modern information technology play a major role in museum education. Among other things, multimedia learning encompasses a variety of learning formats, including learning through slide presentations, learning through animations and narratives in computer-based courses, and learning through illustrations and texts in textbooks [2]. At the same time, the rapid development of information and communication technologies (ICT) is transforming all aspects of museum operations while enhancing the traditional functions of museums. ICT-enabled digital museums can turn geophysical, temporal, and resource constraints into advantages, such as encouraging more visitors, increasing accessibility, transparency, frequency, and duration of each visit, and enriching the experience of each visit [3]. It can be argued that digital museums have gradually replaced traditional museums in stimulating personal growth, cultural exchange, and social enrichment [4]. In order to target and assess the use of multimedia technology in contemporary museums, this study selected museums in Manchester, UK, for offline visits and one-on-one

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interviews with venue staff. In addition, all original multimedia learning materials for this study were sourced from the People's History Museum in Manchester.

1. The learning purpose of the materials

1.1 Target people

Most museums are open to the public, so the audience for museum education is highly random.

They may come from different races, different educational backgrounds, different genders, and even different ages. This presents both opportunities and challenges. This brings with it both opportunities and challenges. The possibility is that if the educational efficacy of museum multimedia learning materials (including text, audio, and video) can be completely utilized, the area of education will develop. The difficulty is determining how to maximize educational impact while also achieving non-discriminatory education in the face of such a diverse audience. Simultaneously, how can we strengthen the audience's memory spots and subtly impact visitors? This is an important problem to consider.

1.2 Special care

The Manchester Museum of People's History has improved its multimedia materials for specific audiences, see Figure 1.

Figure 1: Special care area

The museum provides special headphones for the hearing-impaired, which enable them to receive multimedia audio more clearly through Bluetooth connection and mobile phone scanning. At the same time, the museum also prepares Braille texts and Braille tapes for the visually impaired and allows them to touch some of the exhibits. Through these special forms of multimedia images and audio, the blind can experience the museum's exhibits through their physical senses. In addition, the museum has prepared sensory bags for children, which contain many safe and interesting objects that allow children to stimulate their senses through visual and tactile stimulation to enhance their perception of the materials.

2. Related concepts and examples

2.1 Augmented reality interaction

With the rapid development of new technologies, interactive learning environments have become widespread and are beginning to have a profound impact on everyday educational practices[5][6]. Interactive learning environments are computer-based instructional systems that provide a learning environment for learners and are supported by information technology to help the audience understand the concepts or scenarios modelled that may be involved in the learning process[7]. Such interactive learning environments can interact with learners and provide them with a personalized learning experience that helps promote knowledge acquisition and understanding. Through the development of relevant game software, multimedia materials can enhance the spatial immersion of the audience, enabling them to immerse themselves in the game process and increasing the frequency of interaction between the

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audience and the multimedia materials, thus realizing the effect of augmented reality interaction. Visitors can experience firsthand the hard life of the lower working class in different periods, such as the workflow of matchbox production workers, in the interactive games of the museum (see Figure 2).

Figure 2: Interactive experience game

2.2 Proximity effect

The principle of continuity refers to the fact that presenting the corresponding text and pictures consecutively is easier for students to understand than presenting the text and pictures separately when giving multimedia explanations[8]. Research has shown that in problem-solving, students who read the article and viewed the corresponding illustrations at the same time produced 75% more useful answers than students who read the text and illustrations separately[9][10]. More importantly, sequential presentation can help students make closer connections and associations between text and pictures, thereby improving the absorption and comprehension of information. Researchers have noticed a similar pattern and referred to it as the proximity effect[11]. Therefore, the corresponding text and images must be present in working memory at the same time to facilitate the construction of reference links between them[8]. In short, digital museums should adopt a sequential presentation to enhance visitors' understanding and memory of exhibit content (see Figure 3).

Figure 3: Continuous presentation of text and illustrations

3. Implementation process

3.1 Realistic interaction enhancement process and completion degree

The People's History Museum in Manchester uses projectors to project video onto the walls and audio playback to explain information such as the age of the exhibits and their context. At the same time, smarter information technologies were used. Zhang et al.[12] interpreted interactivity as more active and randomized access to video content by the audience. Instead of a boring loop, visitors can click on the 'start' button to initiate video playback when standing within the video's promotional area and can switch between buttons to explore different periods of

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information during video playback. Through this personalized interaction, the audience can actively interact with the multimedia material according to their wishes (see Figure 4).

Figure 4: Personalized multimedia interactive buttons

The significance of interactivity in video and multimedia instruction was previously discussed by Bransford, Brown, and Cocking[13], who claimed that "Interactivity makes it easy for students to revisit specific parts of the environments to explore them more fully, to test ideas, and to receive feedback." Therefore, in an interactive museum with multimedia materials, the audience can connect with and even participate in the interactive multimedia in the museum. This experience enables the audience to brainstorm during the museum visit, fully explore and accept the knowledge points displayed in the multimedia materials.

Therefore, in an interactive museum with multimedia materials, the audience can establish contact with the interactive multimedia in the museum and even participate in it. In this way, the audience can be influenced imperceptibly, and the interaction between multimedia materials and audience can be enhanced, thus giving full play to the educational utility of multimedia materials.

From my point of view, the application of multimedia materials in museums has greatly accomplished the goal of enhancing the interaction between audiences and multimedia materials. Although the examples I have given are limited to the key manipulation of video materials, there are more interactive games and interactive multimedia design in actual scenes, including the interactive mini-games shown in the pictures above also exist in this museum.

3.2 The promotion process and completion degree of deep learning

During the research, the researcher found that the photocopier in the museum can print the museum-related multimedia materials (i.e. the outline of poster pictures). In the self-study sharing area, there are colour brush tools and puppet characters to assist visitors to paint the posters. Here, visitors can fill in the posters by themselves. They fill in and explain the posters with their own knowledge, which greatly deepens the sense of participation of visitors in the content related to museum education. At the same time, a simple map will appear at the overview at the entrance of the museum, which enables visitors to easily understand the overall explanation of the museum and clear their thoughts to reduce the cognitive processing load of visitors. The actual pictures of the museum are shown in figure 5 and 6.

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Figure 5:Self-study sharing area brush tool

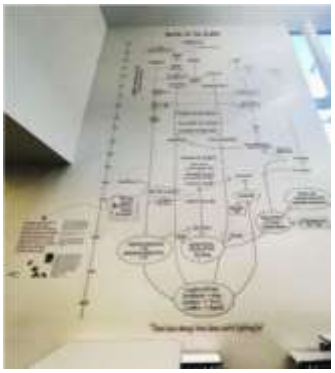

Figure 6:Map at Overview

These wonderful uses of multimedia materials fit perfectly with the hypothesis tested by Moreno and Mayer[14] that personalized information in multimedia science lessons can promote deep learning by actively engaging students in the elaboration of the material and reducing the processing load.

4. Some suggestions

4.1 Use signals and highlight points

Achieving a level of deep learning does not depend solely on the use of multimedia learning materials. The complexity of the multimedia learning material, the design of the learning environment and the level of prior knowledge of the individual are also important factors that influence multimedia learning. Therefore, the use of signals can be considered to direct the audience's attention to the key parts of the multimedia learning material in order to enhance the learning of the multimedia material [15][16]. Signalling is the process of drawing the audience's attention to relatively focused information through the use of words, pictures or gestures. Signalling is expressed differently in different forms of multimedia materials. Text-based multimedia materials, tend to implicitly emphasise in the sentence preceding the key sentence[17]. Picture-based multimedia materials tend to emphasise key information with arrows or colours[18]. According to Mautone and Mayer[14], signalling helps the audience to receive relevant information about the overall structure of the material. This process ensures that the relationships between concepts are clear, allowing visitors to better organise the information and therefore make better inferences and conclusions about the information received.

4.2 Keep things simple

The combination of a small number of text snippets and pictures is more likely to be understood and accepted by an audience than a lengthy text snippet[8]. Findings suggest that students who read a text explaining the steps in the formation of lightning with corresponding illustrations were 50% more likely to generate useful solutions than students who read the same information but inserted additional details into the material[19][20]. This result is consistent with cognitive theories of multimedia learning, which suggest that shorter presentations can help learners select relevant information and organise it effectively (see Figure 7). Therefore, digital museums are able to appropriately use generalisations in their presentations so that visitors can understand them.

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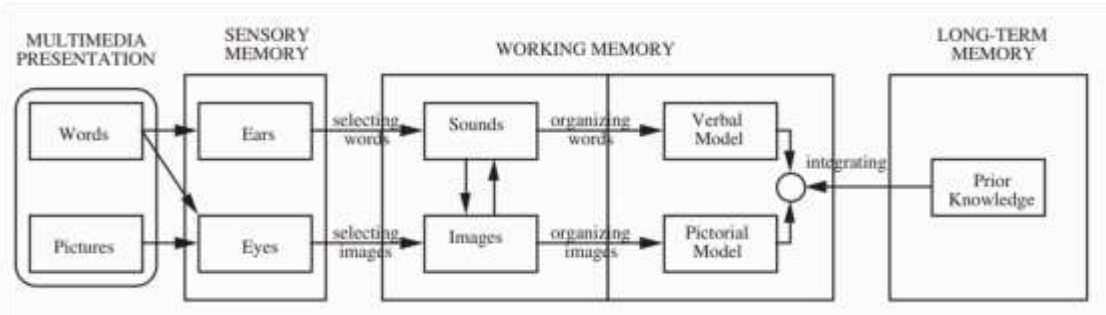

Figure 7: Cognitive theory of multimedia learning

4.3 Corresponding to each other, close to each other

The voice principle is that people learn more deeply when the words in a multimedia message are spoken in a standard-accented human voice rather than in a machine voice or foreign-accented human voice. The following researchers will make use of this principle to propose improvement suggestions for this study. Machine-synthesized sounds can be recognized by human beings in terms of perception. However, based on this study, when the audio heard by the audience in multimedia materials is produced by machine synthesis instead of human beings, it may convey less sense of social existence, thus affecting the audience's deep learning.

Similarly, when the audio that the audience hears in the multimedia materials is the voice of the person with foreign accent instead of the accent of the native speaker, the social reaction of the learners to the information may be reduced, thus affecting the audience's deep learning. Therefore, based on this research, my third suggestion is to use the audio in multimedia learning materials for human voice broadcasting, preferably by native speakers, to increase the audience's sense of social presence, enhance familiarity and arouse resonance, to promote the audience's deep learning.

4.4 Recommendation summary

In addition to the three improvements suggested above, subtle design changes can be made to the multimedia learning materials evaluated in this study according to the principles of personalization, time continuity, image, and capacity limitation. For example, in video or audio, we should adopt more approachable oral language, use the first and second person, and try to make narration in the form of dialogue, to stimulate the social response of learners and improve the learning effect. Or in the process of displaying multimedia learning materials, appropriate time is arranged for voice-over and animation to be played together, and narration and animation are delivered at the same time to ensure maximum learning by the audience.

5. Prospect development

In the future development process, with the integration of virtual reality technology and VR technology, the audience will get a better experience. For example, it can use the panoramic technology to enjoy the museum online and zoom in the details of museum exhibits without dead corners in 360 degrees. Or you can visit 3D three-dimensional multimedia images in offline museums to enjoy an immersive viewing experience. Or you can experience the amazing stereo surround sound during a visit to an offline museum. All of these can stimulate the audience's senses (including hearing, vision, etc.), thus deepening the audience's impression on the key knowledge, making the audience more identified with and interested in the learning materials, and finally achieving the purpose of promoting the audience's deep learning.

6. Conclusion

This paper can be said to be a highly targeted article, with a new perspective on multimedia learning materials in museums. Different from ordinary multimedia materials, multimedia learning materials in museums come in various forms. As informal places of education, museums also bear the responsibility of education. Therefore, after the field trip, the researchers made a detailed interpretation and analysis of the multimedia materials in the museum, from

the initial introduction to the educational function of the museum, to the purpose and evaluation of multimedia materials in the middle stage, and finally to the prospect and development. In this study, the advantages of multimedia materials in museums and the areas that need to be improved can be seen directly. Meanwhile, the researcher provides a mind map made by himself for reference, which is believed to urge the improvement and development of multimedia research. Finally, let me thank the museum that has provided me with all the resources, the People's History Museum in Manchester.

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