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Reflection on the Nature of Science: Strategies and Impact of Venue Education

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Abstract: Teaching activities based on exhibits and those grounded in technology are the primary forms of science education within venues, playing a significant role in enhancing public scientific literacy. This study, based on a survey of 162 learners across six science popularization venues, explores the current understanding and specific manifestations of the nature of science among these learners. The results indicate that both exhibit-based and technology-based teaching activities in science popularization venues need overall improvement. Learners demonstrate an understanding that is relatively traditional, generalized, superficial, and lacks comprehension in certain dimensions. Based on these findings, this study proposes recommendations for the improvement of venue education.

Keywords: Informal learning; Venue learning; Nature of science

Introduction

Museum learning refers to the learning activities carried out using venue resources. As an important form of informal learning, it is an important way to expand beyond school and classroom learning. In recent years, with the rise of informal learning concepts, research on venue learning has become an interdisciplinary research field of common concern among disciplines such as museum science, educational technology, psychology, and education. Combining with the actual needs of science popularization venue work, this study investigates the current situation and specific manifestations of science popularization venue learners' understanding of the essence of science.

Literature review

Science education in venues has long been a significant research topic of interest to scholars. In the early 20th century, museum education became a hotspot in educational research. As studies progressed, the focus gradually shifted from the types of venues to the exploration of learning models within them.

As we embark upon a new epoch, characterized by swift socio-economic progression and the rapid evolution of scientific technologies, there is a discernible elevation in the populace's cognitive levels. Consequently, this has given rise to more stringent requirements concerning science education. Within this milieu, venue-based science education emerges as a pivotal conduit for achieving these heightened expectations. In a comprehensive sense, venue-based science education optimally harnesses the scientific educational resources present within venues (Greenbank 2014). This approach facilitates students in not only the acquisition but also the construction of individual experiences. Moreover, it synergistically combines these personal experiences with the interactive dynamics of social groups, fostering experiential learning, inquiry, and practical engagement within situated contexts. Such immersive and participatory pedagogical strategies are better equipped to address the burgeoning public demand for science education that is both realistic and pertinent (Russell 2012). This quest carries substantial practical implications, as it promises to significantly augment the contributions of science popularization venues towards fulfilling the public's evolving educational needs and aspirations in our progressively complex and information-rich society (Bradley et al. 2021).

In China, most science and technology museums are non-profit organizations funded by the government, and their basic benefits include social and economic benefits. As a service-oriented cultural institution, social benefits are its fundamental benefits (Shen

et al. 2013). The social benefits of science museums are inherently consistent with those of museums. Science museums are an important battlefield for socialist spiritual civilization construction, including providing favorable venues for scientific dissemination and education, spreading correct scientific spirit and ideas, promoting scientific culture, and inspiring scientific concepts. Therefore, understanding the "benefits" of science and technology museums focuses on understanding their social benefits, which are internally reflected in the exhibition quality, educational effectiveness, and public influence of science and technology museums (Wang et al., 2020).If we use a more precise way to describe the "benefits" of a science museum, it actually refers to the breadth and depth of scientific communication and education that the museum receives between input and output. From the perspective of breadth, whether it can benefit a wider public, and from the perspective of depth, whether it can meet the public's learning needs for science and achieve comprehensive development of scientific literacy.

Research methodology

Sample situation

This study conducted field research through a combination of survey questionnaires and semi-structured interviews. A total of 180 questionnaires were distributed, and 172 were collected, with a response rate of 95.6%. Among them, 162 were valid, with an effective rate of 94.2%. The participants in the questionnaire survey come from six science popularization venues in Hangzhou, Zhejiang Province, including the Zhejiang Provincial Museum of Nature, Zhejiang Provincial Museum of Science and Technology, Hangzhou National Specimen Museum, Hangzhou Museum, Hangzhou West Lake Museum, and China Water Conservancy Museum. The learners of science popularization venue education participating in this study are mainly adults from various levels and types of science popularization venues who visit, tour, and learn, collectively referred to as venue learners in this article.

Research tools

This study used the VNOS-D+questionnaire survey. This tool consists of 8 questions, each examining the concept of scientific essence from 7 dimensions. The seven dimensions are: scientific knowledge has an empirical basis; Scientific knowledge is constantly evolving and changing; Science has subjectivity; Theory and laws; The discovery of scientific knowledge requires creativity; Science is based on observation and reasoning.

Scoring process

The scoring of the questionnaire is mainly completed by two raters. Both of these raters have a research focus on science education, as demonstrated by.

After being trained by experts who are familiar with and have used the VNOS-D+scoring criteria, they have developed a deep and accurate understanding of the scoring criteria .

Results

The various dimensions of the scientific essence view of learners in science popularization venues are as follows.

Scientific knowledge has an empirical foundation. 35.7% of the surveyed samples have a scientific understanding of this dimension, and they explained in their answers that the establishment of scientific knowledge requires evidence. Among them, 27.4% of respondents believe that evidence comes from observation and surveying of specific things, 7.5% of respondents believe that evidence comes from simulation experiments, and 7.1% of respondents believe that evidence comes from both sources. 48.9% of the surveyed samples have incomplete understanding and concepts are undergoing transformation. These interviewees understand that the establishment of scientific knowledge requires evidence, but cannot explain the source of the evidence.

Scientific knowledge is constantly evolving and changing. In this dimension, only 3 people have a scientific understanding. They believe that scientific knowledge will change with new observations and reinterpretations of existing ones. 92.1% of the surveyed samples are at a level of incomplete understanding and conceptual transformation. These samples all agree that scientific knowledge will change, but 63.9% of the surveyed samples did not provide any reason, and 30.8% of the surveyed samples provided one reason. 5.9% of the surveyed samples have incorrect understandings of this dimension, believing that scientific knowledge will not develop or change. From the above data, it can be seen that most science educators do not have a sufficient understanding of this dimension, and there are still some erroneous ideas.

Discussions

Based on the above data results, it can be found that the scientific essence of learners in science popularization venues in China has the following characteristics.

Learners in science popularization venues have a more traditional view of the essence of science

Mainly manifested in three aspects. Firstly, the interviewed samples acknowledge the positivity of science but do not understand the source of evidence. Most of the interviewed samples agree that science requires empirical evidence and evidence needs to be provided. This is inseparable from the propaganda in Chinese society and the scientific concepts that people receive in the process of education (Shakor 2019). the interviewed samples lack a good understanding in both observation and reasoning dimensions, and cannot understand that scientific knowledge is not entirely objective due to the subjectivity in the reasoning process. Therefore, they cannot understand that reasoning based on observation will produce different results in the process of scientific development. This is also a reflection and embodiment of the traditional scientific essence view of science popularization venue educators.

More than 80% of the surveyed samples agree that imagination and creativity play a role in scientific development, but do not believe that every aspect of scientific research requires imagination and creativity. Essentially, the surveyed samples lack a deep understanding of imagination. They still believe that science is objective, that science is an objective observation of the natural world, and have not recognized the position and role of imagination and creativity in scientific research.The result indicats that the education on the concept of scientific essence in China is not yet comprehensive and systematic enough.

The scientific essence view of learners in science popularization venues is vague and superficial, lacking a deep understanding of the scientific essence view

In the venue environment, learners participate in scientific activities to stimulate learning motivation and interest, understand scientific knowledge to form concepts and memorize them, and perform logical reasoning on abstract things. However, the knowledge acquired by learners through observation, practice, communication, and other means is often implicit knowledge, which promotes deep thinking among learners on the relationship between science, nature, society, and the social construction of scientific knowledge. Reflection can improve learners' understanding of this knowledge. In venue based science education, reflecting on science as a learning method pays special attention to concepts, learning processes, and learning scenarios. Research has found that people cannot fully understand the essence of science for two main reasons: firstly, they have no way to understand the principles of constructing scientific knowledge; secondly, simply conducting scientific surveys does not automatically lead to an understanding of the nature of science. A large number of respondents agree that scientific development requires creativity, but their understanding of the specific status and role of creativity and imagination is unclear. All of these indicate that the scientific essence view of educators in science popularization venues is superficial, lacking deep understanding and recognition, and lacking the most fundamental understanding of the scientific essence view.

Conclusion

The results of this study indicate that both exhibition based and technology based teaching activities in science popularization venues need to be improved overall. Venue learners exhibit characteristics such as a more traditional, vague, superficial understanding, and a lack of understanding in individual dimensions.

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