

Research on Nurturing Innovative Talents Outside the Classroom Under The "Emerging Engineering Education" Concept

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Abstract: The formulation of the "emerging engineering education" concept has promoted the reform of talent nurturing. In the exploration and practice of nurturing innovative talent, the learning outside the classroom has become an important medium of quality education with its flexible, extensive, and novel qualities, alongside the irreplaceable role of the classroom in educating individuals. This paper objectively analyzes some problems of nurturing innovative talents in colleges and universities under the "emerging engineering" concept, discusses the positive role of learning outside the classroom in cultivating the innovation skills of college engineering students, puts forward principles to be followed in the systemic design of nurturing innovative talents and proposes suggestions to better fulfil the role of learning outside the classroom. At present, the Fourth Industrial Revolution, marked by the application of the Internet, big data and cloud computing has spread rapidly, and in the coming decades, a new wave of scientific and technological revolution and industrial change will form a historic intersection with the development of human society, and the progress and innovation of engineering science and technology will become an important driver of human development. Facing the challenges of the new wave of scientific and industrial changes under the new arena of international competition, the concept of "emerging engineering education" has guided the direction of development and reform of Chinese engineering colleges and universities, and the formulation of "emerging engineering education" requires that the engineering talents nurtured must have a mindset that fulfils the needs of the new economy, especially innovation awareness and ability. As an important medium to nurture students' innovation skills and quality development, learning outside the classroom in colleges and universities plays an increasingly prominent role in cultivating innovation consciousness, stimulating potential, and shaping personality. With its flexible, extensive, and novel qualities, alongside the nurturing role that cannot be replaced by classrooms, learning outside the classroom is crucial for quality education. After years of exploration and development by the education sector and higher-education institutions, learning outside the classroom in colleges and universities is not just a simple supplement and extension of classroom teaching, but has gradually developed into an important educational and teaching component for nurturing talents and platform for cultivating students' innovation skills and improving their overall development. Therefore, it is extremely meaningful to objectively analyze the problems of nurturing innovative talents outside the classroom under the "emerging engineering education" concept and give corresponding suggestions, so as to nurture students with strong practical abilities, creativity, and internationally-competitive, comprehensive engineering talents in colleges and universities.

1. The Main Phenomenon of The Lack of Innovation Skills of College Engineering Students

1.1. Inadequate knowledge structure

With the development of modern science and technology, the total volume of human knowledge has reached unprecedented levels, and it is impossible for a single individual to master all knowledge. To form new modes of thinking in complex knowledge systems and discover new connections at the intersection of multi-disciplinary knowledge, college engineering students are required to build foundations in professional knowledge and understand the knowledge of disciplines related to it, stimulate their understanding of natural science, social science and humanities, constantly broaden their knowledge and horizons, find the connections between different disciplines, courses and knowledge, and develop an overall knowledge and cognitive system. If we singularly emphasize the learning and accumulation of knowledge but neglect the cultivation of creativity, the knowledge we learn will be relegated into lifeless and meaningless dogmas, which will not be of practical use to human society. How can we find out if a

person has genuine innovation skills? It can be evaluated not only by looking at his repository of knowledge, but also the rationality of his knowledge structure, and if the comprehensive skills derived from his knowledge is effectively internalized. At present, the overall knowledge framework of college students in engineering colleges and universities ranges from basic to intermediate, then professional. Although there is a certain extent of hierarchy, in terms of relevance, it is clearly biased towards knowledge for professional purposes. In other words, while the elements of the overall knowledge structure are complete, their proportions are not well-calibrated. This greatly affects the cultivation of college students' innovation skills.

1.2. Weak sense of innovation

A sense of innovation is a conscious state of mind in which students are interested in engaging in unique, novel, and meaningful activities. It includes creative motivations, emotions, and willpower. Higher education is an important training platform for high-quality talents to spread and acquire knowledge, and college students constitute a community with a strong desire for knowledge and exploration. However, it cannot be overlooked that some college engineering students may feel lost without academic

pressure, and without timely adjustment, they will lead their college life in the wilderness of professional knowledge, which will lead to the lack of motivation to be creative. This is reflected in employment, where they will find it difficult to find a job or struggle to work due to weak hands-on and innovation skills. In addition, some students lack international worldviews and understanding of future industrial trends, lack accurate self-positioning, and spend most time purely on learning textbook knowledge, which erode the desire for and sense of innovation.

1.3. Lack of innovative ways of thinking

The modes and levels of thinking are the core factors affecting creativity. The traditional education, which is by the book and old-fashioned, has, to some extent, suppressed students' enthusiasm for learning, eroded their innovative nature, and entrenched mindsets. This greatly limits and restricts their modes of thinking, and results in conventional, homogenous thought. At the same time, learning outside the classroom in some engineering colleges and universities are dominated by cultural, sports and recreational activities, which are less extensive than content within the classroom. There are fewer professional activities organized, with not enough attention paid to academic competitions, which are not conducive to training the innovative thinking of engineering students.

2. Learning Outside the Classroom Has A Positive Effect on The Cultivation of Innovation Skills in Engineering Students

Various forms of activities outside the classroom can stimulate students' creativity and imagination, shape their independent personality and sense of independence, cultivate their innovation skills and team spirit, and strengthen their motivation for achievement and pursuit of success. This is an urgent component to be strengthened in higher education institutions, especially engineering, to nurture talent.

2.1. Learning outside the classroom is conducive to cultivating students' interest in innovation

Passion is the best teacher. The cultivation of students' innovation skills requires fully mobilizing students' subjectivities. To further strengthen the innovation skills of college engineering students, we must firmly establish students' perspectives, strengthen their personal stances, stimulate their self-awareness, and further mobilize students' initiative and enthusiasm. Innovation skills and personality are closely intertwined, and freely pursuing students' personal interests is the best source of motivation to guide and encourage them to explore and learn new knowledge. Therefore, learning outside the classroom has its unique advantages in developing students' creativity.

2.2. Learning outside the classroom is an effective way to broaden knowledge

Broad knowledge is the most important prerequisite in determining the degree of innovation skills in college engineering students. Mastering more fields of professional knowledge will allow them to find commonalities and relevant links for academic innovation. Learning outside the

classroom is an important extension and effective supplement to classroom lectures, and another important channel to broaden students' knowledge. A complete knowledge system, sense of social responsibility, legality, integrity, independent thinking, collaborative spirit, innovation and entrepreneurship are the basic qualities for college students in the "emerging engineering education" concept, which need to be gradually cultivated through the long-term participation in a large number of activities outside the classroom.

2.3. Learning outside the classroom helps to enhance students' practical skills

The starting point of improving students' innovation skills is strengthening their practical skills. The cultivation of students' practical skills is inseparable from the systematic and strict training of theoretical knowledge in professional learning, but also from the training from outside the classroom in academic competitions and social settings. This combines classroom learning with extra-curricular practical experiences to improve students' practical and hands-on skills.

3. Principles to Be Followed in The Design of The Activities Outside the Classroom for Nurturing Innovation Talents

1. Principle of core competencies. The traditional skills structure emphasizes the compound system of knowledge and intelligence with application, while creativity is the organic unity of intellectual, knowledge and non-intellectual components. Core competencies refer to the practical implementation of creativity, in line with the requirements of nurturing innovative talents, while also reflecting the essential application- and skill-oriented nature of undergraduate institutions.

2. Principle of student perspectives. This is modelled after the concept of outcome-based education in the "emerging engineering education" professional certification, which takes the students' innovative consciousness and the improvement of their practical ability as the educational goal, and puts students at the core to realize the students' needs and designs for their own growth and success in an institutionalized way.

3. Principle of complete learning system. The talent development model outside the classroom should contain both theories and practice, research and teaching, school and society, success and employment, and qualities from within and outside the classroom. The establishment of an all-rounded education model can reflect the level of students' sense of innovation and practical skills, and promote the overall growth and development of students.

4. Principle of operational feasibility. All top-down designs should be executable, and the success of learning outside classrooms depends on schools, colleges, and classes in introducing specific student-oriented plans. There is also joint responsibility and implementation of learning outside the classroom shared with relevant business departments and the cooperation and support of other departments is needed to guarantee its successful implementation and operation.

4. Suggestions for Fulfilling the Role of Learning Outside the Classroom in Nurturing Innovative Talents

4.1. Emphasis on curricular reform

In promoting the science and institutionalization of learning outside the classroom, developing a curriculum is both the focus and the difficulty, and it can be done in an integrated manner by drawing on the pioneering experience of classroom curriculum. First, the learning objectives, teaching plans and evaluation mechanisms of learning outside the classroom should be formulated according to the overall targets of different schools and professions. This includes developing a multi-layered teaching system, fully considering the characteristics of majors and grades, scrutinizing the relevance and operability of the curriculum of learning outside the classroom, and exploring the scientific laws and methods of such education to achieve scientific, reasonable and effective organization and implementation, and improve the layers and standard of learning outside the classroom. Second, learning outside the classroom and professional education are designed as a whole. In some majors with strong professional practice and a wide range of social needs, it is possible to fully integrate the practical course component with learning outside the classroom when designing the classroom training program, so as to ensure learning in classrooms is seamlessly connected with practical implementation outside of classrooms. Teachers naturally become the main participants in activities outside the class, and students will not discount these activities.

4.2. Use of flexible teaching methods

Learning activities outside the classroom have significantly different characteristics from those of the classroom, and they require teachers to adopt richer, more diverse and effective modes of teaching and students to interact and be the main participants in the teaching process. Flexible and fresh activities outside the classroom can meet contemporary college students' demand for novelty and change, effectively increasing their enthusiasm, passion and comprehensive abilities. Teaching outside the classroom should adopt various methods such as participation, inquiry, discussion, group work and scenario-based teaching, with flexible and intuitive means of teaching and diverse practical activities. Students are empowered to freely choose course content and learning methods, and practice innovation through active participation.

4.3. Establishment of a sound evaluation system

Learning outside the classroom, as a part of education, must focus on its effectiveness in the development of

innovative talents and be evaluated systematically. Such a mechanism should be considered from the perspective of both the implementers and the participants. From the perspective of the implementer, it should focus on whether the design and implementation of learning outside the classroom is consistent with the overall development of the school and the profession. From the perspective of the participants, it should focus on the developmental indicators of students, such as whether it meets their subjective needs, the richness of the activities, the enthusiasm of students' participation and the coverage rate of the activities. The educational effectiveness of learning outside the classroom should be incorporated into the overall framework of quality evaluation of higher education. Multiple dimensions, such as students' evaluation of activities, faculty's evaluation of students, school's evaluation of faculty, and society's evaluation of school, can be integrated to establish a scientific and reasonable evaluation system for learning outside the classroom.

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