ISSN 2522-6398 Vol. 6, Issue 23: 131-135, DOI: 10.25236/FER.2023.062322

Exploring Strategies to Stimulate Adolescents' Learning Drive - Taking STEM Education as an Example

Yunlei Chen

Faculty of Business, City University of Macau, Macau, 999078, China

Abstract: *Science, technology, engineering, and mathematics (STEM) education advocates the use of disciplinary integration in theoretical teaching, which can effectively guide adolescents to actively adapt to the rapidly developing social environment and receive continuous updating of disciplinary expertise. Moreover, introducing STEM education into adolescent learning can fully highlight the nurturing value of disciplines and promote the development of adolescent core qualities. This paper takes STEM education as an example, analyzes the primary components of adolescents' learning drive, and explores the path to enhance adolescents' learning drive.*

Keywords: *STEM education; Learning drive; Adolescent*

1. Introduction

The present era is undergoing profound changes, and the role of new knowledge, science, and technology is becoming increasingly prominent for economic and social development. To be competitive in a complex world, future talents need to have the ability to quickly acquire new knowledge and skills to solve complex problems, and collect and evaluate information, particularly from a variety of digital media. STEM education helps develop students' scientific inquiry ability, sense of innovation, critical thinking, information technology capability, and other skills and innovations necessary for future society, which would play a role in learners' future life and work sustainably. Furthermore, this study concludes that a curriculum model for adolescent development represented by STEM project-based teaching and learning, which highlights the cultivation of engineering practice and innovation ability, can activate students' learning drive.

2. Concept of learning drive

The term "drive" is an essential concept in psychology, first introduced by R.S. Woodworth in 1918[1], and refers to "an internal impetus based on the needs of the organism, an internal stimulus that causes a response to produce a stimulus when the organism has a need, and a response that leads to the satisfaction of the need". Specifically, the drive is the motive power that provokes behavior.

Thus, learning drive is an internal learning motivation based on the needs of adolescents. It is an internal motivation to learn, and when it is generated, adolescents will develop a certain level of interest in learning, the willpower to overcome difficulties to achieve learning goals and active learning behavior.

Ausubel proposed that the learning drive can be divided into three types[2].

Firstly, cognitive drive. It is a need to acquire knowledge and enrich oneself with knowledge, namely, the desire to know. Students can only emerge from this need if they establish the correct value of learning. Therefore, guiding adolescents to establish a correct view of learning is crucial.

Secondly, ego-enhancement drive. This is a need to obtain a certain social status through efforts to improve oneself, and a sense of accomplishment will be generated when the need is satisfied. It will motivate adolescents to pursue better academic performance or higher ranking and thus study harder.

Thirdly, affiliative drive. Affiliative drive refers to the active learning state that students show to satisfy the need to get recognition or praise from parents or teachers, namely, the need to be respected. Moreover, getting recognition and respect from others is one of the basic needs of human beings, and

ISSN 2522-6398 Vol. 6, Issue 23: 131-135, DOI: 10.25236/FER.2023.062322

timely affirmation and attention can motivate students to learn more actively.

3. Overview of STEM education

The concept of STEM education was first introduced in 1986 in the National Science Foundation's "Report on Science, Mathematics, and Engineering Education in the University"[3], which proposed a programmatic suggestion of "science, technology, engineering, and mathematics" education in response to the international competition for talents and the pressure of economic development to rethink the cultivation of national talents. STEM is an educational planning led by the U.S. government, which aims to break down disciplinary boundaries, solve practical problems through the integrated application of disciplinary literacy, and develop comprehensive talents. STEM refers to Science, Technology, Engineering, and Mathematics, and STEM education is a comprehensive education that integrates science, technology, engineering, and mathematics. Furthermore, through STEM education, adolescents can effectively achieve the goal of in-depth learning, and through the learning drive, adolescents can independently explore knowledge and organization and achieve the effective development of thinking ability. Therefore, it can be seen that this training in higher-order thinking ability is the value of STEM education and the educational concept.[4] Figure 1 shows the structure of STEM education.(As shown in figure 1)

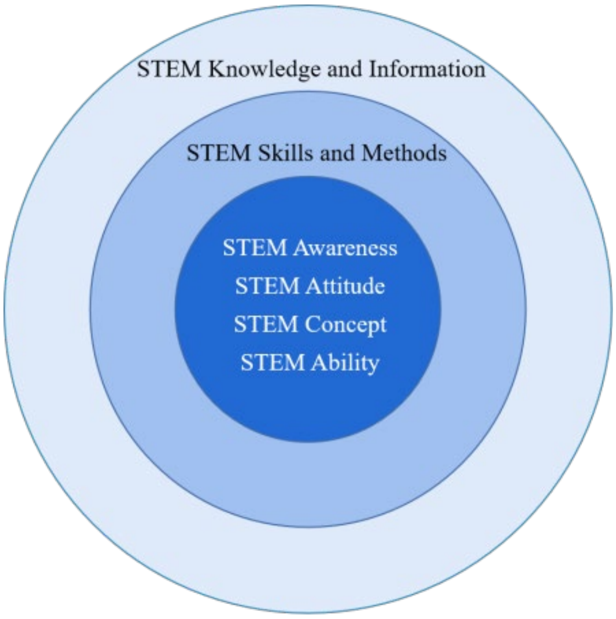

Figure 1. The structure of STEM education

4. Strategies for STEM education to stimulate adolescents' learning drive

4.1 Basic principles

One of the primary factors affecting the continuity and success of a course is the adolescents' learning drive. The learning drive is a core element of learning, a presumed intrinsic force that determines the direction of learning, and affects what is learned, how it is learned, and when it is learned. Additionally, the self-determination theory, which is one of the most commonly used theories of motivation today, divides motivation into intrinsic and extrinsic motivation. Intrinsic motivation is the learning behavior stimulated by the adolescent's intrinsic pleasure through participation in the activity. Extrinsic motivation refers to the learner's involvement in an activity because of an external factor (i.e., a reward). Furthermore, the incentive theory suggests that individuals are stimulated when they are exposed to an external stimulus. Therefore, teachers can provide students with certain external stimuli to stimulate adolescents' interest in learning and elicit their cognitive needs during the lessons. Simultaneously, interest is one of the factors that can enhance adolescents' intrinsic motivation, and the more interested and motivated adolescents are in the learning task, the better they will learn.(As shown in figure 2)

ISSN 2522-6398 Vol. 6, Issue 23: 131-135, DOI: 10.25236/FER.2023.062322

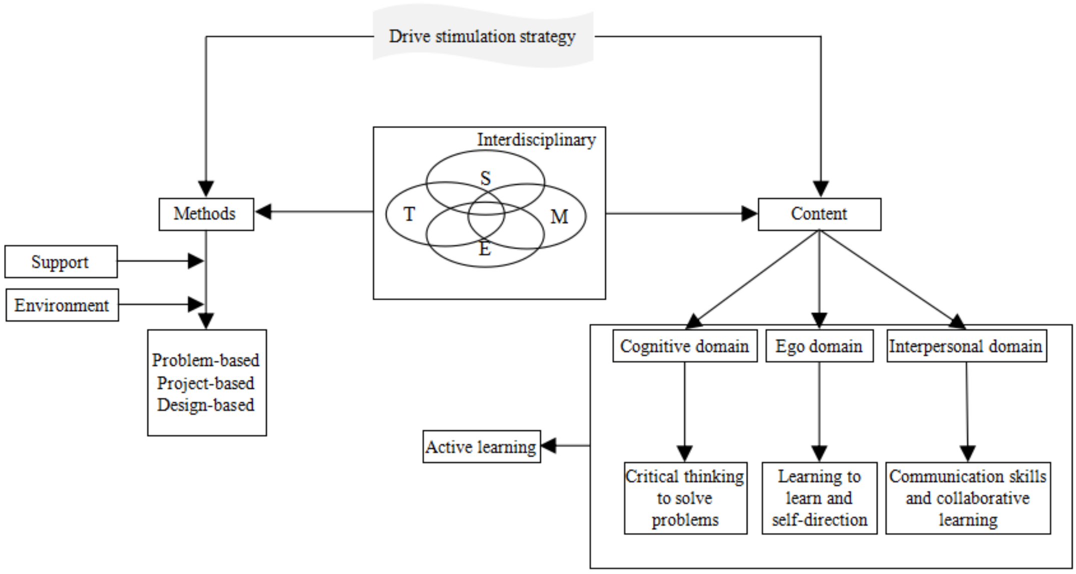

Figure 2. STEM education conceptual model

As shown in Figure 2, teachers can use project-based, problem-based, or design-based teaching methods when conducting STEM teaching activities and provide students with a good learning environment and learning support to enhance adolescents' learning motivation. Therefore, when teachers design STEM teaching content, they should focus on developing adolescent skills in three domains: cognitive, ego, and interpersonal, to help adolescents achieve deep learning. In the cognitive domain, teachers should focus on integrating interdisciplinary content and pay attention to the juxtaposition and progression of knowledge points to help students build a knowledge system and develop their critical thinking and problem-solving skills. In the ego domain, teachers should teach adolescents to learn and give them autonomy over their learning. In the interpersonal domain, teachers can stimulate adolescents' learning drive through collaborative learning activities that promote interaction among all people, develop adolescents' communication skills, and cultivate their collaboration skills.

4.2 Implementation strategy

(1) PBL model

Focusing on problem-solving in real contexts is the key feature of STEM courses, while problem-based learning and project-based learning are the general practice models of STEM courses, and driving question (DQ) is the key support in STEM course design. Yu Shengquan et al. (2015) believe that the most critical part of interdisciplinary integration in STEM courses is the design of the project or problem, which is closely related to the construction of the DQ. In STEM courses, the DQ introduces adolescents to a real-world dilemma, which includes a question or dilemma that adolescents are interested in and want to answer or need to solve. Moreover, a good DQ can stimulate adolescents to discuss and investigate a topic and subsequently come up with a solution based on it. The DQs serve as the core of the STEM curriculum, which plays the role of establishing course themes and objectives, supporting the structure of the course, and defining the dimensions of assessment.

(2) "Engineering" drive in STEM courses

The DQs in the STEM courses include an indispensable element, "engineering". The traditional subjects of science, technology, and mathematics are taught in schools, but "engineering" is a new element that is central to STEM education and distinguishes it from traditional interdisciplinary teaching. In STEM education, "engineering" is distinct from traditional engineering education and is not limited to teaching engineering thinking. Additionally, compared with traditional engineering education, "engineering" in the STEM curriculum includes some engineering-related hands-on operations or knowledge skills. However, it does not involve systematically teaching engineering knowledge; that is, "engineering" is not considered a separate discipline from science, technology, and mathematics. The development of engineering thinking is not the only objective of adolescent thinking in STEM courses, but it takes "engineering" as the center to provide the framework and create the

ISSN 2522-6398 Vol. 6, Issue 23: 131-135, DOI: 10.25236/FER.2023.062322

environment for developing engineering thinking and other higher-order thinking. Specifically, "engineering" is the key element of the STEM course that serves as the driving force. Moreover, this driving force is mainly manifested through the engineering design process, which focuses on two aspects: the first is the linkage of science, technology, and mathematics-related knowledge and concepts, and the second is the development of adolescents' engineering thinking skills and other higher-order thinking.

Jolly (2016) describes the engineering design process in a STEM program as an 8-step process (as shown in figure 3)[5].

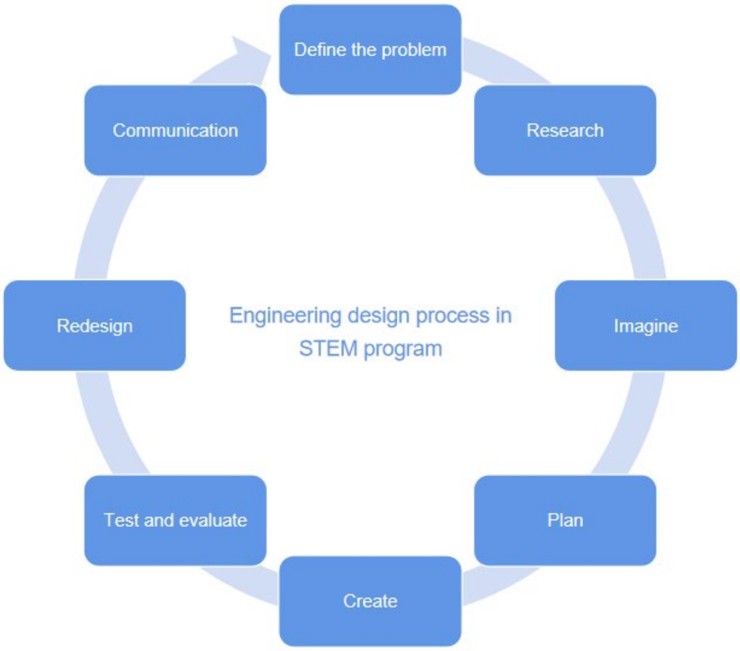

Figure 3. Engineering design process in STEM program

The first step is define the problem, which abstracts the engineering problem to be solved from the real situation.

The second step is background research, which collects relevant knowledge and information needed to solve the problem from multiple channels (online, offline, domain experts, etc.) to prepare for the problem.

The third step is to imagine, brainstorming on the basis of background research, develop thinking, and propose creative solutions to the problem.

The fourth step is plan, after selecting the best solution, develop a detailed plan to carry out the solution.

The fifth step is create, according to the plan to create a prototype to solve the problem (Prototype).

The sixth step is test and evaluate, where the solution and prototype are tested and evaluated.

The seventh step is redesign, according to the results of the test and evaluation to redesign the solution and prototype, solve the problem and optimization.

The eighth step is communication, which includes communication among team members and communication between team members and outsiders about the problem, the solution, and its effectiveness. During the problem solving process, these steps can be repeated over and over again, even between two steps, until the optimal solution is found.

(3) Enhancing internal motivation in complex situations

This kind of learning has actually formed a complete and rigorous system of good structure. The system emphasizes the acquisition of knowledge, which can quickly achieve the predefined goals, but it is difficult to acquire cognitive skills, problem solving and engineering thinking, scientific investigation, design thinking, creativity and innovation. A deep integration of competency-based S, T, E, and M curriculum is especially needed as a vehicle for competency enhancement. Authentic projects, tasks,

ISSN 2522-6398 Vol. 6, Issue 23: 131-135, DOI: 10.25236/FER.2023.062322

problems, etc. are exactly the vehicles that teachers need to design STEM learning for their students.

Learning in complex situations, students will face a variety of challenges, curiosity about the unknown, fear of experimentation, fear of failure, expectation of success, and other attitudes and the emotions caused by a mixture of them, learners need to be practiced in a STEM activities, to obtain the correct values and the ability to dispatch a positive attitude towards the problem. Teachers have to act as mentors, evaluators and other roles in STEM activities, and every good STEM teacher must also be a good designer. Teachers need to help students give personal meaning to their learning experiences in specific contexts and activities, thus facilitating the retention of what has been learned and further facilitating transfer when learning new knowledge. Teachers need to further design a program of student learning activities based on the STEM education curriculum design thrusts and key steps. The activities need to fully mobilize learning initiatives and lead students to investigate, inquire and do hands-on work. Through inquiry-based learning, students are engaged in questioning, experiential learning and hands-on activities that enable them to discover new concepts and develop new understandings.

5. Conclusion

In conclusion, cultivating students' learning drive is not only necessary for core literacy education but also the need of social and technological progress and development. Additionally, teachers should consciously combine what they have learned with their life experiences, guide students to evaluate the application of technology from a practical perspective, and further recognize the important role of drive, thus achieving the expansion of STEM education content and simultaneously helping adolescents to form the autonomous learning drive.

References

[1] Woodworth R S. Dynamic psychology[M]. Columbia University Press, 1918.
[2] Ausubel D P. The acquisition and retention of knowledge: A cognitive view[M]. Springer Science & Business Media, 2012.
[3] National Science Foundation (US). Division of Undergraduate Science, Mathematics Education. Report on the National Science Foundation Disciplinary Workshops on Undergraduate Education: Recommendations of the Disciplinary Taskforces Concerning Critical Issues in US Undergraduate Education in the Sciences, Mathematics and Engineering[M]. National Science Foundation, 1989.
[4] Martín-Páez T, Aguilera D, Perales-Palacios F J, et al. What are we talking about when we talk about STEM education? A review of literature[J]. Science Education, 2019, 103(4): 799-822.
[5] Jolly A. STEM by design: Strategies and activities for grades 4-8[M]. Routledge, 2016.