

Student Core Competence and Evaluation under Engineering Education Certification System

Yun-song Tan*, Hao Jin and Xiao-hua Liu
Wuhan Institute of Technology, Wuhan, Hubei, China

*Email:

543585898@qq.com

Abstract. The purpose of this study is to explore the impact of engineering education certification on students' core competence, and to understand the current way of evaluating students' core competence in domestic universities, to implement the quality assurance mechanism of students' learning effectiveness, and to provide reference for domestic output-oriented engineering education certification. Finally, some useful suggestions are put forward for the current plight and future research of continuous improvement of certification specialty.

Keywords. Engineering education; Core competence; Evaluation

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1. Introduction

Education is the cornerstone of a country. Higher education is the main social activity to train senior professionals and professional personnel, and it is one of the important components in the education system. Engineering education is an important component of higher education in China. The core of engineering education certification is to confirm that engineering graduates meet the established quality standards recognized by the industry. It is a qualification evaluation oriented by training objectives and graduation export requirements. The certification of engineering education requires the establishment of professional curriculum system, the allocation of teachers and the allocation of school running conditions to be carried out around the core task of students' graduation ability, and emphasizes the establishment of professional continuous improvement mechanism and culture to ensure the quality and vitality of professional education. China Engineering Education certification is organized and carried out under the leadership of China Engineering Education Certification Association to implement the specialized certification of engineering education in higher education institutions. Engineering education certification is the internationally accepted quality assurance system of engineering education, which is also an important basis to realize international mutual recognition of engineering education and engineer qualification. China's engineering education

certification began in 2006. By the end of 2019, a total of 241 institutions of higher learning nationwide had passed the engineering education certification in 1,353 majors, involving 21 engineering majors such as machinery and instruments.

It is increasingly important to ensure the quality of university or higher education, and quality assurance of higher education has become one of the important contents of higher education research and public policy in various countries. Implement educational objectives and develop students' core abilities to ensure students' learning effectiveness. Therefore, the evaluation of students' learning effectiveness is the focus of higher education quality assurance at present. Student learning effectiveness is a quality assurance system based on output-based system, which emphasizes continuous improvement and attaches importance to the cultivation of graduates' core abilities. The purpose is to evaluate whether certified majors achieve their self-defined educational goals and determine that graduates have core abilities to perform professional work based on their achievements. Attach importance to teaching effectiveness and evaluation, and establish a long-term continuous improvement mechanism. However, since the implementation of engineering education certification, there is still an urgent need to make efforts in the establishment of self-evaluation mechanism and the implementation of continuous improvement. At present, in the process of engineering education certification, the main problem is that they tend to pay more attention to the overall education planning, and lack of in-depth exploration and discussion in the curriculum, especially the integration of the overall teacher into the curriculum design, development, implementation and evaluation. The problems are not deeply related to the curriculum and students' learning outcomes, but still remain in the evaluation of the overall structure. Teachers' participation and investment in engineering education certification are not enough, curriculum planning and integration are not complete, and there is no curriculum design based on educational objectives. In recent years, the trend of international higher education pays more and more attention to students' learning results and emphasizes the cultivation of students' core abilities. In order to promote the quality assurance mechanism of students' learning effectiveness, the primary task is to clearly define the three aspects of core abilities that students should have when they graduate, including professional knowledge, skills and attitudes, according to the development orientation of the school and the establishment purpose and educational objectives of the major itself. In other words, the achievement of core competence is closely related to students' learning effectiveness. At present, most of the accredited majors have completed the establishment of core competence system, but the evaluation mechanism of core competence needs further research. The purpose of this study is to analyze the current status of engineering education accreditation quality assurance system and student core competency assessment. After the implementation of engineering education certification system, the improvement of students' core competence and how to implement the evaluation of students' core competence are studied[1].

2. Literature Review

Countries around the world have reached a consensus on the importance of the quality of higher education, and there are specialized agencies responsible for monitoring and ensuring the improvement of education quality. The same is true for engineering education certification, which not only has a set of certification standards, but also has a professional body responsible for it. The Accreditation Board for Engineering and Technology in the US, ABET, The Canadian Engineering Accreditation Board and Engineering Council UK, etc. In order to establish a set of mutually

recognized mechanism and platform for certification systems of various countries, engineering education certification bodies from Australia, New Zealand, Canada, the United States, Ireland and the United Kingdom signed the Washington Accord (WA) in 1989. The main spirit, provided that each signatory Member state acknowledges each other's accredited degrees, thereby enabling graduates of those countries to work in the member State of the agreement or to obtain engineering and technology licenses, thereby achieving international connectivity.

The development of higher education quality assurance refers to a set of theoretical and practical system in which internal and external institutions control, examine and evaluate teaching related factors according to a set of quality standards and working procedures under the guidance of higher education quality concept and value orientation, so as to ensure the quality of higher education to the society. The basic idea is to improve the standard of teaching and research in universities, to protect the interests of students and parents, and to enable universities to contribute to social and economic development. Quality assurance has been gradually promoted around the world since the 21st century. In Europe, almost all countries have established quality assurance systems of varying degrees. The key to improving the quality assurance of higher education is to strike a balance between internal improvement and external accountability. External quality assurance is an extension of internal quality assurance, which is evaluated by an external independent evaluation or certification body. The external expert panel, usually composed of scholars and experts from other schools, evaluates the educational quality of the institution in a fair, fair and open way, and thus learns whether the institution itself has reached its due level and performance. Internal quality assurance is concerned with students and teaching operations. Teachers in the front line classroom teaching quality assurance if teachers teach well, students learn well, the quality of teaching has been the most basic guarantee.

There will be a greater emphasis on accountability for performance in higher education, with particular emphasis on evaluating student outcomes and transparency of evaluation results and information. In terms of academic degree standards and professional training programs of various countries, learning results are used to show the quality and level of higher education to varying degrees. It should be the most reasonable and appropriate to examine the quality of higher education by students' learning results. Therefore, in the quality assurance mechanism, the evaluation of students' learning effectiveness is highly valued, but also the current trend[1].

3. Content of Students' Core Abilities

In recent years, ABET has put forward many innovative and practical education reform plans for engineering education, among which the most important one is to develop the core competence of the department, that is, the ability and knowledge that students have when they graduate, including: the ability of applied mathematics, science and engineering knowledge; Ability to design and perform experiments and analyze and interpret data; The ability to design systems, components, or programs to meet specific requirements; Ability to function in a cross-functional team; Ability to identify, articulate and solve engineering problems; Understanding of professional and ethical responsibilities; Ability to communicate effectively; The broad education required to understand the impact of engineering solutions in global and social contexts; Recognize the necessity of lifelong learning and the ability to practice it; Knowledge of contemporary issues; Technology, skills and modern engineering skills required to perform engineering operations. These eleven competencies outline the quality standards for bachelor of Engineering degree education in the United States.

The graduation requirement stipulated by the engineering education certification in China is a specific description of the knowledge and ability that students should master when they graduate, including the knowledge, skills and accomplishment that students have mastered through the study of this major. There are twelve standards in total, mainly including: the ability to use mathematics, science and engineering knowledge; Ability to design and perform experiments, analyze and interpret data; Skills, techniques and the ability to use modern tools to solve complex engineering problems; Ability to design engineering systems, components, or programming; Ability of project management, effective communication, field integration and team work; Ability to explore, analyze and apply research results and solve complex engineering problems; To understand the environmental, social and global impact of engineering technology and develop the habit and ability of continuous learning; Ability to understand and apply professional ethics and social responsibility. The hierarchical structure of students' core competence is shown in Figure 1.

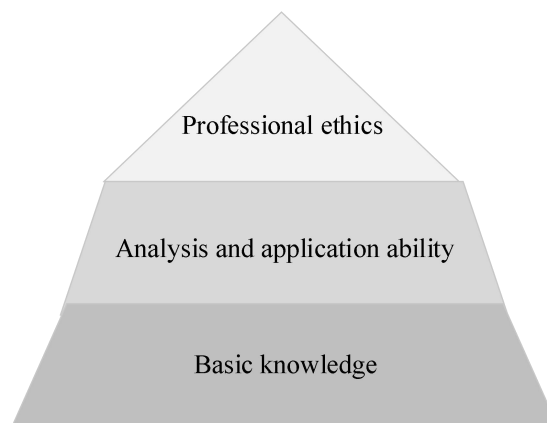


Figure 1. Core competency hierarchy.

Common standards for graduation requirements are characterized by clear, open, measurable, and comprehensive coverage. The standards will be incorporated into the professional development program and must be known and understood by both teachers and students. The standard will be decomposed into index points, which will be effectively implemented into the curriculum system, and whether it is achieved through objective and reasonable methods. The twelve general standards are the minimum requirements. Graduates should be higher than the general standards in terms of knowledge, skills and accomplishment, and be able to solve complex engineering problems and achieve professional training goals.

At present, the problem is that a lot of work has been done in the aspects of students' core ability, achievement of targets, curriculum and teaching methods, and multi-evaluation, but there is a lack of point-to-point and point-to-line connections. In other words, they failed to further analyze and interpret the evaluation results to propose improvement mechanisms corresponding to the core competencies. The connection of these lines is the core to prove the achievement of continuous improvement in engineering education certification. Otherwise, the data prepared only represent that they have superficial data, in fact, no introspection mechanism has been established, and continuous improvement has not been implemented. Therefore, it is necessary to further discuss the achievement of students' core competence.

4. Continuous Improvement and Evaluation

Evaluation is an indispensable part of the teaching process. Teachers' teaching efficiency, students' learning effectiveness and excellent course design can all be revealed through evaluation. The importance of assessment lies in how teachers use the information obtained from assessment to understand the core competencies of students and provide schools and teachers with continuous improvement, as shown in Figure 2.

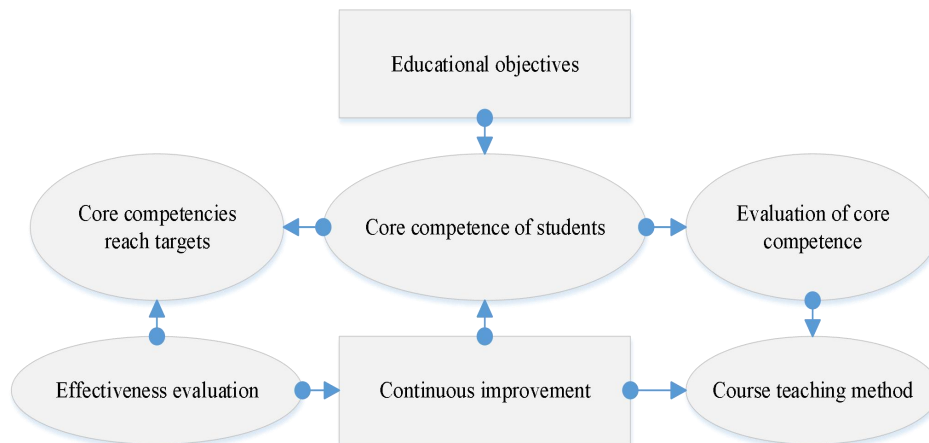


Figure 2. Continuous improvement mechanism.

4.1. The evaluation method should conform to the teaching objectives

The evaluation goal must be closely related to the teaching goal, evaluation is one of the teaching activities to achieve the overall teaching goal, the purpose is to know whether the students reach the standard. To help students develop their potential and achieve high level learning goals. Importance is that the method of evaluation can give some evidence of whether students' learning is in line with teachers' expectations. Evaluation can teach students how to learn, how to think, and how to show learning results in as many aspects as possible. If the evaluation content is inconsistent with the objective, the student will be deprived of the opportunity to learn again. When the evaluation method is consistent with the teaching objective, the evaluation result can be regarded as the learning result.

4.2. The teaching content should conform to the way of evaluation

Teaching content is the main body to help students learn, while evaluation is used to examine how well students learn. If the evaluation task is inconsistent with the teaching activity, the teacher will not be able to evaluate the effectiveness of the teaching activity, and will not know the learning status and ability of the students. In the past, teachers believed in the fairness and validity of pen-and-paper tests, while pen-and-paper tests often emphasized memory, so they must be evaluated in multiple ways according to the requirements of engineering certification. Ensure that course objectives, teaching activities and evaluation methods are consistent, better understanding of student effectiveness, and then achieve continuous improvement of quality assurance.

4.3. The purpose and application of scoring criteria

The scoring standard originally refers to the notes in scoring, and has been extended to be regarded as a scoring standard of learning evaluation. The criteria for determining whether a student has achieved his or her work objectives are guidelines, principles or criteria that can be used to assess the student's performance and response to the work to see how well the student has achieved the teacher's original

expectations. Students can also adjust themselves to improve their performance through this process. Grading standards must be planned earlier than lesson plans and should be based on the learning objectives of each unit of instruction. This is conducive to the consistency of scoring standards and teaching objectives.

5. Conclusions and Suggestions

The purpose of this study is to explore the impact of the implementation of engineering education certification on students' core competence, analyze the development of engineering education certification, understand the indicators of students' core competence, and put forward some beneficial suggestions for the evaluation of core competence. At present, more than 1,000 engineering majors have passed the certification. The core concept of engineering education certification is "Student-centered, Results-oriented and continuous improvement". This idea fundamentally changed the concept and practice of school teaching and management, promoted the optimization of talent training program, and promoted the reform of classroom teaching paradigm.

Conflicts of Interest

There is no conflicts of interest.

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