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Evaluation Method of Course Goal Achievement Degree of Engineering Education Certification Based on Intelligent Image Processing

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Abstract: The accreditation of engineering education professional qualification certificate is an important way to improve and ensure the quality of engineering education, which is also an important aspect of the quality assurance of engineering education in China. With the acceleration of economic globalization and closer international exchanges, China's engineering technology education is facing greater challenges. More and more international forces are impacting China's engineering technology education, and technological change has also changed the content and methods of engineering technology education. How to cultivate the compound engineering and technical talents that meet the needs of the market is a major problem faced by all countries. The professional qualification certificate of engineering education is an important way to solve this problem, which has attracted extensive attention from the industry, universities and the government. Therefore, this paper used intelligent image processing technology to study the degree of realization of the objectives of the engineering education professional qualification certificate course. In the experiment of certification and evaluation of engineering education, 50.22% of the students believed that management ability was the most necessary ability. Only a few students thought that the ability of psychological quality was more important, accounting for 13.28%. Therefore, it was necessary to study the certification course of engineering education.

1. Introduction

It is one of the hottest research topics to analyze the evaluation methods for the achievement of the curriculum objectives of the engineering education certification. In order to evaluate the current situation of engineering education, Smith Jeremy reviewed 67 engineering education programs and

initiatives related to the common goals of maintaining life and alleviating human suffering [1]. The purpose of Hammack Rebekah's research was to explore university teachers' views on integrating engineering into the classroom and the obstacles to doing so [2]. Rouvrais Siegfried suggested expanding the concept, design, implementation and operation (CDIO) framework as a comprehensive activity to better meet industry requirements and students' ability expectations as future engineers [3]. Denton Maya aimed to understand how Community Cultural Wealth (CCW), an asset based framework, was applied to science, technology, engineering and mathematics education research [4]. However, due to the lack of data sources, the above studies were only at the theoretical stage and had no practical significance.

It is innovative to use intelligent image processing methods to analyze the evaluation methods for the goal achievement of the engineering education professional certification courses. Among them, Peter-Burton Erin E aimed to obtain the results of a systematic cross case analysis. He explored the scope of engineering learning opportunities in five examples [5]. Mavromihales Mike aimed to evaluate the effectiveness of game based learning in the undergraduate module of computer-aided design and manufacturing. Although it was widely used in some disciplines, the application of game based learning in engineering and technology seemed to be limited [6]. Berdanier Catherine GP discussed the ethical reflection of American engineering doctoral students after two weeks of studying electronic manufacturing in India [7]. In 2018, Herkert Joseph proposed that the lessons learned from aircraft crash cases included the need to strengthen the voice of engineers in large organizations. It was also necessary to let professional engineering societies participate more in ethics related activities and pay more attention to moral courage in engineering ethics education [8]. However, due to the definition of traditional thinking, the above studies could not be highly integrated and give full play to their advantages.

This paper was based on previous literature and research on science and engineering students. In terms of innovation, the innovation of this paper was reflected in the following aspects: (1) Three international graduate competency standards and two engineering education professional certification graduate competency standards were compared, and the similarities and differences between the two were found. (2) Based on the professional qualification certificate of engineering education, the basic connotation of engineering and technical talents was summarized according to the current social development trend and the prospect of students' career development, and the corresponding evaluation indicators were established. (3) Science and technology majors were used as research objects for empirical research.

2. Investigation of the Evaluation of Engineering Education Professional Certification Courses Based on Image Processing

2.1 Professional Certification of Engineering Education

In recent years, China has made great progress in the research of engineering education certification, but there is a big gap between China and overseas advanced level. This is mainly because China's literature is not rich enough; there are few professionals engaged in specialized research; the number of certification agencies is small; the implementation is not strong enough; there is a lack of in-depth theoretical research and practical experience. In China, the professional qualification certificate of engineering education is not only a bridge connecting engineering education and engineering education, but also a strong guarantee to improve the registered engineer system and ensure the quality of engineering education [9-10]. Based on the definition of engineering education professional certification by overseas experts and scholars, this paper defines the relevant majors (electrical automation, etc.) of engineering education professional certification as follows: The professional qualification certification of engineering education refers to the quality

management and accreditation of the relevant majors (electrical automation, etc.) participating in the certification of engineering education within the scope of engineering education by the participants of engineering education, such as personnel from relevant industries, engineering technicians, experts and scholars, and college teachers engaged in engineering education activities, so as to ensure that the trained engineering talents meet the needs of the development of engineering education. In recent years, with the increasing attention paid to professional qualification certificates, China Engineering Education Professional Certification Association has referred to overseas professional qualification certificates according to the current situation of engineering education in China. The standard items of professional certification of engineering education in China are shown in Figure 1:

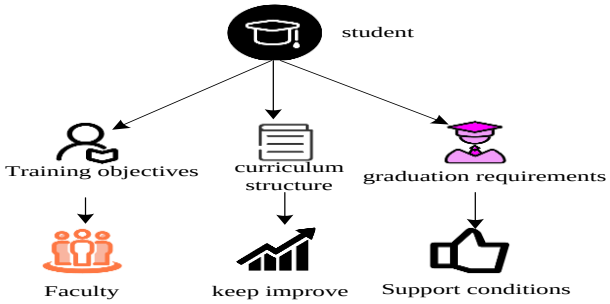


Figure 1: Standard items of engineering education professional certification

2.2 Training Orientation of Engineering Education Objectives

With the development of the times, the training objectives of engineering education in China also have their own characteristics. Figure 2 shows the training objectives of China's engineering education at each stage.

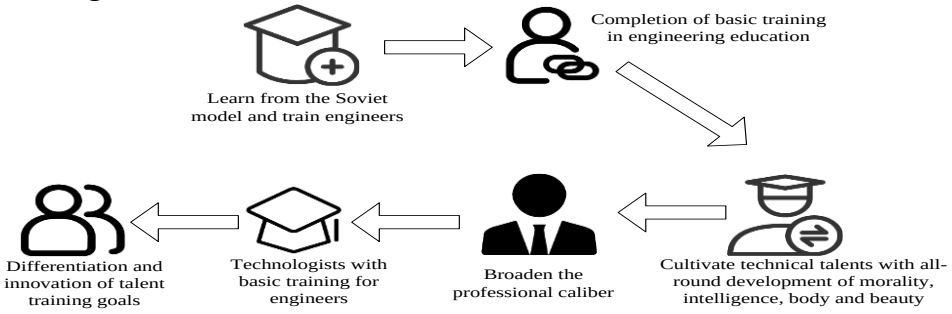


Figure 2: Training objectives of engineering education in china in different periods

Since the founding of the People's Republic of China, the training objectives of engineering education in China have changed greatly, and have played a good guiding role in practice. In short, in different historical stages of China, the training objects of engineering education are relatively general, and there is no clear goal [11]. Therefore, in defining the orientation of talent training objectives, it is necessary to take the orientation of modern engineer talent training objectives as its core work, and gradually improve the vocational training objectives in accordance with the relevant provisions of the professional qualification certificate of engineering education; by starting from the current situation of engineering education in China and based on social needs, the training objectives of engineering education at different stages in China are analyzed, and their advantages and disadvantages are summarized; by learning from overseas advanced management experience, a forward-looking, instructive and practical training goal for modern engineers is formulated to guide the reform of engineering education in China [12].

2.3 Basic Links for Continuous Improvement of Engineering Education Optimization Quality

(1) Establishing Plan-Do-Check-Act (PDCA) cycle mode for engineering discipline

Engineering colleges and universities should establish a distinctive and sustainable management system according to the actual situation of engineering teaching. In the process of formulating career development plans, problems should be found and solved in a timely manner; in terms of professional talent training program, teaching team construction, high-quality courses construction, practice base construction and other issues, it points out the development direction for training modern engineering talents; in the process of implementing the development plan, after discussion and effective implementation of the plan, the idea of professional development is innovative and this is a new road to industrialization; when implementing the plan, all aspects of its implementation need to be comprehensively reviewed; in the review stage, it is necessary to comprehensively and massively carry out the acceptance of teaching achievements, student management and scientific research. It also needs to establish a professional supervision team and hire a professional teacher to serve as the leader of the teaching supervision team of the secondary college, so as to propose a feasible plan for the training of modern engineers; in the process of feedback on the improvement results, the completed work is summarized, and the engineering teaching is constantly improved through re-planning and design methods. These continuous improvement measures form the practice mode of PDCA cycle, which embody the basic principles of quality management.

It is an important standard for engineering education to effectively master the status and data of career development, and propose specific solutions to problems, so as to improve the professional rectification plan and establish a constantly improving quality management system. This relates to the development of a profession and is also the key to training modern engineers [13]. The flow chart of engineering discipline of PDCA cycle model is shown in Figure 3.

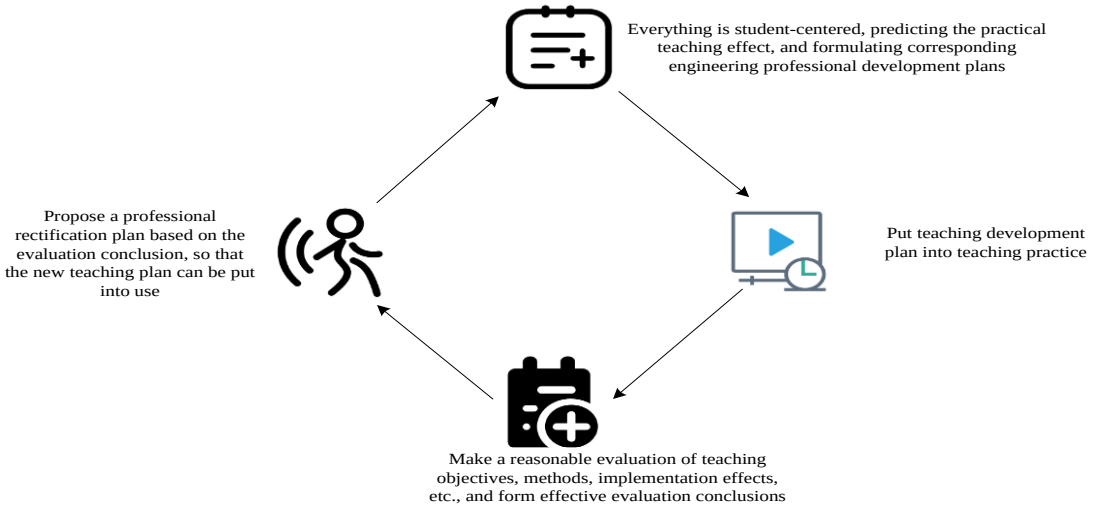


Figure 3: Flow diagram of PDCA mode for engineering discipline

(2) Establishing and improving the internal monitoring system of teaching links

The training of modern engineering and technical personnel is a complex systematic project. It is necessary to establish an effective internal supervision system, and narrow the gap with expectations, so as to establish a perfect monitoring system for the training process of modern engineers based on the professional qualification certificate of engineering education [14-15].

The internal monitoring system of teaching links is an important part of monitoring teaching work. The internal quality monitoring of the teaching link can effectively avoid the difference between the expected teaching quality and the teaching quality in the teaching process. Through the

opportunity of monitoring and evaluation by teachers, teaching management personnel, students and other relevant groups, the monitoring means are used to achieve the monitoring effect, and the internal quality monitoring system of the teaching link is established. The basic methods are as follows: Teachers, teaching administrators, students and other relevant groups monitor and evaluate the opportunity, and use an objective and rational way to measure the implementation effect of teaching links. The flow chart of the internal supervision system in the teaching process is shown in Figure 4.

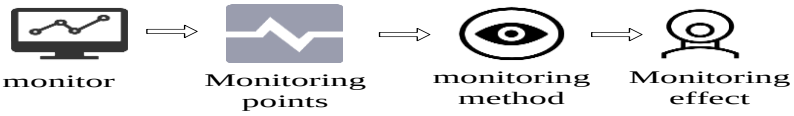


Figure 4: Quality monitoring process of teaching link

The strengthening of internal supervision of engineering education is to improve the teaching level of engineering specialty and enhance the adaptability of engineering education and enterprises. By organizing students and using correct evaluation methods, the evaluation effect is achieved, and a teaching quality monitoring system for engineering education is established. The specific methods are as follows: The school and departments organized experts, department leaders, teachers and student groups to evaluate the degree of realization of professional teaching effects through routine inspection, lectures and teaching evaluation. The flow chart of the internal supervision system in the teaching process of the engineering specialty is shown in Figure 5.

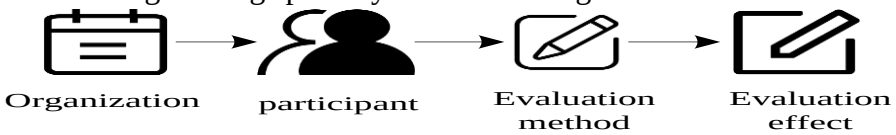


Figure 5: Teaching quality monitoring process of engineering education major

(3) Improving the follow-up and feedback mechanism of graduates

The establishment of tracking and feedback mechanism for new graduates is relatively simple. On the one hand, college students are at the border between the school and the company, so they can clearly understand their employment intentions and career development. The difficulty coefficient of establishing, collecting and maintaining relevant information is relatively small. Colleges and universities generally collect and feed back the basic information of fresh graduates by collecting their basic information, on-site questionnaires and symposiums; on the other hand, the evaluation of college graduates in terms of professional training objectives, curriculum system, content and methods, practice links, teachers' quality and ability is more reasonable and objective, so the data collected are representative and of research value. For college students with certain social practice experience, the construction of the tracking and feedback mechanism is relatively complex. The root cause is that the connection between the school and the graduates is cut off. Some colleges and universities establish good relations with the graduates through QQ alumni groups, alumni activity centers, alumni associations and other channels. Compared with newly graduated college students, they have relatively rich work experience, which is of great significance in professional development planning, curriculum reform, innovative practical ability, etc. At the same time, colleges and universities should also investigate and analyze graduates' engineering professional knowledge, innovation ability, professional ethics and other aspects through symposiums, questionnaires and alumni 'feedback, so as to formulate an effective professional development and reform plan and truly achieve continuous improvement.

2.4 Spatial Adaptive Image Smoothing Algorithm in Teaching Quality Monitoring

This part describes an unsupervised learning method based on edge preservation and spatial adaptive smoothing. The overall energy function in this paper is expressed as follows:

$$\varepsilon = \varepsilon_d + \lambda_f + \varepsilon_f + \lambda_e * \varepsilon_e \tag{1}$$

Among them, ε_d is a data item; ε_f is a smooth term; ε_e is the edge reserved item; λ_f and λ_e are constant balance weights. To maintain structural similarity, data items are used to measure the color difference between the output image and the input image. I represents the input image and T represents the output image. The data items in the color space of the color system (RGB) are defined as follows:

$$\varepsilon_d = \frac{1}{N}\sum_{i=1}^{N}\left\|T_i - I_i\right\|_2^2 \tag{2}$$

Here, i represents the pixel index and N represents the total pixels. To solve this problem, this paper proposes a clear edge preservation evaluation method to maintain the importance of edge points. Before giving this criterion, this paper would introduce the concept of boundary oriented graph, that is, the definition of boundary reaction. A simple edge response is the sum of the local gradient amplitudes of the image:

$$E_i(I) = \sum_{j\in N(i)}\left|\sum_c (I_{i,c} - I_{j,c})\right| \tag{3}$$

Among them, $N(i)$ represents the neighborhood of point i, and c represents the color channel of input image I. A similar edge map of the output smooth image F can also be calculated as $E(T)$.

The edge reservation terms herein are defined by minimizing the quadratic difference of their edge responses between the edge guide images $E(I)$ and $E(T)$. It is assumed that B is a binary mapping. Among them, $B_i = 1$ represents important edge points and $B_i = 0$ represents non important edge points. The definition of edge reservation in this paper is as follows:

$$\varepsilon_e = \frac{1}{N_e}\sum_{i=1}^{N} B_i * \left\|E_i(T) - E_i(I)\right\|_2^2 \tag{4}$$

Among them, $N_e = \sum_{i=1}^{N} B_i$ is the total number of critical edges. The “important edge” is a subjective concept, which is different in different applications. The most ideal binary mode is to mark users’ preferences manually, but it is very difficult to mark manually at the pixel level. This paper adopts a simple and efficient edge detection method, and applies it to this algorithm according to user preferences.

3. Evaluation Method of Achievement Degree of Engineering Education Professional Certification Course Objectives

Investigation is the most effective way to understand objective things. The research on the core competence of science and engineering students can effectively reflect the cultivation of the core competence of colleges and universities. Through the investigation of science and engineering undergraduates, this paper understands their current situation and existing problems, and puts

forward corresponding countermeasures.

3.1 Investigation on the Core Competence of Students Majoring in Electrification

It mainly consists of the following stages:

Investigation preparation stage:

By consulting the literature and understanding the research background, a questionnaire was prepared on this basis, and the questionnaire was revised and improved under the guidance of the tutor. Finally, a formal questionnaire was formed.

Investigation implementation stage:

The survey was conducted from October 2020 to January 2021. The questionnaire was edited through the online questionnaire star system and distributed through mobile phones and the Internet.

Investigation, recovery and analysis stage:

As of January 2021, the online questionnaire was distributed through the online questionnaire star system, and 500 valid test papers were recovered through mobile phones. The target population of this survey was science and engineering students.

The contents of the questionnaire included single choice, multiple choice and filling in the blank. The content of the questionnaire included the following: the concept of core competence, the role of core competence, the training approach of core competence, the training method of core competence, the curriculum arrangement of core competence, etc. The relevant content of the survey and the number of questions are shown in Table 1:

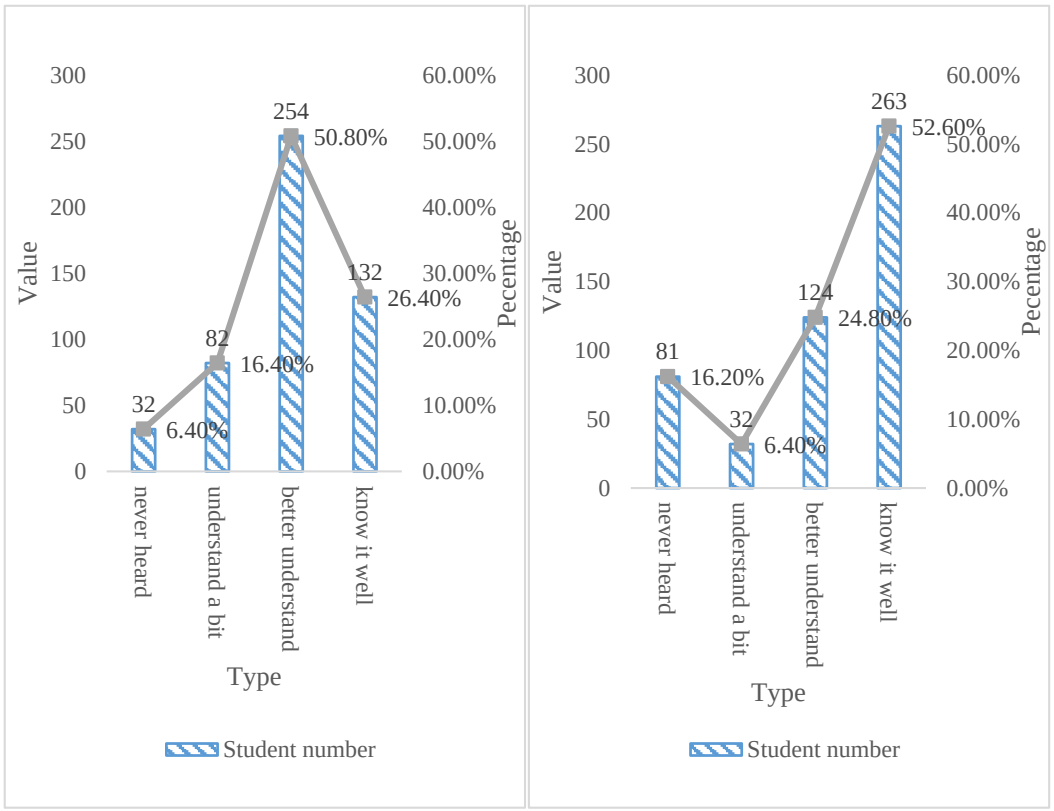
Table 1: Relevant contents of student questionnaire

Serial number	Investigate subject	Surveyors
1	Basic information of the survey object	500
2	Cognition of core competencies of science and engineering students	500
3	Mastery and evaluation of core competencies for science and engineering students	500
4	Condition	500

3.2 Evaluation of Investigation Results of Core Competence of Students Majoring in Electrification

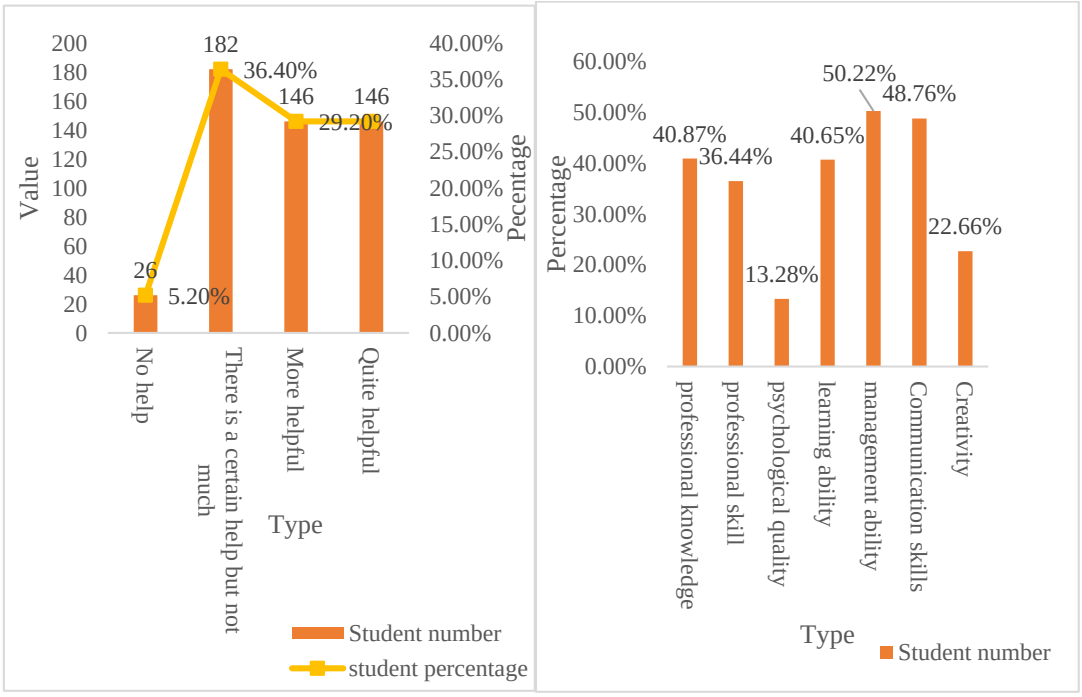
As China formally joined the Washington Agreement and accepted the recognition of the International Energy Agency (IEA), the core competence of the Graduate Core Competence and Professional Standards was widely valued by universities and the society. However, through this survey, this paper found that these students had some differences in their understanding of their core competence. The attitude of students towards engineering education is shown in Figure 6.

As shown in Figure 6 (a), 32 students showed that they had never heard of the concept of core competence, accounting for 6.4%. The number of people who knew something about it was 82, accounting for 16.4%. There were 254 people who knew more, accounting for 50.8%. 132 people knew it very well, accounting for 26.4%. In Figure 6 (b), 81 people said that they never heard of the ability to solve complex engineering problems, accounting for 16.2%. 32 people said they knew a little, accounting for 6.4%. The number of people who knew more was 124, accounting for 24.8%. 263 people were very familiar with it, accounting for 52.6%. Therefore, the impact of engineering certification education on education in China was relatively good. However, different cognition of core competence would inevitably lead to different evaluation. The statistical chart of ability evaluation of science and engineering students is shown in Figure 7.



(a) Students' cognition of core competence (b) Students' cognition of ability to solve complex engineering problems

Figure 6: Statistics of students' attitudes towards engineering education



A. Students' evaluation on the necessity of cultivating core competence
B. The abilities that science and engineering students should have most (multiple choices)

Figure 7: Statistics of ability evaluation of science and engineering students

As shown in Figure 7A, 26 of them believed that the core competence training was not helpful or necessary, accounting for 5.2%. 182 people thought it was helpful but not much, accounting for 36.4%. 146 people thought it was helpful, accounting for 29.2%. There were also 146 people who thought it was quite helpful, accounting for 29.2%. In Figure 7B, most students thought that management ability was the most necessary ability, accounting for 50.22%. Only 13.28% of the students thought that the ability of psychological quality was more important.

The choice of training methods to cultivate core competence should be based on the learners' own conditions and the environment. In addition, the cultivation of the school's internal system is an important way to cultivate students' core competence, which plays an irreplaceable role.

4. Core Competence Cultivation and Continuous Improvement Strategy of Engineering Talents

Through the investigation and analysis of the core competence of Chinese science and engineering students, and based on the core competence indicators proposed in this paper, this paper would comprehensively analyze how to infiltrate the core competence cultivation into the whole process of talent cultivation from seven aspects.

4.1 Concept Introduction

(1) Establishing a new concept of engineering talent training

The main characteristics of the new industrial revolution are as follows: The combination of new technologies and the emergence of new business models have brought about new changes in production, organization and business models. In order to adapt to the development of the times and cultivate talents that meet the requirements of the development of the times, the concept of talent training must be changed and a new education concept that meets the requirements of the development of the times must be established. After China introduced the professional qualification certificate of engineering education, the three ideas proposed in the Washington Agreement strongly impacted the concept of higher engineering education in China, so that colleges and universities must actively absorb advanced teaching concepts and establish new training concepts, so as to cultivate a new generation of engineering and technical talents to meet the needs of social development.

(2) Establishing the concept of output oriented engineering education

The traditional engineering education is a major centered teaching mode. Major setting follows the principle of discipline division, and its teaching mode tends to solve the problems that are determined, linear, closed and static in a scientific way. The key of knowledge structure is systematic and complete discipline knowledge system. In the selection of course content, it focuses on professional requirements, while ignoring the needs of social industries and enterprises. The implementation of professional qualification certificate of engineering education puts forward higher requirements for "output oriented" engineering education.

(3) Establishing the concept of student-centered engineering education

The professional qualification certificate of engineering education always adheres to "people-oriented" as the starting point to meet the needs of different students and reasonably allocate teaching resources. Training objectives determine the development and academic performance of students. In order to achieve the intended learning effect, it is necessary to provide the corresponding teaching environment.

4.2 Design of Training Objectives for Demand Oriented Engineering Talents

The training objective refers to the concretization of the education purpose in various schools at all levels, and the training of qualified talents by various schools at all levels to meet the needs of society, industry and enterprises. The establishment of the training objectives of colleges and universities should take advantage of the educational concept of "student-centered and results oriented", and break the traditional and single educational concept model, so as to establish the training objectives of colleges and universities from both the internal needs of colleges and universities and the external needs of society, industry and enterprises.

(1) Design of training objectives for engineering talents oriented by external demands

The determination of university training objectives should be based on external needs. External needs include social needs, enterprise needs and alumni expectations. Social demand refers to the demand for purchasing power of higher education formed in a certain period according to the demand for labor force and professional and technical talents from the future economic and social development of the country. The greatest driving force for the development of higher education and resource allocation is social demand. With the development of society, enterprises and industries to a certain period, the industry and enterprises have a great demand for human resources and professional and technical personnel.

(2) The design of training objectives for engineering talents guided by internal orientation

The internal needs of university education goals include the orientation of the school and the development of students. The orientation of the university is the orientation of the university itself and the orientation of the trained talents. Only the correct orientation can provide suitable talents for the local economic development. The focus of college students' development is the school's planning of its own development direction and ability, and the internal needs of the university's training objectives should be both from its own perspective and focus on the development of students.

(3) Selection of teaching mode of core competence oriented engineering talents training

With the development of society, higher engineering education is constantly changing, and the training mode of engineering talents is also constantly reforming to meet the needs of social and economic development. If colleges and universities want to bring the cultivation of core competence into the cultivation of engineering talents, they must choose a suitable talent cultivation mode, and analyze its advantages and disadvantages, so as to lay a theoretical foundation for talent cultivation.

5. Conclusions

Based on the theory of education and the background of engineering education qualification certificate, this paper used the methods of literature comparison and intelligent image processing to clarify the connotation and characteristics of its main abilities. The requirements of the Washington Agreement, the Sydney Agreement, the Dublin Agreement, the general university criteria for excellent engineer training programs, and the Chinese engineering qualification certificate were compared and summarized according to the five talent quality criteria. According to the current social and economic development requirements and the future development prospects of students, the new core competence system was established, which ran through the entire training process of cultivating students.

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