The Application of Information Technology in Primary Science Education under the Background of Digitalization

Haiyan Kuang[1, *], Yingxin Liu[2, a]

*Corresponding author. Email: 2399472116@qq.com,[a]Email: yingxin888@126.com

[1] Graduate School of Shenyang University, Shenyang, Liaoning Province, China,
[2] Graduate School of Shenyang University, Shenyang, Liaoning Province, China

Abstract. Primary science course bears heavy responsibility of science enlightenment, and foundational primary science education experiences play a significant role in defining students' long-term science trajectories. And the deep integration of information technology and science education is highlighted in the digital era. This study shows a review of primary science education and its integration with information technology, presents some core technology that are effectively improve science teaching, summarizes the issues it faces and discusses the path to promote the integration process.

Keywords: primary science education, information technology, science literacy, digitalization

1 INTRODUCTION

Scientific quality is an important part of national quality, and is the basis of social civilization progress. Primary science education undertakes the task of scientific enlightenment and plays an important part in cultivating students' scientific literacy, aiming to make students establish scientific thinking, admire the scientific spirit, master the basic scientific method, understand the necessary scientific and technological knowledge, and have the ability to apply it to analyze and judge things and solve practical problems. In 2021, the State Council released the Outline of the National Science Quality Action Plan (2021 -2035), pointing out that we should promote the deep integration of information technology and science education, and implement scenario-based, experiential and immersion learning. The scientific and effective application of information technology can not only help students to better acquire the necessary science knowledge, but also better play the main initiative of students, cultivate their spirit of exploration, and improve their scientific literacy[1].

2 CHANGES IN PRIMARY SCIENCE EDUCATION UNDER THE CONTEXT OF DIGITALIZATION

In 2016, General Secretary Xi Jinping pointed out at the "Science and Technology Conference" that "scientific and technological innovation and science popularization are the two wings of achieving innovative development, and science popularization should be put on the

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same significant position as scientific and technological innovation", raising the status of science popularization to an unprecedented historical height, which has become the fundamental guideline for the high-quality development of science popularization and science quality construction in the new development stage. The outline is clear, during the "14th Five-Year" period, China will focus on improving the level of science education at the basic education level.

2.1 Current situation

Science education mainly disseminates scientific knowledge, teaches scientific method, cultivates scientific thinking and understands scientific spirit; science popularization education popularizes scientific and technological knowledge, advocates scientific method, disseminates scientific thinking and promotes scientific spirit, both of which have inherent similarity and aim at improving scientific quality [2].

According to the recent U.S. National Survey of Science and Mathematics Education (NSSME), elementary teachers are emphasizing science concepts through explanation, class discussions, group work and hands on activities. As a result, opportunities for students to develop science literacy by engaging in scientific tasks themselves remain somewhat limited, and resources are not full exploited. Efforts to implement effective, feasible and scalable primary science education practices are greatly hindered by too many competing curricular requirements, resourcing limitations and context specific challenges. Under the background of digitalization, the way of primary science teaching needs to be more advanced.

2.2 Related technology

Augmented Reality

Supported by virtual simulation technology, Augmented Reality technology has its natural advantages in virtual restoration of exhibit shapes and colors, virtual display and dissemination, and virtual product development, which can fully be exploited in the science classes helping students get a closer look at some limited sources. As an emerging technology, augmented reality technology has been successfully developed in the fields of games and science and technology education. For example, science and technology museums have developed augmented reality programs to make the display of exhibits more interesting through image recognition. Augmented Reality-based immersive learning environments can provide highly immersive, flexible and interactive virtual environments in science classes, and have previously been applied in science and technology museum exhibitions to improve visitor experience and further enhance knowledge acquisition.

Virtual Reality.

VR is the ultimate application form of multimedia technology, as well as the crystallization of the rapid development of computer hardware and software technology, sensing technology, robotics, artificial intelligence and behavioral psychology and other scientific field. Virtual technology can reinforce the real world, simulate and virtualize the content dynamically and multi-dimensionally that cannot be experienced visually in the science textbooks, so that students can intuitively feel and construct knowledge [3].The application of virtual reality technology in science education can break through the limitations of time and space, blur the age limit of the audience, make possible the content that cannot be realized or displayed in reality,

make up for the lack of objective conditions, and create a good virtual learning space.

3D Printing Technology

3D Printing is a rapid prototyping technology that builds objects layer by layer in three-dimensional space by using malleable bonding materials and model files as a blueprint. 3D printing can materialize students' ideas and provide a new perspective to traditional teaching methods, which can realize each student's personalized ideas and enhance students' interest and engagement. Applying 3D printing technology to science education can improve students' hands-on ability as well as innovative and creative thinking.

3 THE APPLICATION OF INFORMATION TECHNOLOGY IN PRIMARY SCIENCE EDUCATION

3.1 Analysis of related bibliographic

This review focused on the integration of information technology and science education. As Figure 1 shows, the greatest number of papers were published between 2007 and 2022, and it is on the rise.

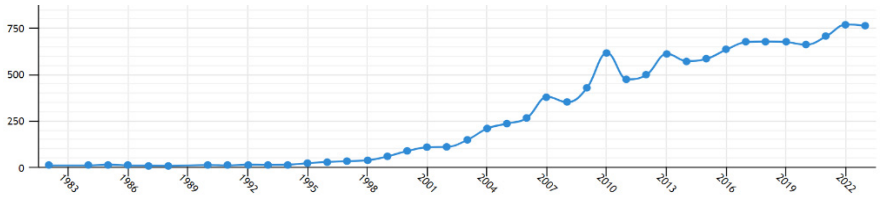

Fig. 1. Publications Per Year

3.2 Systemic challenges to the integration of primary science education and information technology

According to current domestic research outputs in China, teachers' fast-paced, small-paced, inadequate exploration and eager testing of results are still common in science classrooms, and important processes reflecting "real scientific life" such as scientific reasoning, scientific modeling, and scientific argumentation are also rare [4], which is not conducive to the cultivation of students' scientific literacy. In the environment of digital transformation of education, we need to make full use of the advantages of modern technology to accelerate the construction of new ways of science education, improve national scientific literacy, and strive to take the lead in the world's science education in some directions.

In the process of application, some teachers are prone to the problem of "technology-only" when using information technology for science teaching. The integration of information technology and science curriculum refers to the integration of scientific knowledge in life, the role of information technology to extend the teaching space of science curriculum, through the complementary network information, to better broaden the scientific knowledge of primary school students, rather than simply through the way of information technology to elementary school science teaching.

In primary science classrooms that incorporate information technology, some teachers integrate information technology as a teaching aid into the classroom, but do not integrate classroom content with technology in depth, resulting in the generalization of technology and the blurring of teaching styles, which ultimately alienates students' growth of humanistic feelings. In the end, it alienates students' needs for humanistic growth[5]. Some "highbrow" activities do not necessarily lead to real learning and do not necessarily improve students' scientific literacy significantly. In the context of technological empowerment in the digital age, the purpose of primary science teaching is no longer directed at cultivating "knowledgeable" people with scientific literacy, but focuses on cultivating intelligent, critical, and creative comprehensive talents [6].

4 APPROACHES TO THE PROMOTION OF SCIENCE LITERACY IN PRIMARY SCHOOL

Science literacy is regarded as an important indicator of the achievements of science education, and the dimensions of science literacy and its composition also guide the methods and approaches of science education; while science popularization education mainly aims at popularizing scientific and technological knowledge, advocating scientific methods, spreading scientific ideas and promoting scientific spirit, and aims at improving the quality of science.

First of all, the integration of quality resources inside and outside the school should be strengthened. At present, China vigorously advocates the school-library cooperation mechanism within and outside schools. The organization and implementation of youth science education should promote the mechanism of collaborative education, break the barriers between primary and secondary schools, institutions of higher education, research institutes, and science and technology enterprises, and form an efficient linkage and cooperation mechanism to achieve synergistic development in educational resources, information channels, and cultivation modes[7]. The primary science course covers a wide range of areas, so it cannot be limited to the resources in textbooks and classrooms, but should make full use of the science and technology museums, scientific research institutions, colleges and universities, science and technology enterprises and other off-campus activity sites and their facility resources, and form mechanisms for off-campus visits, investigation and practice, and project research to enrich the organization of science teaching[[8]].

Secondly, students can be encouraged to participate in the scientific research process. The use of social media and technology-enhanced data access, participation in real scientific research, and exposure to scientific communities can strongly enhance the interaction between science, educational outreach, and scientific research [[9]]. By giving students a practical understanding of "how scientists do science," they can understand the practice of science, deepen their understanding of scientific culture, and develop their scientific dispositions and habits of mind[[10]].

Thirdly, the advantages of information technology should be fully utilized to transform obscure and difficult scientific knowledge into lively and interesting science resources, to strengthen the comprehensive design of science curriculum resources, and to present traditional school-based resources in a three-dimensional and diversified manner [[11]]. Information technology visualizes scientific knowledge by concretizing abstract scientific concepts, creat-

ing contextual teaching, and creating a highly interactive learning environment to motivate students and improve learning outcomes.

5 CONCLUSION

This review has outlined and described the changes of primary science education under the background of digitalization. Furthermore, related papers about the integration of information technology and science education are analyzed through Word Cloud network. While there remain some areas for further development in the process of integration, the larger issues of scientific nature and feasibility will need to continue to be addressed. The integration of information technology such as AR, VR and 3D technology with primary science education can provide technical guarantees, enriches the form of science education, and offers various kinds of resources for science education. In sum, to better promote the application of information technology to primary science education, advanced technologies and science resources should be more available to education field, and endeavors should be exerted inside and outside schools.

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