The Influence of STEAM Education on the Improvement of Students’ Creative Thinking*

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Abstract—Interdisciplinary education is the cornerstone of cutting-edge science and the source of hi-tech. STEAM education is an effective means of interdisciplinary education, and innovation is a necessary complement to interdisciplinary education. STEAM education stems from STEM education and is better than STEM education, emphasizing on interdisciplinary methods and cultivating students’ innovative abilities. The interdisciplinary education has a good effect on improving students’ innovative ability. This paper first introduces the basic concepts of STEAM education, and then analyzes the impact of STEAM education on students’ innovation ability. Finally, it discusses the implementation of STEAM education in teaching from several aspects: cultivating students' innovative ability from an interdisciplinary perspective, carrying out practical projects to improve students’ innovative ability, and cultivating students’ innovative ability to solve practical problems.

Keywords—STEAM education; innovation; interdisciplinary education

I. INTRODUCTION

The rapid changes of modern society, the current era of global network information and knowledge economy, and the diversified development of society, make people need to learn more diverse and more flexible knowledge to adapt to this fast-developing society. Having the ability to innovate becomes a prerequisite for coping with the future diversified environment. Students with high level of innovation ability can more effectively solve the difficulties encountered in their study, life and future work, and adapt to the changes in the era of global network information technology. Therefore, how to effectively cultivate students’ innovative ability has become a major teaching reform project in various schools.

The essence of innovation is creativity. Creativity refers to the use of the learned knowledge to produce a unique, novel and valuable product thinking [1]. In the future social development, students should have the ability and quality to innovate. The innovation ability is constantly developing in students’ learning and growing processes, and the congenital and acquired factors will affect the development of students’ innovative ability. Innovative ability is achievable. As places for students to learn knowledge, schools need to cultivate and protect students’ innovative ability through education and teaching practice [2].

II. THE BASIC CONCEPTS OF STEAM EDUCATION

STEAM is derived from STEM education. STEM education refers to the related education that integrates technology, science, engineering, and mathematics [3]. Technology refers to the effective tools or methods to solve problems; engineering refers to the knowledge of using scientific principles to create artificial objects; mathematics refers to the science that studies the relationships between numbers; they complement each other, support each other, and are often crossed and integrated in the processes of solving problems. STEM education focuses on science and engineering education. Later, people realized that the complete STEM education also needs the addition of the education of arts, so the STEM education evolved into the STEAM education and became the current educational trend [4].

The STEM education concept was first proposed by the American science education organization in 1986. This educational concept was supported and recognized by the government and relevant educational organizations, and relatively complete education systems were developed by professionals, which are also applied to the current STEAM education. STEAM Education is the innovative fusion of diversified disciplines and incorporates a variety of subject knowledge. This educational concept breaks the boundaries between disciplines in traditional education, allowing students to learn to integrate engineering, mathematics, science and other subject knowledge, take part in practice activities involving different disciplines and solve the problems encountered in study and life [5].

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A. Emphasizing Interdisciplinary Learning

STEAM education emphasizes the integration of diverse disciplines, emphasizes the breaking of the boundaries between disciplines in teaching, emphasizes the interdisciplinary learning, has broken the boundaries between disciplines in traditional education, and integrates the subjects of engineering, mathematics, arts, science, etc. STEAM education allows students to link together specialized and fragmented knowledge, creates a relatively unified discipline, and allows students to view problems and solve problems in a complete mindset. STEAM education avoids the separation of knowledge of different disciplines. Interdisciplinary learning helps to develop students' creative ability [6] and learning ability.

B. Emphasizing Practical Problems

The cultivation of innovation ability should not stay at the abstraction and theory level, but should be integrated into the solution of practical problems, pay attention to the solution of practical problems, and attach importance to the real processes. The original intention of education is to let students learn the methods and skills to solve problems, and learning is the process of learning to solve problems. However, traditional education only pays attention to the teaching of textbook theories, ignores the core skills of learning, and does not pay attention to the cultivation of students' innovative ability, making students' ability to solve problems generally poor. And there are differences between the content of education and the real society, making it difficult for students to cope with the difficulties encountered in society [7]. STEAM education breaks the traditional education mode, integrates various disciplines, improves students' ability to solve practical problems, and provides a new education and teaching model. In the STEAM education model, the problems encountered by students in the learning process are often the difficulties they will encounter in real life or in their future work, which are real, complex, diverse and similar. For unknown and vague practical problems, students can't find useful solutions from real, complex, diverse and similar. For unknown and vague practical problems, students can't find useful solutions from real, complex, diverse and similar. STEAM education integrates arts with mathematics, engineering, science, technology and other disciplines. It not only develops and improves students' operational ability, model making ability, spatial imagination, etc., making students have the innovative ability that they cannot have when studying in the traditional education mode [12]. Through the STEAM education, students not only have the basic engineering science knowledge to solve practical problems, but also have a more diversified and innovative problem-solving ability.

STEAM Education focuses on developing students' innovative abilities, helps students develop comprehensive and systematic innovative abilities and characters, and improves their comprehensive ability.

The core of innovation ability is creativity. The ability to create can be acquired and promoted through continuous learning and practice. Especially for students who are in their youth, the cultivation for creativity is the most critical. STEAM education can cultivate their diverse learning interests and abilities, and make them master the STEAM education knowledge system; and carry out learning projects based on practical problems, which can improve their innovative ability to solve practical problems. Students can verify whether their innovative ideas are effective through practical exercises which can help students to find problems and recognize their own shortcomings in the process of solving problems. STEAM Education advocates cross-integration learning of multiple disciplines, cultivates students to use divergent thinking to solve practical problems, fosters their innovative ability and helps them succeed in future social work [13].

STEAM Education develops students' innovative abilities in problem-based, project-based approaches that reproduce real-life scenarios. Project-based learning and problem-based learning are beneficial to students in developing their own learning goals and adapting their learning methods [14]. Compared with the traditional education model, the project-based and problem-based learning methods help to improve students' interest in learning and enable students to participate in the STEAM education. Students solve related problems by integrating the multidisciplinary knowledge they have learned. This helps them identify key issues, motivates their innovative thinking to solve problems, transforms them from passive learning to active learning, improves their ability to solve problems, and improves their team organization ability, making them have the ability to quickly adapt to the fast-changing information society.
IV. THE SPECIFIC IMPLEMENTATION OF STEAM EDUCATION IN TEACHING

The implementation of STEAM education in practical teaching should reflect the above basic concepts and characteristics: from the interdisciplinary perspective; carrying out problem-based, project-based practical activities; requiring students to learn to solve practical problems; cultivating students' innovative ability; and guiding students to use divergent thinking and innovative ideas to solve practical problems.

A. Cultivating Students' Innovative Ability From the Interdisciplinary Perspective

STEAM Education emphasizes the cross-integration of mathematics, engineering, science, arts and other disciplines. Therefore, schools can develop STEAM education through the use of modern information network technology, setting up interdisciplinary courses, and the preparation of teaching materials to promote the development of students' innovative ability. First of all, the use of modern information network technology enables teachers to pass the teaching content to students through a diversified teaching mode, so that students can more deeply understand the teaching content and learn better in the STEAM education mode. Students can also collect, organize, and analyze more knowledge through online means to find ways to effectively solve problems [15]. Secondly, the school should provide a variety of courses to meet the needs of different students, and strictly control the professional qualities of the courses, and then give students the right to choose the projects freely, guide students to use project-based, problem-based methods to learn effectively. Carrying out interdisciplinary education through the above-mentioned ways, integrating the multiple disciplines, and making students use a variety of innovative thinking to find suitable materials and tools to solve the corresponding problems will certainly help the cultivation of innovative talents.

B. Carrying out Practical Projects to Cultivate Students' Innovative Ability

STEAM Education focuses on getting students to practice. Creativity is similar to the muscles of the human body, keeping exercise can make the muscles more flexible. Learning is also the same. Allowing students to continuously verify the knowledge they have learned in practical projects and insisting on carrying out project practice for students can continuously develop students' technological creativity and ability to solve problems. The practice of projects should not only be the basic verification of the knowledge acquired, but also motivate students to solve problems in different creative ways. To achieve the above teaching goals, schools and teachers need to focus on cultivating students' interest in learning when implementing the STEAM education. Individuals who want to have high level of creativity often need to have the persistent learning attitude. Unless the student himself has a strong motivation to learn, it is necessary to encourage students to start from their favorite subjects, and then gradually learn the knowledge of other subjects. And students can develop their creativity through the communication with other students or by studying on the Internet.

C. From the Perspective of Real Situations, Cultivating Students' Ability to Solve Problems

STEAM Education emphasizes that students should solve problems in real situations and attaches importance to project-based, problem-based learning with projects as the core. The authenticity of the projects lies in the comprehensiveness and authenticity of the problems. The problems students will encounter in their future life and work are often complex and diverse, and they are more difficult than problems encountered by students in the classes. Therefore, it is required that the problems involve the knowledge of multiple disciplines, so that students need to use interdisciplinary knowledge to solve problems, which helps students to use the knowledge they have learned to solve practical problems. Take the "Pulley labor saving device" project as an example. This is the knowledge that junior high school students have learned in class. STEAM education requires students to design and produce labor-saving devices after understanding the scientific theories and knowledge, and finally participate in group competitions. The teacher first explains the scientific principles, and then explains the safe use of common tools to students, such as 3D printers, CNC milling machines, laser cutting machines and other digital devices. After that, students freely team up to design, produce and debug the devices. In this project, students are introduced to the principles and uses of the labor-saving device, which reflects the "science" subject knowledge in STEAM education; learning to use digital equipment reflects the "technology" subject knowledge; the parts used in the students’ designs of the devices reflect the knowledge of "engineering" discipline; and the assembly of parts reflects the knowledge of "arts" discipline. Finally, the adjustment of the pulley labor-saving device (such as selecting suitable fixed pulleys and moving pulleys, pulley direction, rope length, etc.) embodies the knowledge of "mathematics" discipline. In this real-life-based project, students have experienced a multidisciplinary, problem-based STEAM education that helps improve their ability to innovate.

It should be noted that the school needs a good education platform for project-based and problem-based learning. The school should establish an open STEAM education platform and combine online network learning with offline lab hands-on practice. Students can freely and openly conduct STEAM learning and access resources through the network; there are various digital devices (such as CNC milling machines, 3D printers, laser cutting machines, etc.), open source hardware, etc. in the laboratories. Students can conduct project-based learning in the laboratories under the guidance of the instructors. It is the goal of STEAM education to make students integrate the learned subject knowledge, solve practical problems under real situations, stimulate students' interest in learning, and improve their creative ability and teamwork ability, which also provides a guarantee for the cultivation of innovative talents.
V. CONCLUSION

STEAM education has gradually become the development trend of China's recent education, but its current status of immature development in China will face certain difficulties in the implementation of education in the future and slow down the pace of development. The implementation of STEAM education is not aimed at the specific and detailed reform of a certain subject, but it should be used as an entry point to promote the comprehensive development of education in China, promote curriculum reform, make up for the shortage of curriculum teachers, outdated teaching materials and single teaching mode and explore the talent training model to realize the all-round development of students under the concept of quality education, and enables students to possess 21st century skills. It is believed that under the joint promotion of the government and education departments and educational institutions, both STEAM education and “research-based learning” courses will cultivate more complex innovative talents.

REFERENCES


