

# Teaching Design of Comprehensive Practical Curriculum in Primary Schools based on STEM Education

## --A Case of "Kingdom of Trees"

Min Zhang

Information Institute, Yunnan Normal University, Kunming 650000, China.

### Abstract

**Comprehensive practical courses in primary and secondary schools in China play a significant role in developing students' comprehensive qualities. STEM education promotes the integration of knowledge and the concepts of interdisciplinary, fun, experience, contextualization and collaboration. It not only promotes the development of comprehensive practical courses, but also promotes the cultivation of students' practical and creative abilities. On the basis of discussing the connotation and concept of STEM education and the feasibility analysis of combining it with the integrated practical curriculum of elementary school, this paper designs a teaching case of the integrated practical curriculum of elementary school based on STEM education.**

### Keywords

**STEM Education, Comprehensive Practical Curriculum, Interdisciplinary, Instructional Design.**

## 1. Introduction

STEM education originated in the United States [1]. The report Science, Mathematics and Engineering Education for Undergraduates, which is generally regarded as the origin of STEM education [2], first put forward the term "science, mathematics, engineering and technology education". Since STEM education plays a significant role in the cultivation of talents in international competition, countries have followed the example of the United States to advocate STEM education in order to cultivate scientific and technological innovative talents. STEM education started to enter our education field in 2001. STEM education has been slow to develop since then. After the release of STEM education development strategy in 2008, domestic scholars have been conducting research on the connotation, practical application and significance of STEM education. STEM education was first included in a Ministry of Education document in 2015. Driven by the relevant programmatic documents, STEM education has become a research hot spot for educators in China [3]. In order to promote students' hands-on and develop students' thinking this paper introduces STEM education into the comprehensive practical activity curriculum in primary schools and designs teaching cases based on STEM education to enrich the practical exploration of the comprehensive practical curriculum in primary schools.

## 2. Concept definition

### 2.1. The philosophy and concept of STEM education

STEM refers to the abbreviation of the four disciplines of Science, Technology, Engineering, and Mathematics, emphasizing the cross-fertilization of multiple disciplines [4]. STEM education is not a simple superposition of science, technology, engineering, and mathematics education, but

rather an organized and systematic intersection and then integration of the four disciplines into an organic whole [5], so as to better develop students' STEM literacy.

STEM education promotes interdisciplinary, fun, experience, contextualization and collaboration. Interdisciplinary teaching is put forward as opposed to sub-disciplinary teaching. It means moving away from a focus on a single discipline and instead focusing on the multiple disciplines involved in the problem solving process. The most important core feature of STEM education is interdisciplinary. In the implementation of STEM education, the integration of multidisciplinary knowledge can bring freshness and excitement to students. Challenging activities in the learning process will greatly stimulate students' interest and thus bring fun and satisfaction, which fully reflects the concept of teaching for fun. Including self-learning and teacher-teaching, STEM education also emphasizes the physical involvement of students. They can learn knowledge in the process of hands-on, brain-work, and games. Education is not only the teaching of teachers, but also the learning of students. One-sided knowledge instillation goes against the principle of student subjectivity, while STEM education values student experience. STEM education is contextual. We cannot talk about STEM education in isolation from real life, but in relation to the reality of students' lives. Collaborative means sharing, exchanging and discussing knowledge based on experiential project-based learning, helping each other in problem solving, and constructing group knowledge. STEM education is based on authentic tasks and requires the cooperation of others.

## **2.2. Comprehensive Practical Activity Course for Primary Schools**

Comprehensive practical activity courses refer to the practical courses conducted by students independently under the guidance of teachers and based on their direct experience. It closely relates to students' lives, focuses on the comprehensive application of knowledge and skills, and reflects the value of experience and life to students' development. It is a compulsory course as well as an activity course. It includes information technology education, research study, community service and social practice, and labor and technology education. Its overall goal is to enable students to apply their knowledge appropriately to analyze and solve problems in order to promote overall development and enhance core literacy.

First it is an empirical course. Experience and experience are valuable assets. Students need to have a certain level of experiential learning in order for this to happen. In this course, students build on their existing experience and gain new experience in problem solving. Secondly it is a practical course. It focuses on students' hands-on and experience, and hands-on and brains are essential. Diversified practical learning is its characteristic. Third it covers a wide range of areas. It is very inclusive, not confined to the classroom, books and campus dead knowledge, it enters the realm of students' lives, society and nature, easier to stimulate students' interest in exploration.

## **2.3. Feasibility Analysis of Combining STEM Education with Comprehensive Practical Activity Courses**

STEM education fits in with the integrated practical activities curriculum in many ways. Both have the same overall goal. STEM education is aimed at developing students' innovative, practical and problem-solving skills; Integrated practical activity courses are designed to develop students' problem-solving skills and innovative spirit. STEM as knowledge integration education, interdisciplinary is its core feature. The subsequent "STEAM" and "STEM+ Education" are the concrete manifestation of the continuous extension of interdisciplinary to other fields. The word "integrated" in the comprehensive practical activity course can be seen, it does not point to a certain discipline or a certain field of knowledge, but is the product of the interplay between disciplines. STEM education focuses on hands-on experiences where students explore new things, learn and understand new knowledge in the process of problem

solving. Similarly, the content of integrated practical activities courses such as research studies, community service and social practice encourage students' independent participation. STEM education cannot leave real-life problems and is closely related to real life. Contextualization is also necessary for the curriculum of comprehensive practical activities in primary schools. Pupils' abstract thinking is immature and must rely on specific situations and relevant experiences. Both STEM education and the comprehensive practical curriculum for primary schools are addressing real problems. The problem solving process is complicated and tedious, which students cannot complete independently and cannot do without teamwork. In view of this, the combination of STEM education and Comprehensive practical activity courses in elementary school is feasible because they both focus on innovation and practical skills, interdisciplinary, practicality, contextualization, and teamwork.

### **3. Teaching Design of Integrated Practical Activity Course for Primary Schools Based on STEM Education**

#### **3.1. Preliminary Analysis**

**Content Analysis:** The chapter "The Kingdom of Trees" is a chapter of the comprehensive practical activity course in the second grade. It focuses on the knowledge of trees, including their roles, growing conditions, different species and growth habits, etc. Students use STEM education to get hands-on participation in order to gain knowledge in inquiry activities. **Learner analysis:** In terms of motivation for learning, students at this stage are new to nature, which provides the motivation to explore. In terms of ability, students have the ability to observe, think and communicate. They can participate in inquiry. In terms of development, students are at the concrete computing stage, relying on concrete things for reasoning and needing hands-on experience, which fits in with the practical nature of STEM education. **Analysis of Teaching Strategies:** The case "Kingdom of Trees" is a problem-solving type of knowledge. Students do not have a ready-made problem schema in their heads. We should use mainly inspirational strategies, supplemented by classroom discussion methods and role-playing, to explore in depth with participation and discussion.

#### **3.2. Teaching design of "The Kingdom of Trees"**

We first define the theme of the event. This chapter revolves around the "knowledge of trees", so the theme is "The Kingdom of Trees". Then set the activity objectives. Knowledge and skills objective is to know the types of trees, their growth habits and methods of planting trees; Process and methodological objective is that develop students' teamwork and hands-on skills in the process of tree planting; Emotional Attitude and Values Objective is that students will develop the emotion of protecting trees and loving nature after learning about trees. This case is based on the objective to design three inquiry events. The inquiry events reflect STEM education while having a focus. The name of Activity 1 is to learn about the trees in your hometown. It is an exploration of tree species and habits, focusing on STEM mathematics education. The name of Activity 2 is Trees and Life. It is an inquiry into the relationship between trees and life and their value to humans, mainly reflecting STEM science education. The name of Activity 3 is Making Friends with Trees. Students experience the process of planting trees with an emphasis on STEM technology education.

In the three project activities, the resources and tools used, the design of the activity process, the design of the learning support, and the embodied STEM education concept differed due to the different content of the activity projects.

Activity 1.

Contextualization: Trees are everywhere in front of and behind houses, on both sides of the road and on the hillside. They are either tall or short, some will wither, some are evergreen .....Do you know their names and habits? Come and investigate!

Resources & Tools: Information search tools (e.g. laptop, smartphone, iPad, etc.) Park.

Activity process design: Students will choose their own group leaders. Discuss and explore specific knowledge such as types of trees, tree habits. Create a survey to record and analyze the field trip based on the content, either by data or graphs, and create a "tree business card".

STEM Education: The data recording mainly reflects STEM mathematics education.

Learning Support Design: The teacher assists students in solving problems. Teachers should help students identify and analyze the information searched.

STEM Education Philosophy: fun.

Student Activities: Students may intercept branches or leaves of trees and take photographic samples as needed. Students categorize and summarize sample materials for recording. Conclusions are drawn after analysis.

Activity 2.

Contextualization: The dense forests support a variety of creatures and humans. To this day, we still cannot live without trees. Do you know how trees are related to our lives?

Resources & Tools: Related books, information search tools, forests near schools.

Activity process design: Discuss the relationship between trees and our lives. What are all the roles of trees? Students can look up relevant books and the Internet during the discussion; what is the environment like in the forest and what kind of trees are there?

STEM Education: Biological knowledge and chemical knowledge, with a focus on STEM science education.

Learning Support Design: The teacher adds to the students' discussion that trees produce oxygen for humans to breathe and that different tree species serve different purposes and have different values.

STEM Education Philosophy: Interdisciplinary and contextualization

Student Activities: Students experience their surroundings in the forest, observe the height, thickness and sparseness of trees, record and classify them, and look up the habits of trees online.

Activity 3.

Contextualization: To care for trees is to care for life, and to care for ourselves. In order to add a piece of green to our earth, take action and plant trees!

Resources & Tools: Tree planting instructions, saplings, shovels, water.

Activity process design: In the tree-planting activity, the teacher informs the students of the steps to plant the trees, and the students cooperate to plant the trees and experience the fun in the process of planting the trees. Group work cannot avoid disagreements, and the teacher needs to pay attention to the students' emotions and emphasize the collaborative nature and sense of responsibility.

STEM Education: Hands-on student work, mainly reflecting STEM technology education.

Learning Support Design: Teachers should give students trust and inspire a sense of ownership. Teachers should actively encourage students' creative ideas during the tree planting process.

STEM Education Philosophy: Experience and collaboration.

Student Activities: Students first dig a hole of appropriate depth, put the sapling in, bury it in the soil, and finally water it.

After the implementation of the activity we conduct a pedagogical evaluation, teacher evaluation, student self-assessment and mutual evaluation, with the main perspectives of

creativity, participation and cooperation. Finally, we make changes and optimizations based on the problems that arise from the implementation of the activities.

#### 4. Conclusion

There are some problems in the application of STEM education in the comprehensive practical activity courses of elementary school. Comprehensive practical activity courses have been detached from the reality of life. Teachers' own level of STEM literacy is low. The relationship between other disciplines and comprehensive practical activity courses is controversial. In the practice of integrating STEM education into comprehensive practical activity courses of elementary school, educators should continue to identify problems, summarize the rules and solve them. For example, ongoing reinvention of comprehensive practical activity courses based on specific issues. We should focus on teacher staffing and quality improvement. We need to deal with the relationship between subject teaching and comprehensive practical activity courses under the concept of STEM education. In short, the core concepts of STEM education are consistent with the characteristics of comprehensive practical activity courses. STEM education can update people's understanding of comprehensive practical activity courses, draw educators' attention, improve teaching strategies, promote the optimization of curriculum implementation, and ultimately achieve the improvement of students' core literacy.

#### References

- [1] Du Wen bin. Exploration of hot topics and characteristics of foreign STEM education research[J]. *Electrochemical Education Research* 2018,39(11):120-128.
- [2] Yu Sheng quan, Hu Xiang.STEM education concept and interdisciplinary integration model[J]. *Open Education Research*,2015,21(04):13-22.
- [3] Zhong Cen cen. Analysis and suggestions on the current situation of STEM education in primary and secondary schools in China[J]. *Digital teaching in primary and secondary schools*,2018(07):32-35.