

# STEAM-Based Education Program for Students of Geography in University of Jinan

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**Abstract.** Interdisciplinary synthesis is the basis of STEAM education. Geography as a comprehensive subject plays an important role in STEAM education. Geography is a very interdisciplinary and comprehensive subject, which involves natural science, social science and technical science. The cultivation of students in geography involves all aspects of STEAM education. Geography in University of Jinan has a perfect curriculum system and practical system, which based on STEAM education, and has a teacher's team with multi-disciplinary background, which can be used to explore a talented training model based on STEAM-education in colleges and universities.

## 1. Introduction

STEAM is an educational approach to learning that uses Science, Technology, Engineering, the Arts and Mathematics as access points for guiding student inquiry, dialogue, and critical thinking<sup>[1]</sup>. The end results are students who take thoughtful risks, engage in experiential learning, persist in problem solving, embrace collaboration, and work through the creative process. STEAM education originated in the United States in the 1990s. The initial form is that STEM, later added art to the original STEM education, which means that the contents of arts, humanities and social sciences are integrated into STEM, which provides creative sources for the practice of science and engineering.

STEAM education teaches science, technology, engineering, art and mathematics in an interdisciplinary way to guide students to adapt to updated professional knowledge and rapidly changing social life. STEAM education supports the students to realize the world in a comprehensive way, to transform the world in an integrated and innovative way, and to develop their innovative ability to solve problems. The United States promulgated the STEAM Education Law and fully implemented the STEAM education development strategy from kindergarten to undergraduate level, in 2015, which attracted the attention of all countries in the world<sup>[2]</sup>. Germany, Japan, Australia, South Korea and so on also regard it as an important strategy for talent training. Ministry of Education of the People's Republic of China issued the "Thirteenth Five-Year Plan" for education information, stating that it is necessary to actively explore the application of new education models such as interdisciplinary learning (STEAM education) to enhance students' innovative ability, in 2016<sup>[3]</sup>.

## 2. STEAM's Idea and its Core Features

STEAM education is a new educational curriculum and educational concept. Interdisciplinary, situational experience, cooperation, practice and innovation are the core features of STEAM.

### 2.1 Interdisciplinary integration

The interdisciplinary integration of STEAM concept pays more attention to subject integration and general education, emphasizing the problem as the forerunner. science, technology, engineering, art, mathematics and other knowledge related to the problem to solve practical problems, so as to realize the comprehensive improvement of students' ability. Science, technology, engineering, mathematics and art play their respective roles in people's analysis and transformation of the world. Science

supports people to know the law of the world; engineering and technical support people transform to the world according to the needs of society; art helps people to enrich the world with a good form; and mathematics is the development and application science and engineering for people; and art provides a thinking method and an analysis tool for the technology. STEAM education is not to focus on some aspects of the knowledge, but to guide the students to adopt the way of learning the subject, and to use the interdisciplinary thinking to solve the real problems in life.

## **2.2 Situational experience**

STEAM education adheres to the educational concept of practical learning and emphasizes students' active participation in the process of learning experience<sup>[4]</sup>. It requires teachers to create situations and combine subject knowledge with reality. Students gain experience in situations, and constantly discover problems, analyze problems, and solve problems in the process of experiencing situations. Situational experience can bring great interest to the students' study and train the students' various abilities while learning happily

## **2.3 Cooperation**

Teamwork is an important aspect of STEAM education to the cultivation of students. It often needs the strength of the team to put forward and solve the problems. The cultivation of cooperative spirit is indispensable<sup>[5]</sup>.

## **2.4 Practical and innovative**

The combination of theory and practice to solve practical problems is an important way to cultivate students' innovative ability. Finding problems from life, and using the knowledge learned to design projects and solve problems requires students' innovative thinking. The cultivation of innovative ability is an important goal of STEAM.

# **3. The Significance of STEAM Education in the Cultivation of the University in China**

## **3.1 STEAM education concept can improve the effect of college talent cultivation.**

The development of educational and teaching activity projects based on the STEAM education helps to promote teachers' understanding and application of the STEAM educational concept and thus enhance the effectiveness of curriculum activities<sup>[6]</sup>. The concept of STEAM emphasizes the teaching integration of science, technology, engineering, mathematics, humanities and art, and it pays attention to the solution of real problems, project activities and design activities to highlight the application of scientific and engineering knowledge. The inquiry process of solving project design problems is the same as that of scientists exploring the real world. Since there are often real and real problems in the STEAM education activities, so the learning goal is clear, and the interest of the students will be more intense. The practical problems are often more complex and require the comprehensive application of interdisciplinary knowledge, so the team learning of the group will also be strengthened. The comprehensive application of interdisciplinary knowledge is helpful for students to deeply understand and apply the knowledge of different subjects, and it is beneficial to the cultivation of innovative talents.

## **3.2 The application of STEAM education concept can help to change the teacher's concept and improve the professional level of the teacher**

Teachers are the foundation for the cultivation of innovative talents, and the establishment of teachers' STEAM education concept is an important factor in determining innovative talents. The learning and participation of STEAM education is helpful to improve teachers' deep understanding and application of science and technology knowledge. Improving teachers' own vision and professional skills in participating in activities will also help teachers adapt to the development of modern education. In STEAM educational activities, teachers have changed from teaching authority to mentors, coaches, participants and so on, and participate in multi-disciplinary integration with students. STEAM educational concept of learning activities can effectively improve the professional skills of teachers.

The educational activities with the concept of STEAM education, teachers' own hands-on ability training is one aspect; on the other hand, the development ability of teachers' teaching activities improving in cross-disciplinary environment has become the most critical step in science education activities

### **3.3 STEAM education is beneficial to the combination of enterprises, schools and scientific research institutes**

The smooth development of STEAM education requires the participation of teachers and members of the community from different professional backgrounds; STEAM-based education is not the work of the teacher or school, but the construction of a social education ecological environment. From "school teaching community" to "social teaching community" should be a development trend. It is the combination mode of enterprise, university and scientific research institute in Chinese education. The government has planned the educational community of university, enterprises and scientific research institutes in education in China.

## **4. The important role of Geography in STEAM Education**

Geography is a very interdisciplinary and comprehensive subject, which involves natural science, social science and technical science. Geography originates from human production and life, serves human production, life, and production activities, are practical activities. The cultivation of students in geography involves all aspects of STEAM education. Geography is faced with a number of aspects related to the human living environment. Many problems need to be solved with a scientific attitude and method. In the process of resolution, advanced science and technology are indispensable, precise mathematical methods and even engineering projects are indispensable. In cooperation, many projects are designed and completed to create a beautiful environment for human life, and it cannot be separated from the creation of environmental art.

Apply geography to life is the ultimate goal of geography learning, geography-related issues in the environment are technical and engineering education. On the basis of comprehensive understanding of the characteristics of geographical environment, students can further deepen environmental cognition and solve production and life problems through the use of tools and equipment, the combination of skills and methods, the design and operation of projects, and so on. The process of problem solving is also the process of improving students' geographical design ability and action ability. The core literacy of geography should cultivate students' view of human-land coordination, which belongs to the cultivation of emotions and values. It cannot be separated from the humanistic education method. The art education added later is a representative humanistic education. In specific teaching, by incorporating artistic elements and penetrating humanistic feelings, we can help students understand the relationship between human and land, and understand the importance of coordinated development of human and land.

## **5. STEAM-Based Education Programs for Students of Geography in University of Jinan**

University of Jinan is a famous comprehensive university, which located in Northern of China. There are 10 disciplines in University of Jinan, economics, law, pedagogy, literature, history, science, engineering, medicine, management and art are included. So, it has a good environment conducive to the implementation of STEAM education. As a very practical comprehensive subject, the integration of STEAM concept in the teaching process of geography science specialty is beneficial to the cultivation of professional talents<sup>[7]</sup>.

### **5.1 Establishment of STEAM-Based Curriculum of Geography**

There are more than 100 courses of geography in University of Jinan, Students must complete 165 credits as required in order to obtain an undergraduate diploma (Table.1). 43.5 credits for compulsory courses of general education account for 20.3% of the total credits, which is 13.8% of the science, technology and the humanities in this category of the course. 66.5 credits for basic course account for 40.3% of the total credits, which is 45.2% of the science and mathematics in this category of the course. 25 credits for specialized course account for 15.2% of the total credits, which are 52%, 44%,

24% and 16% of the technology, engineering, arts and mathematics, respectively, in this category of course; Students can choose the course which he interested of specialized course and get 25 credits. 30 credits for practice and project course account for 18.2% of the total credits, which are 6.7%, 6.7%, 11.7%, 16.7 and 5% of the sciences, technology, engineering, arts and mathematics, respectively, in practices course; and project course is all related to STEAM.

Table.1 STEAM-Based Curriculum of Geography

Course of Category	Course Credits (Total 165)	Percentage	STEAM Percentage of Course Credits (Category)									
			Science		Technology		Engineering		Arts		Mathematics	
			Credits	Percent-age	Credits	Percent-age	Credits	Percent-age	Credits	Percent-age	Credits	Percent-age
Compulsory Course of General Education	43.5	20.3%	>2	>4.6%	2	>4.6%	/	/	>2	>4.6%	/	/
Basic Course	66.5	40.3%	13	19.6%	/	/	/	/	/	/	17	25.6%
Specialized Course	25	15.2%			13	52%	11	44%	6	24%	4	16%
Practice and Project Course	30	18.2%	2	6.7%	2	6.7%	3.5	11.7%	5	16.7%	1.5	5%
17(%)												

## 5.2 Practice-oriented curriculum design and platform construction

Geography curriculum includes three modules: general education courses, professional courses (including curricular practice) and concentrated practice courses. Practical curriculum designed in every category of course in Table.1, which embodies the concept of STEAM education. The setting of practical courses or projects at each level is aimed at gradually cultivating students' practical innovation ability. The basic practice platform of disciplines is the basis for cultivating students' professional skills. A professional training and experimental center and 18 practices teaching bases have established which can provide a large number of practical opportunities for the comprehensive practice of the students every year. It has achieved good results and demonstrated the advantages of geosciences students.

## 5.3 Construction of STEAM-based teacher's team

The multi-professional collaboration is the foundation of the STEAM-based talent cultivation, so a teaching team with a multi-professional background is a necessary condition to cultivate the STEAM talents. The comprehensive characteristics of geography provide good conditions for the cultivation of STEAM talents. The Geography teachers in University of Jinan have many years of scientific research experience and strong professional practice ability. STEAM-based education is not the work of a teacher or school, but the construction of a social education ecological environment. Enterprise and scientific research institute are the members of STEAM-based teacher's team. 18 practices teaching bases have established which can provide a large number of practical opportunities for the comprehensive practice of the students.

## 6. Summary

STEAM education teaches science, technology, engineering, art and mathematics in an interdisciplinary way to guide students to adapt to updated professional knowledge and rapidly changing social life. STEAM education is a new educational curriculum and educational concept. Interdisciplinary, situational experience, cooperation, practice and innovation are the core features of STEAM. The comprehensive application of interdisciplinary knowledge is helpful for students to deeply understand and apply the knowledge of different subjects, and it is beneficial to the cultivation of innovative talents.

Geography is a very interdisciplinary and comprehensive subject, which involves natural science, social science and technical science. The cultivation of students in geography involves all aspects of STEAM education. Geography in University of Jinan has a perfect curriculum system and a practical system based on STEAM education, and it has a teacher's team with multi-disciplinary

background, which can be used to explore a talented training model based on STEAM educational concept in colleges and universities.

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