Research on Interdisciplinary Integration Mode based on STEM education Concept

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Abstract: With the widespread popularity of computers and networks in people's work and life, the amount of data has increased dramatically. Nowadays, how to collect and store the data effectively is the main problem that needs to be solved at present. Based on Hadoop technology, this paper gives the system requirement analysis, system architecture design and key modules design of massive data processing platform, and elaborates the key points of the data processing platform development based on Hadoop technology to provide some references for the relevant researchers.

1. Introduction

Premier Li Keqiang pointed out in his government work report in 2015 that in order to promote mass entrepreneurship and innovation, and to visit Shenzhen firewood customer space personally, the General Office of the State Council subsequently issued the Guidelines on Developing Mass Creative Space and Promoting Mass Innovation and Entrepreneurship. With the popularity of "Creator" all over the country, it has become a heated topic for educators to carry out Creator Education. But many people have some misunderstanding in the understanding of customer education. Creator education does not just encourage students to abandon their studies and unrealistically engage in creative inventions and entrepreneurship, but emphasizes the core qualities of creator's interest-driven, hands-on practice and creative innovation, and promotes STEM education of interdisciplinary knowledge integration. It helps students to lay a solid foundation of scientific, technical, engineering and mathematical knowledge. On the basis of it, we should cultivate their innovative spirit and practical ability to promote the growth of innovative and entrepreneurial talents.

2. STE education and Its Development

STEM is the abbreviation of four disciplines of science, technology, engineering and mathematics, emphasizing the interdisciplinary integration of many subjects. STEM education is not a simple superposition of science, technology, engineering and mathematics education, but a combination of four subjects to form an organic whole, in order to better cultivate students'innovative spirit and practical ability.

STEM education originated in the United States. American science educators first put forward the concept of scientific literacy in the 1950s, which has been generally recognized by other countries'science educators. They believe that improving the national scientific literacy is the key to enhancing the comprehensive strength of the country. This is inseparable from the rapid development of Science in the first half of the 20th century, when science was omnipotent in the public mind, and science was regarded as the inexhaustible driving force of social development and progress. With the relative stability of the scientific knowledge system, as well as the tremendous changes brought by technology and engineering to life, technical literacy has come into public view. For example, Professor Hurd of Stanford University pointed out in 1975 that "technical literacy and scientific literacy should be the main objectives of science teaching together."[1]

By the 1990s, the National Science Foundation of the United States first used STEM to describe

events, policies, projects or practices involving at least one STEM discipline [2]. Before that, the common abbreviation was SMET, namely science, mathematics, engineering and technology. For example, in 1986, the National Science Council issued a report on Undergraduate Science, Mathematics and Engineering Education, which for the first time explicitly put forward a programmatic proposal for the integration of science, mathematics, engineering and technology education. SMET is therefore regarded as the beginning of STEM integration.[3]

After 2001, STEM gradually replaced SMET and became a general term for four subjects. During George W. Bush's two terms of office, STEM has emerged as a new concept in various U.S. reform policies and programs and even laws [4]. For example, in August 2007, the United States Congress passed the National Competitiveness Act, approving an investment of US$43.3 billion in federal STEM research and education programs between 2008 and 2010; in October of the same year, the National Science Council issued a report on the National Action Plan: Addressing American Science, Technology, Engineering and Mathematics Education. The urgent need of the system reminds us that we should always strengthen STEM education for students.

After President Obama's administration, the importance of STEM education has been upgraded to a new level. At the beginning of his tenure, he promulgated the American Revitalization and Investment Act, which will increase financial input to support STEM education. During his first term, Obama announced the implementation of "Competitive Excellence Program", "Education for Innovation Program" and "Ten-Year Plan for New Science and Technology Education", and constantly increased the focus on the development of STEM education. In 2014, the White House and the U.S. Department of Education put forward STEM national talent cultivation strategy, aiming at STEM education in primary and secondary schools, proposed to realize STEM innovation network cooperation, train excellent STEM teachers, establish STEM expert teacher group, and funding STEM focus. Schools and increasing STEM investment in scientific research and other practical and specific plans are widely accepted by the world [5].

3. Project design for interdisciplinary integration

The core and most important task of STEM interdisciplinary integration is the design of projects or problems. If there is no good structured project design, it will lead to a series of problems, such as learning difficulties, inefficiency, strong frustration and little learning gains. STEM project design emphasizes that knowledge should be embedded in real situation problems, and that students should be motivated to actively use the relevant knowledge of various disciplines to design solutions to improve students'ability to solve practical problems across disciplinary boundaries.

STEM education is a typical teaching practice of constructivism. Referring to the teaching design model based on Constructivism [6], this paper attempts to propose a STEM project design model (see fig.1). On the basis of "teaching analysis" and taking "project or problem" as the core foothold, this model designs the key links of learning resources and tools, learning activity process, learning scaffolding and learning evaluation in the process of project completion or problem solving. At the same time, it pays attention to the systematization and structuralization of students'acquisition of knowledge after project completion. Migration, and the corresponding reinforcement exercises and summary promotion.

3.1 Teaching Analysis.

In the early stage of teaching design, teachers need to make detailed analysis of the following three aspects: 1) teaching objectives; 2) learner characteristics; 3) interdisciplinary knowledge map (learning content). The purpose of analytical teaching is to define the learning theme and make a detailed description of the three dimensional goals of the course. The purpose of analyzing learner characteristics is to ensure that project design is suitable for students'ability and knowledge level, and to fully analyze learners' intelligence and non-intelligence factors. STEM education emphasizes that learning should complete the tasks in real situations. To ensure that the tasks include teaching objectives, it is necessary to conduct in-depth analysis of the learning content and to clarify the

knowledge content, the structural relationship between the knowledge content and the type of knowledge content. This can provide a basis for balanced knowledge coverage of the whole course by drawing a knowledge map of learning content and showing the relationship between interdisciplinary knowledge.
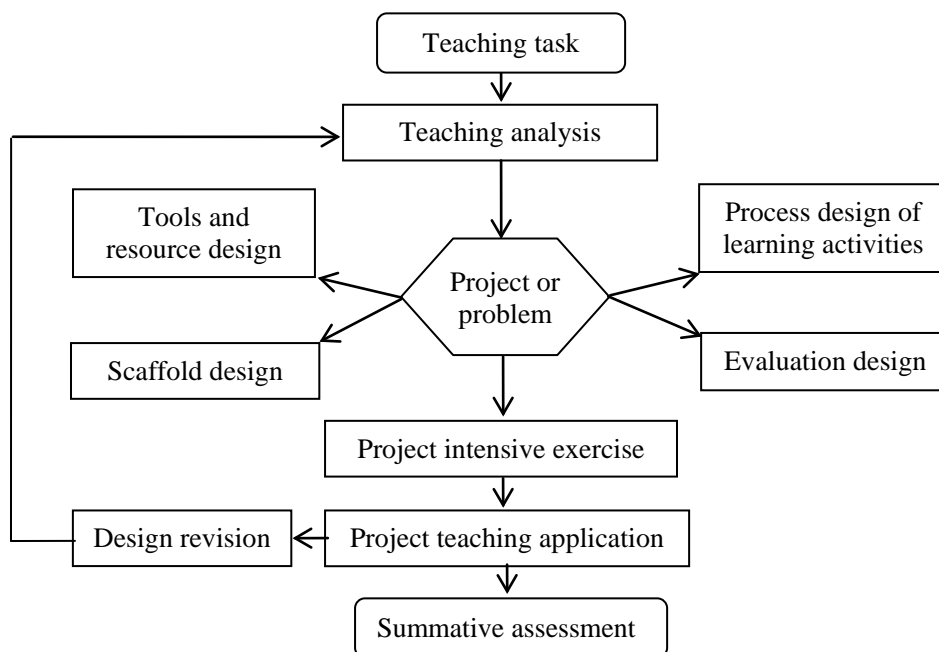
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                          │  Teaching task  │
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        ┌─────────────────►┌──────────────────┐
        │                   │ Teaching analysis │
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  │  Tools and   │◄────────┤   Project or   ├────────►│ Process design of │
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Fig. 1 STEM interdisciplinary project design mode

3.2 Learning Task Design.

Learning task is the core and foothold of the whole STEM instructional design mode. STEM teaching is based on real situation, which requires learners to be involved in real and non-well-structured learning tasks. The process of students'learning is the process of solving practical problems and completing practical projects. Problems or projects constitute the core of driving learning, instead of acting as examples of concepts and principles as teachers teach. Learning tasks can be problems or projects: they all represent complex problems of continuity and require learners to adopt active, constructive and real-world learning styles. Learning tasks must be presented in specific situations, and design problems need to be specified in specific situations. Because knowledge in textbooks is abstraction and refinement of real life, it is necessary to restore the background of knowledge and restore its original vividness and richness in designing learning scenarios. Sometimes the performance of the same problem in different scenarios (different working environment, social background) is different. STEM teaching should design learning situations based on the results of previous teaching analysis, so that learning problems can be integrated with real learning situations, not in a state of separation or barely synthesis.

3.3 Tools and Resource Design.

Problem solving or project completion requires learners to learn independently and construct meanings on the basis of a large amount of information. Therefore, designing appropriate learning environment and abundant learning resources and tools is an indispensable part of STEM teaching design. Learning environment design mainly includes equipment, equipment and various information tools needed in teaching, such as 3D printers, open source circuit boards and so on. It also needs some cognitive tools to support or guide the expanding thinking process, such as Scratch Visual Programming Tool, Concept Mapping Tool, SPSS Number. According to analysis tools, network communication tools, 3D modeling tools. In terms of learning resources, teachers need to design: 1) to understand the detailed information about learning problems and necessary preparatory knowledge; 2) information that students may need to consult in solving learning problems; 3) to strengthen exercise materials.

3.4 Learning Scaffold Design.

STEM education attaches importance to learners' learning status while ignoring teachers' guiding role. STEM teachers need not only to maintain the control, management, help and guidance of various teaching links, but also to change from classroom protagonists to behind-the-scenes directors and become helpers and promoters of business meaning construction. In the process of problem solving, different students adopt different learning paths and meet different difficulties. Teachers should give timely feedback and help according to different situations, guide students to carry out independent exploration or cooperation, and mobilize students'initiative to participate. Students are prone to learn in the face of abundant information resources in independent learning. In view of the deviation between learning behavior and learning goal, teachers should set key control points in the process of problem solving, standardize students'learning, and help students reflect on and deepen their knowledge. Therefore, in view of the difficulties that students may encounter in the process of problem solving, the key to ensure that students learn and solve problems in the nearest development zone is to provide support, load-bearing, connection and other support.

In STEM education project, scaffolding can ensure students'success when they can not complete tasks independently, improve their ability level to meet the task requirements, and help them realize the potential development space. Scaffolding enables students to experience the thinking process experienced by some experienced learners (such as teachers), which helps students to understand and understand knowledge, especially tacit knowledge. By internalizing scaffolds, students can acquire the skills of independently completing tasks. The scaffolding can also show the real situation of the learning task and let the learners feel, experience and enter the complex real situation. Typical scaffolds include: situational scaffolds, setting up situations to help students enter learning; problem-based scaffolds, creating problem situations, triggering thinking; experimental scaffolds, demonstration experiments, student experiments, family experiments, etc; information-based scaffolds, including teachers'existing knowledge, network knowledge, materials; knowledge-based scaffolds, mainly providing. A framework for evaluating and generating new experiences and information; a procedural framework refers to the order of doing things; a strategic framework refers to the means and strategies used to achieve different teaching effects under different teaching conditions; a paradigm framework refers to typical examples and examples; and a training framework refers to strengthening students'cognitive understanding and raising through guidance and practice. Enhance students' learning ability.

3.5 Learning Activity Design.

Students acquire knowledge and know the objective world in the process of completing STEM education projects, not directly from books or teachers. Cognition and learning occur in the process of completing tasks and solving problems, and are accomplished through learning activities as an intermediary. Therefore, effective STEM education project design must take effective learning activities as the intermediary to promote the internalization of knowledge. Only in this way can we really improve students'learning efficiency and promote the occurrence of students' learning.

STEM learning activity design is that teachers choose and design learning activities flexibly according to teaching objectives, teaching content and teaching situation, so that students can participate in learning activities. Different teaching modes often show their characteristics from different teaching links and procedures. Each teaching mode has its own relatively fixed logical steps of activities and teaching tasks to be completed at each stage. Different sequences of activities naturally form different teaching modes.

3.6 Learning Evaluation Design.

Teaching evaluation includes formative assessment and summative assessment. In order to better achieve the teaching objectives in the process of teaching activities, teachers need to constantly carry out formative evaluation in the process of teaching. Formative assessment tends to use scales, behavioral observation and knowledge tests to understand the staged teaching results and problems, and to modify and improve the teaching implementation plan in time. Summary evaluation is generally arranged in the end of teaching activities, in order to test whether the learning effect achieves the expected teaching objectives. STEM teaching focuses on cultivating learners'ability to solve practical problems, which is more flexible and diverse than traditional paper-and-pencil tests and pays attention to learners' real abilities. For example, it can be evaluated by teachers or groups according to pre-established evaluation criteria. Formative evaluation and summative evaluation serve different purposes, and they both play an important role.

3.7 Summary and Intensive Exercises.

After the completion of the project, teaching summary should be timely conducted to facilitate learners to systematize scattered knowledge. STEM teaching pays attention to practical problems and focuses on interdisciplinary application of knowledge. Therefore, it is more necessary to summarize the knowledge involved, extend the output of STEM learning from practical problem solving to abstract knowledge level, and let students form a certain knowledge system and structure. Teaching summary can be carried out independently by teachers, or in the form of cooperative reporting by student groups under the guidance of teachers.

After the teaching summary is completed, teachers should design a set of optional and targeted supplementary learning materials and intensive exercises for students according to the results of group evaluation and self-evaluation. Such materials and exercises should be carefully selected to reflect the basic concepts and principles as well as to meet the needs of different students, so as to correct the original misunderstanding or one-sided understanding through intensive exercises, and ultimately achieve the meaning construction that meets the requirements.

3.8 Trial and Improvement of Project Plan.

In the process of project implementation, on the one hand, we should strictly implement the designed scheme to ensure the implementation of the teaching scheme; on the other hand, we should constantly revise the design scheme according to the actual teaching conditions and the results of formative evaluation to ensure flexibility.

4. Conclusion

With the popularity of creative customers in China, there has been a worrying leap forward in education for tourists. Do not follow the rules of education, and let students learn open-circuit boards, 3D printing, robots and so on. They pay too much attention to the cool technology, lack of scientific education design, and lack of basic knowledge integration injection, which makes the education of creating customers become the school showcase, and the emergence of bubble seedlings.

Therefore, this paper puts forward the overall planning of project design through subject knowledge map to realize the balanced coverage of interdisciplinary knowledge. At the same time, special emphasis has been placed on summarizing and strengthening exercises. These targeted improvement measures, as well as learning from the advantages of traditional Chinese education in knowledge acquisition, can provide reference for STEM education implementation in other countries.

References

[1] Hurd, P. D. Science, Technology and Society:NewGoals for Interdisciplinary Science Teaching[J]. Science Teacher, 1975, 42(2) : 27-30.

[2] Byhee, R. W. Advancing STEM education: A 2020 version[J]. Technology and Engineering Teacher, 2010, 70(1) : 30 -35.

[3] X.L.Zhu and H.B.Sun. Research on the development of human resources in science and technology-- Interpretation of STEM integration strategy in the US [J]. Higher engineering education research, 2010, (2) : 21-25.

[4] Z. J. Zhao. Education for innovation [J]. Education in Liaoning, 2012, (18): 19.

[5] G. F. Yang. A summary of Obama administration's STEM education reform [J]. Management of primary and secondary schools, 2014, (4):48-50.

[6] Sanders, M. STEM, STEM education, stemmania[J]. The Technology Teacher, 2009, 68(4) : 20 - 26.