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International Comparison of Professional Degree Education Certification in Environmental Engineering

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Abstract. This paper takes environmental engineering education professional certification as the research object. (1) Through extensive literature research, the environmental engineering education professional certifications such as ABET, ECUK and ASIIN are taken as examples to the certification institutions involved in engineering education certification in developed countries. The content of the certification standard, the certification procedure, the relationship between the certification and the qualification of the engineer were systematically sorted and analyzed in detail. Through comparative analysis, the similarities and differences between the three certification bodies are obtained. (2) The comparative analysis method was used to classify the characteristics of engineering education certification in developed countries as “six combinations”.

1. Case Selection

This paper selects the American Accreditation Board for Engineering and Technology (ABET), the Engineering Council of UK (ECUK), the German Engineering Professional Certification Body (ASIIN) and other developed countries to carry out environmental engineering education professional certification specific cases. From the development of education certification, organization in-depth analysis and comparative analysis of certification standards, procedures and contents, and certification mechanisms, explore the similarities and differences between the certification of environmental engineering education in developed countries, and summarize their mature experiences.

2. Comparative Analysis

2.1. Common Analysis

The similarities in the certification of environmental engineering education in the United States, Britain and Germany mainly include the nature of characteristic, organizational structure, and certification procedures. The details are shown in Table 1.

As can be seen from the above table 1, the certification bodies have the same characteristic and they are all non-profit organizations and independent of the government. The government does not occupy a leading role in the certification process. The private certification body is completely autonomous. The certification standards, procedures and certification work are formulated according to professional characteristics. The government mainly plays a role of participation and support. Second, the organizational structure is the same to each other, they all adopt the board of directors system, the board of directors is responsible for administrative and supervisory work, the board of directors has set



up or authorized a special certification committee to carry out specific certification work. Third, the certification procedures are similar, and their certification procedures are basically in line with international standards.

Table 1. The same point of certification for environmental engineering education in the United States, Britain and Germany.

		ABET	ECUK	ASIIN
Same Point	Characteristic	Non-profit and independent of the government		
	Organization	Board system		
	Procedure	Application - Self-evaluation - Field visit - Professional certification - Certification results		

2.2. Difference Inquiry

The differences in the certification of environmental engineering education in the United States, Britain and Germany mainly include the types of certification, standards setters and details, the connection between certification and qualification of engineers, and the hierarchical structure of certification organizations. The specific differences are shown in Table 2.

Table 2. Differences between the certification of environmental engineering education in the United States, Britain and Germany.

		ABET	ECUK	ASIIN
Differences Point	Types of Certification	professional certification school certification	project certification	course certification school certification
	Standard setter	1.Board of Directors → General standards 2.Executive Committee →Supplementary Standards	1.Board of Directors → General Standards 2.Engineering Society →Professional Standards	ASIIN related members, industry experts, university professors, student representatives and other stakeholders
	Details	1.General standard 2.Common standard 3.Supplementary standard	1.General learning output 2.Special learning output 3.Professional supplementary standard	1.General standard 2.Special standard
	The connection between certification and engineer qualification is different	Minimum threshold for industry access and engineer qualifications		Mutual recognition, fully equivalent, industry-only access permission

(1) Differences in certification types

Their specific types of certification vary. ABET certification is divided into professional certification and school certification. The professional certification mainly evaluates the quality of professional teaching provided by higher education institutions. This is similar to the only form of certification for ECUK, project certification, but there are big differences. The British ECUK is

mainly for four degree-based project certifications, but it is not completely classified according to the degree level, but closely combined with the educational basic requirements of registered engineers, which fully reflects the ECUK certification features—close connection with the certification and acquisition of engineer qualifications. Although ASIIN in Germany is also carried out project certification and school certification, the biggest difference is that the certification subject of German project certification is curriculum rather than professional, which can be clearly seen from its certification standards. The concept, content, structure and other aspects of the degree program are specified in detail, so its project certification can be either a clearly defined subject certification or an interdisciplinary professional certification. At the same time, its special standards are specified for 13 basic disciplines, so the special standards required for interdisciplinary professional certification must meet the specific standards of the relevant basic disciplines.

(2) Differences in standard setters

Among them, ABET and ECUK basically adopt the board of directors to coordinate with relevant academic authorities, industry associations and experts to develop common standards, and then set up professional supplementary standards by the certification committee of the specific implementation professional certification. However, ASIIN in Germany is more concerned with the idea of certifying various stakeholders. Its certification standard is based on the European Higher Education Quality Assurance Standards and Guidelines, in addition to inviting industry experts, university professors and members of the Association Society. Student representatives and government representatives were also invited to participate in the development of certification standards, allowing a wider range of stakeholders to participate in the development of degree programs, goal development and evaluation of learning outcome, which also provided a basis for the government's education policy formulation and reference.

(3) Differences in specific certification standards details

The General Standards of ABET, Common Standards, and Professional Supplementary Standards provide detailed regulations for students, teachers, courses, hardware facilities, projects, and support forces in environmental engineering, and comprehensively certify requirements and settings of environmental engineering professional certification standards. The comprehensive consideration of this certification standard is inseparable from the unique characteristics of the United States, the large-scale private university and its consistent university self-government system. In the ECUK certification standards, general learning outcome, special learning outcome and professional supplemental standards are developed in terms of students' practical ability and skills. They also emphasize the professional requirements, holiday work experience and quantitative standards of outcome. The general standard of German ASIIN is based on the curriculum. Established for the center, since ASIIN's certification subject is a course, the certification standards have detailed requirements for curriculum setting, resources, exams, information preservation and disclosure, and course quality. At the same time, its special subject standard is divided into the scope of the curriculum. The special subject certification standard for environmental engineering requires environmental engineering professional degree education to meet computer and information science, physical technology, materials and process engineering, Basic engineering-specific subject certification standards for industrial engineering, earth science, mathematics, and physics. In summary, the ABET certification standards focus on professional and comprehensive facilities requirements. The ECUK certification standards focus on the requirements and considerations of students' practical ability and skills. The ASIIN certification is based entirely on the curriculum. sexual and comprehensive considerations to carry out specific certification work.

(4) Differences in certification organization hierarchy

The organizational structure of ABET, ECUK and ASIIN is different, and they are regulated and bound by relevant departments and laws of different countries. Among them, ABET in the United States and ASIIN in Germany all set up certification committees under the board of directors to organize specific certification work, while ECUK in the United Kingdom is an engineering institute authorized to cooperate to carry out certification work for different professions. This has a certain impact on the relationship between engineering education certification and engineering qualifications in the UK. Because the UK's engineering education certification and engineer qualification are carried

out in the same engineering professional society, this complicated and huge workload requires ECUK to not carry out all the certification deployment work. Therefore, it is necessary to coordinate and decentralize the engineering professional to implement the specific certification activities.

(5) Differences between the relationship between certification and the qualification of engineers

The ABET certification and the ECUK certification provide an admission entry to industry access and engineer qualifications. Only after they have successfully graduated from a professional that has passed the certification can they enter the environmental engineering industry to engage in related work. At the same time, students can only apply for and pass the environmental engineer qualification if they have obtained a master's degree (through environmental engineering professional certification). The ASIIN certification is mutually acceptable with the acquisition of environmental engineers, and completely equivalent. As long as you graduate from an ASIIN-certified environmental program, you will receive a professional qualification certificate. This is also the only access permission for the environmental engineering industry.

3. Characteristics

Through the above analysis of the similarities and differences between the professional certification of environmental engineering education in the United States, Britain and Germany, it is concluded that the characteristics of engineering education certification in developed countries include the following six aspects:

(1) Combination of independence and binding

From the nature of the certification body, the certification body is a non-governmental, voluntary civil institution. It is neither subordinate to certain social groups or individuals, nor controlled by certain universities, nor is affiliated with a certain government department. They are a social intermediary and an independent legal entity with high independence. It is the independence that guarantees the fairness of certification. But the independence of certification does not mean that the certification body can be the only one who wants to do it. Certification bodies are also subjected to internal constraints. It can be seen that the certification bodies of each country is also bound by the corresponding laws and relevant government departments in the country. At the same time, the certification bodies must obtain the approval of the relevant accreditation bodies and accept management constraints. Moreover, the certification body must strictly certify the standards and certification procedures to carry out certification activities for relevant institutions or professions, and publicize relevant certification matters and certification results through websites and magazines, meanwhile accept public supervision by institutions and the public.

(2) Combination of authority and sociality

Certification is a quality improvement process based on self-assessment and peer assessment. Throughout the certification process, teachers from various institutions of higher learning, executives from various departments, and practitioners in specialized industries are involved in the evaluation of certification. A certification team composed of experts and scholars not only guarantees the fairness of the certification process, but also provides strong guarantee for the authority of certification behavior and results. On the other hand, in addition to peer experts, there are a certain number of public representatives participating in the certification system, supplemented by the participation of the public, which not only provides guarantee for the authority of certification. At the same time, it has greatly mobilized the enthusiasm of the people who are enthusiastic about higher education to participate in higher education management, and has improved the openness, transparency and notarization of certification. Timely reflected the existing industry needs of the society to the real management and work of higher education. In the middle, it has increased the connection and interaction between higher education and society, so that higher education can hear the voice of society and understand the dynamics of society, improving the reality of education and satisfying the diversified needs of society. Finally, the participation of public representatives has fully promoted democracy and formed a good atmosphere for the whole society to pay attention to, supervise and higher education.

(3)Combination of voluntary and mandatory

Accreditation means that the quality of the university has reached the required standards, which will help to gain recognition from the society and the public, obtain relatively high-quality students in the increasingly fierce market competition, and cultivate graduates who are welcomed by employers. You can give priority to the government's various grants and subsidies, so colleges and universities generally apply for certification on their own initiative and voluntarily. But on the other hand, certification is mandatory. The quality assurance system of higher education in various countries has certain requirements for the certification work of colleges and universities. At the same time, once the colleges and universities are certified, they must undergo regular review by the certification bodies. Moreover, the acquisition of some engineer qualification certificates clearly requires the applicant to complete the certification of the professional courses.

(4)Combination of institutional and flexible

Certification is a mechanism for self-discipline and self-development in colleges and universities. With the continuous development and improvement of the certification system, each certification body has formed a reasonable and perfect organization, comprehensive and objective certification standards, a scientific and orderly certification process, and a democratic and fair decision-making mechanism. Although the certification activities are carried out in strict accordance with certain procedures and standards, the institutional procedures and standards are not static. According to the needs of social and economic development, some indicators (or weights) should be "fine-tuned" to continuously meet external The actual needs of higher education requirements. The certification standard is formulated by the institution and the certification body. Standards are constantly changing and developing through democratic consultations.

(5)Combination of openness and confidentiality

The certification body will publish the certification information on its website to accept the supervision of the public and stakeholders to ensure the fairness of the certification. At the same time as the relevant certification information is disclosed, the certification body also attaches importance to the confidentiality of relevant information. Experts, staff and public representatives participating in the certification generally sign a confidential agreement with the certification body to clarify the relevant responsibilities and powers.

(6)Combination of internality and externality combined

National colleges and universities have internal quality assurance mechanisms in line with the characteristics of the school. According to the certification standards and certification procedures, the actual implementation of the self-assessment method will be determined according to the actual conditions of the school. A relatively complete self-assessment mechanism has been formed internally to meet the certification body's certification. At the same time, the certification bodies of various countries have also strengthened cooperation and established mutual recognition mechanisms to promote the recognition of national professionals and graduates.

4. Common Problems and Development Directions

From the above case analysis, we can see that the common problems in engineering education certification in typical developed countries are: (1) The engineering field faces new challenges and puts forward new requirements for engineering education certification. The 21st century engineering field faces new major challenges, including the development and utilization of solar energy, the search for and development of clean renewable energy, and the promotion of engineering ethics and moral health. Faced with these new challenges, countries should start reforms in various fields, apply more advanced concepts and technologies to production practices, and train talents that are more in line with the actual needs of society. Therefore, in the process of engineering education certification, there should be more adjustments and adaptations to the new challenges of the engineering community. (2) The existing certification standards and standards are relatively fixed, and they are easily out of touch with reality. As the main gathering place for talents, the school has become the most powerful base for coping with challenges. At present, the regulations and standards for engineering education certification in various countries are relatively fixed, which may lead to a certain degree of disconnection between the educational certification standards and the actual needs of the engineering

community and society. The teaching direction and output of certified schools cannot better meet the needs of engineering development. Style and Spacing

5. Summary

Therefore, in order to better cope with the challenges of globalization, national engineering education certification should gradually adjust the whole process of certification, especially the setting of certification standards, and should adjust the specific certification standards with the times to make it more reflective of engineering. Practical application, more in line with the needs of engineering development. For example, in addition to strengthening advanced engineering courses and practical teaching, it is important to focus on students' actual output, including their ability to apply engineering theory, techniques, and methods to solve a wide range of engineering problems and students' perceptions of engineering activities. The ethical abilities embodied in engineering practice.

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