

STEAM Theory of Museum Education in Chinese Children Aged 9 to 12 Technology Literacy Cultivation Mechanism

-- Planetarium in Shanghai as an Example

Lan Xu *

College of Fashion and Art Design, Donghua University, Shanghai, 200051, China

* Corresponding author Email: tiffanyxu12366@sina.com

Abstract: STEAM museum education is an important way of the Chinese government fosters the talent, science and technology literacy is to improve the basis of primary and middle school students' creative thinking and independent thinking, but the museum course level is uneven. Lack of course characteristics, misunderstanding the training target and lagging education is one of the reasons lead to this phenomenon. In order to improve the quality of STEAM education in China, this work analyzes the curriculum significance of teaching framework, teaching content and teaching effect of Shanghai Planetarium. Planetarium as a public space with popular science education significance, China has invested a lot of resources in its construction, so it also has outstanding ability to cultivate scientific and technological literacy. The Chinese government has made museums pay attention to their role in promoting STEAM education. Shanghai planetarium STEAM education ability among China and the world top, since its open that has formed across age of STEAM education technology literacy curriculum system.

Keywords: Museum STEAM Education; Shanghai Planetarium; Scientific and Technological Literacy.

1. Introduction

STEAM originated in the United States education, they are abbreviations for Science, Technology, Engineering, Arts, and Mathematics, the purpose is to break the disciplinary boundaries, cultivate students' innovation ability, developing critical thinking and improve students' ability to solve practical problems. Science and technology are strong, the country is strong. Science and technology are the core of the creative development of various industries and have a direct impact on China's economic development.

Deputy director of Shanghai education commission Ni Minjing is put forward: "Scientific and creative thinking should be cultivated from an early age, after high school, it is very difficult to make progress in science and innovation. "So to cultivate students higher-order thinking as early as possible. 9-12 years old is an important stage to cultivate children's thinking mode. Children can obtain basic logic through direct perception. However, children's attention concentration time is short, so it is necessary to set up interesting and operable courses to echo the learning characteristics. As STEAM museum education important constituent, the museum project as mediation, in inspiring and diversified ways to stimulate learning desire. Planetarium as branch in the museum and have the same education goals with museums; Astronomy, as a branch of science, guides the audience to explore technology through astronomical knowledge.

Planetarium passes by means of immersion education science and technology knowledge, based on China's existing education environment, government issued policies such as "the Primary School Science Curriculum Standards for Compulsory Education" [1], museums need to pay more attention to STEAM in the education of scientific and technological literacy cultivation mechanism. By ensuring

that the museum set up consistent goal, closely cooperate on the function, China's macro education system can have high quality STEAM education platform. This study attempts to help China's STEAM education clarify the design idea of science and technology literacy courses and create a STEAM education structure with Chinese characteristics by analyzing the STEAM education technology literacy cultivation strategy for children aged 9 to 12 years old in Shanghai Planetarium.

2. Museum STEAM Education for Children Aged 9 to 12

2.1. Bubbling of Training Courses

Through contextualized educational approach and provides the opportunity for audience with mining the principle behind phenomenon, explore the links between society and nature, but each pavilion lacks STEAM education characteristics, convergence and other related problems. In 2021, the Ministry of Education "about promoting education new infrastructure building a supporting system for the quality education guidance" [2] points out that building a high-quality education development demand-oriented education new infrastructure. This content that STEAM education has entered into the focus of education in China, but the national museum development STEAM education means is mainly copied, the causes of this phenomenon, the most main is not set up for characteristic museum exhibits STEAM education courses. At present Chinese STEAM education training mechanism is still in groping. It is reasonable to learn from existing experience in this period, but if do not combine the experience with its characteristics, it will inevitably lead to the bubble problem of STEAM education.

2.2. The Cultivation Goal is One-sided

The training goal of STEAM course is to use the interdisciplinary curriculum system to improve students' ability to solve practical problems and cultivate comprehensive talents. At present, there is a deviation in the understanding of training objectives in museums. First, a partial understanding of a branch as all STEAM courses; Second, strong utilitarian personnel training, curriculum design for each technical competition; The third is to ignore the learning characteristics caused by age. These reasons cause the curriculum derailment, students won't be able to establish systematic knowledge network.

2.3. Lagging Cultivation Methods

Modern means of education is children establish important channel of communication between various disciplines, however, the current training method slightly backward, digital technology and traditional media did not set up the universal bridge, learning dimension old stereotypes. Existing museum digital technology and audience matching degree is low, no timely follow up of primary and secondary school curriculum reform. At the same time, limited by information means, the development speed of digital exhibits is slow. Thus, education mode should follow the time development to meet in a critical stage of cognitive development 9 to 12 years old children.

3. Planetarium as an Effective Way to Improve the Quality of STEAM Education

3.1. The Necessity of Planetarium as a Way to Improve Scientific Literacy

Playing the educational role of museums and planetariums is the inevitable result of improving the scientific and technological literacy of STEAM education for children aged 9-12 years. Supported by a variety of resources, planetariums not only provide informal learning opportunities, but also inspire a love of astronomy and technology through age-specific workshops.

3.2. The Advantages of Planetariums in Promoting Technological Literacy

3.2.1. Flexibility of Educational Content

The flexibility of the course content comes from the targeted design for the audience. In "From STEM Education to STEAM Education - A dialogue between David Anderson and Ji Jiao on Museum Education"[3], David Anderson believes differentiation of STEAM education should combine the history and the status of the modern science and technology. Planetarium curriculum content should be rich and varied, according to the study of different age characteristic, topics range from the astronomical knowledge to astrophysics, in order to meet the technological literacy of ragged audiences.

3.2.2. Education Supports Lifelong Nature

As a place of public education, planetarium provides learning opportunities from childhood and encourages independent thinking. As the growth of the age, planetarium by updating the exhibits, set up new curriculum and deepen the audience's understanding of the science and technology knowledge, applying with thinking mode and for people of all ages provides long-term support.

3.2.3. Situational Education

"The aesthetic, artistic and STEAM education concept "[4] think should build on-demand supply STEAM education platform, and uses the unitized, contextualized model provide personalized teaching services. Build conducive to teaching and learning experience for easy understanding, make the audience's understanding of the universe and the earth into individual thinking, in the first perspective to understand knowledge of science and technology and the universe.

4. STEAM Education Model Analysis of Shanghai Planetarium for Children Aged 9-12 --Take Light and Shadow Calendar Class as an Example

4.1. Curriculum Significance

The sun directly affects the earth four seasons change, the sundial as important basis of judgment throttle, 9-12 years old children how to through the sundial clear seasonal changes? And what's the standard to judge change? The western zhou dynasty prime minister zhou gong designed the sundial to determine time, The Shanghai Planetarium's Light and shadow calendar course for children aged 9-12 reveals the change of solar terms while it shows the wisdom of the ancients. Through this course lectures, practical operation and interaction, helping audience to build a more complete, closer connection with reality of astronomy knowledge framework.

4.2. Teaching Content

Shanghai Planetarium's STEAM education for children between the ages of 9 and 12 strives to make the audience actively participate in the course. As a result, the audience before the main part of the course helps to understand for a knowledge reserves, such as solar terms, to choose teaching way. By creating situational teaching environment; interacting with the sun in the form of digital virtual. Striking visual effects and color matching 9-12 years old children's learning characteristics, to help the audience to focus on course. Including understanding the sun trajectory, the influence of the sun on the earth's climate, the sundial works, through modern means to cause the audience think of light years operation principle of science, technology and other aspects. This is Shanghai planetarium characteristic content.

According to the principle of the solar operation and the structure of the sundial, guiding audience made personally to think independently instead of "teacher do, students follow suit" in the traditional model. It includes the design, discussion, communication, construction, display and other links. Through students' production and teachers' supplement, audiences' understanding of relevant issues is deepened.

4.3. Teaching Effect

Since STEAM courses develop integrated thinking skills, so just observe student feedback. In the end, the teacher will summarize the action of the sundial related knowledge, inviting students to ask questions, to assist understanding effect. In digital technology as the foothold, independent thinking for the teaching method, using the characteristic resources, link science and technology knowledge and the real world. The "learning by doing" changes the traditional mode, pay more attention to individual thinking, inspire for science and technology knowledge, the curiosity of the real

world, improve the innovation consciousness, and STEAM course level.

5. The Museum Contributes to the Future Vision of STEAM Education for 9–12-year-olds

5.1. Resource Sharing of Featured Courses

Characteristics of curriculum resources sharing make the audiences fairer, overlapping knowledge of science and technology. From the perspective of museum, characteristic course resources sharing power pavilions understand quality curriculum system, effective improve the teaching quality. From the perspective of audience, resource sharing provided diversified STEAM courses, which helped the integration of subject knowledge and audience experience. From elementary school to see, the museum's courses can't do quality and quantity is big, and share the featured course, improving the quality of teaching inevitably.

5.2. Setting Courses According to Local Conditions

Development characteristic course can depth analysis the characteristics of museum and communicate knowledge of science and technology to different audiences. In the early stage of the construction of characteristic courses, when learning other museum courses should also constantly think about the characteristics of the itself, excavate own advantages, understand the audience and integrate our exhibits with the audience.

5.3. Multi-party Education Platform

The museum STEAM course should have dual system support. First, at the macro level, according to the policy dividend, build a resource supply platform on demand to provide protection for museums, schools and audiences. The second is bottom-up, which requires museums, schools and other social sectors to participate in STEAM education construction to cope with the poor education effect caused by the dispersion of resources.

5.4. Educational Methods Keep Pace with The Times

Museum of the application of modern education means has not formed the scale, some countries have used such as 3D printing as education approach, explore education means

update iteration, provides the high-quality STEAM courses. Shanghai planetarium notice the importance of teaching approach to keep pace with times, using LED structure imaging, optical star, multi-sensory teaching experience to build situational teaching environment, providing support to improve the level of STEAM course.

6. Peroration

CAI Yuanpei's educational concept of "China should aim at cultivating students' all-round development" is the germ of STEAM education in China. The 9–12-year-old mindset sets the stage for the rest of your life. As a modern model to improve children's critical thinking ability, innovation ability and comprehensive use of knowledge, STEAM education should increase training efforts according to the learning characteristics of young children, emphasize fun and universality, and link scientific and technological knowledge with the real world. Museums and other informal education places should be emphasized to provide new ideas for improving the quality of STEAM courses. Shanghai planetarium situational learning environment and the characteristic of teaching framework, create a teaching blueprint for a STEAM course on technological literacy for 9–12-year-old, promote transformation STEAM education teaching thought. It is also easier to innovate critical thinking and integrate knowledge from various disciplines. Museum in powering STEAM education development, cultivating all-round development of innovative talents for China to provide strong support.

References

- [1] Ministry of Education of China. (2022). Compulsory education primary school science curriculum standards. [https:// www.gov. cn/ zhengce/zhengceku/2022-04/21/ content_ 5686535. Htm](https://www.gov.cn/zhengce/zhengceku/2022-04/21/content_5686535.htm).
- [2] Ministry of Education of China.(2021).Guidance on Promoting the Construction of New Education Infrastructure and Building a High-quality Education Support.
- [3] David Anderson & Ji Jiao.(2017). From STEM Education to STEAM Education: A Conversation between David Anderson and Ji Jiao on Museum Education. *Journal of East China Normal University (Educational Science Edition)*(04),122-129+139. doi:10.16382/j.cnki.1000-5560.2017.04.013.
- [4] Qi Wu. (2022). Aesthetic Education, Art and STEAM Education Concept. *Educational Science Research* (02),1.