

Optimization and Reform of Talent Training Scheme for Engineering Majors Under the Background of Engineering Certification

Jun Xu^{1,2a*}, Gengmin Jiang^{1,2b}, Liying Xing^{1,2c} and Wenyu Zheng^{1,2d}

¹*Department of Civil Engineering and Architecture, Nanyang Normal University, Nanyang473061, Henan, China*

²*Nanyang Lingyu Machinery Co., Ltd., Nanyang 473000, Henan, China*

^a*xujunhit@126.com*, ^b*jianggengmin2013@126.com*, ^c*xlynany@163.com*, ^d*zhengwyny@126.com*

**corresponding Author*

Keywords: Education Sci, Engineering Certification, Engineering Specialty, Talent Training Program.

Abstract: With the advancement of science and technology, the modern industry is advocating higher requirements for the education of engineering professionals. Engineering education (EE), an important part of higher education, has played an important role in providing our country with quality engineering majors. Engineering certification is an important tool and foundation for improving the quality of engineering training and engineering professional training. Finding engineering experts suitable for the development trend of the new industrial road under the guidance of the certification standards for professional EE is an important task of EE in our country. The purpose of this thesis is to study the optimization and reform of the training program for engineering professionals under the background of engineering certification. In this article, in the context of engineering certification, we use literature research methods, comparative research methods, and system analysis methods to study engineering professional talent training programs. The results of the empirical analysis show that the engineering professional talent training program under the background of engineering certification emphasizes the application of EE in the talent training model, improving theory and practice, school-enterprise alliance, social development, technological progress, demand attraction and persistence of market feedback, and adhere to the principles of the system. It has formed an innovative model of talent training for optimization, stability and continuous improvement of engineering professionals. This will improve the implementation framework of modern engineering training strategies adapted to the actual development of EE in our country. To implement the effective operation of the framework, the training of modern behavioral engineers has laid the foundation for smooth training and created convenient conditions. Under the guidance of engineering qualifications, 80% of vocational colleges can guarantee the quality of education of engineering professionals.

1. Introduction

1.1 Background of Topic Selection

Engineering certification is very important in higher education. The globalization of talents and education, especially the global flow of engineering professionals, and the international mutual recognition of engineering certification, will promote the development of international economic globalization. At present, the structural surplus and shortage of engineering students coexist. Engineering students cannot fully meet the needs of companies. A country with advanced EE has established a world engineering innovation and talent highland research center through EE reform, exploring and forming unique Chinese model and Chinese experience. The engineering certification system aims to absorb the theory of higher education and clarify the direction of professional construction. Certification of majors, emphasis on expertise, vocational education reform, completion of talent development Therefore, promoting the training of engineers and technicians through certification of engineering professionals is an important guarantee for improving the quality of training engineers and technicians, and in the international competition, the higher engineering technology education of our country has a great meaning.

1.2 Significance of the Research

As the current training program for engineering professionals is not perfect enough, engineering professionals cannot be trained well, resulting in engineering professionals unable to meet the needs of enterprises. At this time, we need to make improvements, and we need to carry out engineering certification for engineering professionals. my country has interpreted the peculiarities of foreign engineering professionals training. This allows our country to learn from foreign advanced and typical experiences, seize the opportunity to develop EE, explore modern engineering training measures guided by EE professional certificates, and establish connections with EE. And at this stage, we found existing problems in the training of engineering experts in our country. New innovations in modern engineer training are of great importance in practice.

1.3 Relevant Work of Engineering Certification

Xiaobo Y pointed out that certification is an important tool for schools to ensure quality of education. Supervise the self-assessment process of schools with their own advantages, as well as peer universities, industries, etc. The purpose of this is to make more rational decisions about whether internal improvement methods are reasonable [1]. Zhang W outlined the development process of the engineering professional qualification system and the role of the professional qualification system as the minimum standard for the quality of education received from two aspects of protecting the collective interests of society, universities, teachers and students [2]. Promote the improvement of the quality of other related professions. School inspections and basic education, as well as the development of education evaluation standards. Tomic B introduced the training situation of foreign engineers in detail, and analyzed in detail the training mode of foreign engineers from the aspects of curriculum, education, training objectives, school-enterprise cooperation, continuing education and national engineer education [3]. However, I think that due to subject restrictions, the lack of research on engineering certification will inevitably lead to the inability to understand the root cause of the problem of training engineering professionals.

1.4 Innovation Points of This Research

(1) Engineering certification trains engineering professionals. Experienced engineering professionals can master more basic knowledge and basic professional skills, have excellent social adaptability and positive innovative thinking [4].

(2) This article regards the training of engineering professionals internationally as a systematic project, created related training programs, and dynamically implemented the latest EE theoretical ideas and innovative practical methods, and introduced them in the entire research process. Various training programs have been developed to make them clearer and clearer, and intuitively reflect their mutual relationship [5].

2. Method of Training Program for Engineering Professionals

2.1 EE Professional Certification Overview

The certification body specialized in EE is a professional certification body supervised and administered by an EE professional qualification examination agency supervised by a general university, and is composed of a team of experts in related fields and industries [6]. Its purpose is to provide the quality assurance of preparatory education for relevant engineering science and technology talents when they introduce this industry [7-8]. For professional certification, the college needs to establish a special curriculum system, appointed teachers and formed under the conditions of school operation [9]. All these focus on the core task of improving college students' graduation technical ability, and ensure the quality through the establishment of professional and continuous improvement of management mechanism and culture, the relationship and vitality of vocational education and college students' vocational education [10].

2.2 Research Ideas

Here, first, we will use the literature search method to collect and summarize the searched literature, and merge related concepts and reasons [11]. Second, use comparative research methods to summarize the training experience of foreign engineering professionals, analyze the current situation and existing problems of engineering professionals in developing countries, and refer to the training of foreign engineering professionals in China, and point out the enlightenment [12]. Third, according to the seven standards and requirements of EE professional certification, we proposed feasible measures for training modern engineers [13]. The specific research ideas in Figure 1 are as follows:

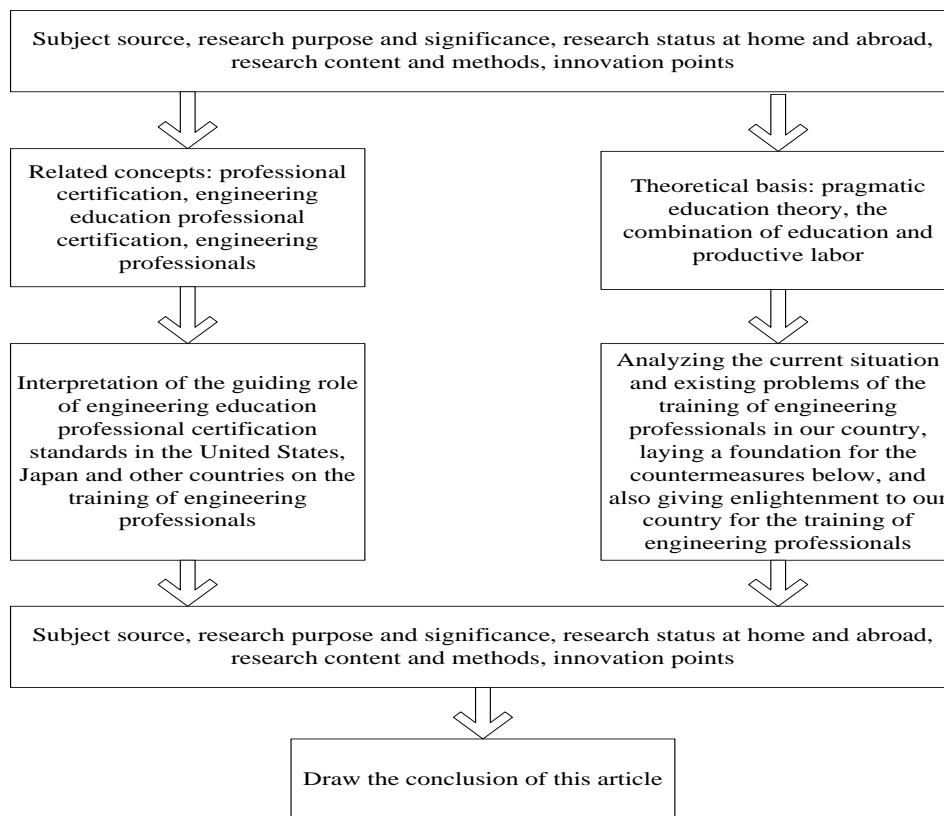


Figure 1: Research ideas.

2.3 Research Methods

This paper mainly adopts research methods such as bibliographic research methods, comparative research methods and systems analysis methods.[14].

(1) Literature research method

The literature research method is a reasonable, objective and scientific method for searching, collecting, summarizing and providing information on literature resources [15]. In this article, we will refer to related books and journals and search online databases to organize related research results in China and overseas, objectively and scientifically grasp the subject and core of the research, and provide support and research for this article [16].

(2) Comparative research method

Comparative research is a collaborative research on the relevance and difference of things, discovering the similarities and differences of things and clarifying their internal laws [17]. This article conducts a comprehensive analysis of all aspects of foreign engineering professionals training [18]. Combining foreign literature, find out the gap between our country and these foreign countries, and provide useful guidance for the training of engineering professionals in our country [19]-[21].

(3) System analysis method

System analysis method is a research method that comprehensively analyzes the composition, structure, operation, etc. of the system. It takes the research goal as system engineering and provides feasible solutions with reference value [22]-[24]. This work is based on the research of the engineering professional training program certified by EE, which is considered systematic

engineering and after a systematic analysis of the seven standard elements of professional certification of EE, a training program for engineering professionals arrive [25]

2.4 Standards for EE Certification

The logical relationship of the certification standards is: to focus on all students, to continuously improve their own quality, to graduate requirements and the quality assurance mechanism of the department. The system structure of EE certification standards is shown in Figure 2:

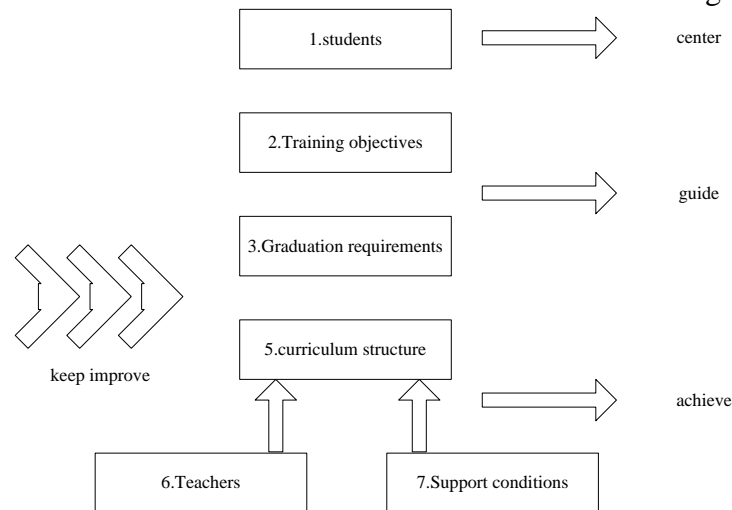


Figure 2: System structure diagram of EE certification standards.

3. Experiments on the Training Program of Engineering Professionals in the context of Engineering Certification

3.1 Status Quo of How to Train Professional Engineers in the Background of Engineering Certification

(1) Unreasonable professional status and professional construction

Due to the influence of ancient educational concepts and resource allocation, some universities often encounter problems such as narrow locations, too narrow locations, lack of location features, and ignorance of location benchmarks. Regarding the training model, the current improvement is only the change of practice time, and does not pay attention to the connection between the actual teaching content of the curriculum and innovative practice. The reform of disciplines, majors and curriculum systems cannot keep up with the development of applied talents to engineering practice and innovation.

(2) Incomplete innovation platform and innovation mechanism

The student innovation skills training platform is not perfect, the student innovation team and the innovation laboratory, but affected by the early education model, further discourages the healthy integration of students' extracurricular activities of scientific and technological innovation with the humanities, science and technology innovation activities. Student innovation activities are restricted, and participation in various competitions such as electronic design competitions is restricted. The proportion of winners in the total number of students is very low, which makes it difficult to improve innovation ability.

(3) The construction of teaching staff is not in place

In order to meet the requirements of the professional certification related to EE, course teachers in related majors must have a solid theoretical foundation of science and technology, and must have strong engineering and practical application capabilities, and be able to effectively impart their knowledge directly to the general public. Go among the students. Although the faculty structure of some colleges and universities has been significantly improved, and the number and proportion of qualified teachers have increased significantly, for those teachers with a practical background in construction engineering and a sense of independent innovation, it is still not enough to provide guidance they learn and carry out hands-on activities of independent innovation. In order to solve this problem, the characteristics of the electronic information colleges of the relevant universities need to carry out more reforms and explore innovative talent training models to improve the quality of innovative talent training for students.

3.2 Principal Component Analysis Method of Enterprise Talent Demand Questionnaire

(1) The basic idea of the principal component analysis method

Principal component analysis is to reorganize the original indicators into unrelated groups, that is, a new comprehensive index with unique information. At the same time, based on specific principles and actual needs, some comprehensive indicators have been extracted to reflect the high proportion of information contained in the original indicators.

(2) Some concepts of principal component analysis method

In the principal component analysis method, some of the concepts involved are initial variables, principal components, factor loadings and so on. Here are a few examples to illustrate these concepts:

The research problem observed n samples and m variables, that is, the original data is a matrix

$$Y = (Y_{pk}), p = 1, 2, \dots, n; k = 1, 2, \dots, m \quad (1)$$

The initial data should usually be processed with variable standardization to eliminate the effect of the difference of the variables, as shown in formula (2):

$$y_{pk}^* = \frac{y_{pk} - \bar{y}}{\sqrt{\text{var}(y_k)}} \quad (2)$$

① The original variable (Y), which is an m -dimensional random variable, the formula is as shown in (3):

$$Y = (Y_1, Y_2, \dots, Y_m)' \quad (3)$$

② Principal component (X): It is the linear combination of initial variables. If, then the p -th principal component of Y is

$$X_p = n_p Y, (i = 1, 2, \dots, m) \quad (4)$$

Among them $n_p = (n_{1p}, n_{2p}, \dots, n_{mp})'$

③ Variance contribution rate: It is an index used to indicate the strength of the principal component's ability to integrate the original variables. The variance contribution rate of the p -th principal component is

$$\lambda_p \left[\sum_{k=1}^m \lambda_k \right]^{-1} \quad (5)$$

④ The cumulative variance contribution rate is the proportion of the original variable information extracted by the first i principal components, namely

$$\sum_{p=1}^i \lambda_k \left[\sum_{k=1}^m \lambda_k \right]^{-1} \quad (6)$$

⑤ Factor loading is an important indicator to describe the economic significance of the principal component, and its absolute value is an important basis for economic interpretation of the principal component. Suppose the load of the x -th variable on the y -th principal component is a_{xy} , then

$$a_{xy} = \sqrt{\lambda \mu_{xy}}, (x, y = 1, 2, \dots, m) \quad (7)$$

4. Training Plan for Engineering Professionals under the Background of Engineering Certification

4.1 Status Quo of the Training of Engineering Professionals in My Country

As my country currently has the world's strongest engineering technology team, and the quality of engineering expertise has been improved year by year, the number of engineering graduates has increased year by year, and it has now become the world's number one. According to statistics from the Ministry of Education, as of 2014, the number of in-service graduates of my country's Higher Education Engineering College has reached a record 1,316,873. Table 1 mainly shows the changes in the total number of engineering graduates in my country in the past five years:

Table 1: The number of engineering graduates in my country.

years Number of people	Number undergraduate graduates	of Number of master graduates	Number of PhD graduates	Total number of people
2010	813218	111250	17428	941896
2011	884542	123849	15804	1024195
2012	964583	150544	17890	1133017
2013	1058768	158105	18331	1235204
2014	1132226	166110	18537	1316873

4.2 Training of Foreign Engineering Professionals Has Inspired My Country

Absorb the successful experience of cultivating professional engineers under the guidance of professional certification of EE abroad and carry out reforms in EE and teaching in line with the reality of domestic EE, and find ways to train engineering professionals suitable for China's national conditions. This is also the current state of my country's EE work.

(1) Improve the engineering certification system

The engineering certification system helps to further improve the implementation process of the training of engineering professionals. Many foreign countries have established specialized EE

certification agency, It can promote the development of engineering training certification work, and strongly guarantee the training of professional engineers. These countries are implementing internationally recognized certification standards based on the development and development history of a certification system specializing in EE. Therefore, according to the actual development of engineering colleges and universities, various multi-dimensional certification standards have been formulated.

(2) Develop various training programs for engineering professionals

In foreign countries, EE is closely related to society and companies. According to the reality of social development and changes, the company's employment needs and standards, and the relevant standards and requirements, the training program for engineering professionals is constantly adjusted. Possess EE professional qualifications, can accurately find the types of deliverables, and formulate various talent training programs.

(3) Close ties between engineering colleges and enterprises

Enterprises participate in the formulation of the school's talent development plan, on the one hand, it promotes the EE and teaching reform of the university, and on the other hand, it helps the university to continuously adjust its talent development plan according to the actual needs of talents. The close ties between foreign engineering colleges and enterprises not only make up for the shortcomings of EE theory for students, but also skillfully transform the enterprise engineering practice base into a second platform for cultivating engineering professionals. Strengthening the organic combination of theory and practice, students' adaptability to EE has significantly improved the overall quality and ability of future engineering professionals.

(4) Focus on improving the humanities quality and professional knowledge of engineering professionals

By studying the standards related to EE professional certification abroad, it is found that foreign countries have higher requirements for the professional knowledge and skills that engineering professionals must possess, and relatively strict regulations have been established in terms of humanistic quality and professional ability. In order to cope with the weak humanistic foundation of engineering students, many foreign engineering universities require them to study humanities, social studies and management, etc., thereby increasing the amount of humanistic knowledge retained and broadening their horizons, enhancing students' humanistic quality and developing professional capabilities Ability.

(5) Increasing international recognition is an inevitable trend for the reform and development of higher EE in the future.

Although the United States and Germany have very different engineering talent training models, the engineering schools of the two countries have acquired relatively strong international awareness in terms of teacher training goals, majors and curriculum settings, and courses. Both focus on the use of multiple methods to promote students' engineering learning and an international perspective on solving engineering problems from multiple angles.

4.3 Investigate and Analyze the Quality of Chinese EE

In a questionnaire survey on the main problems in the quality of Chinese EE, most of the academicians of the Academy of Engineering and university teachers agreed that the students' internationalization ability is insufficient, the timeliness of professional ethics education is lacking. They lack the ability to analyze and solve real engineering problems. The shortcomings are closely related to the lack of close cooperation between education and research at our university and the

weak link of practical education. The specific situation is shown in Figure 3.

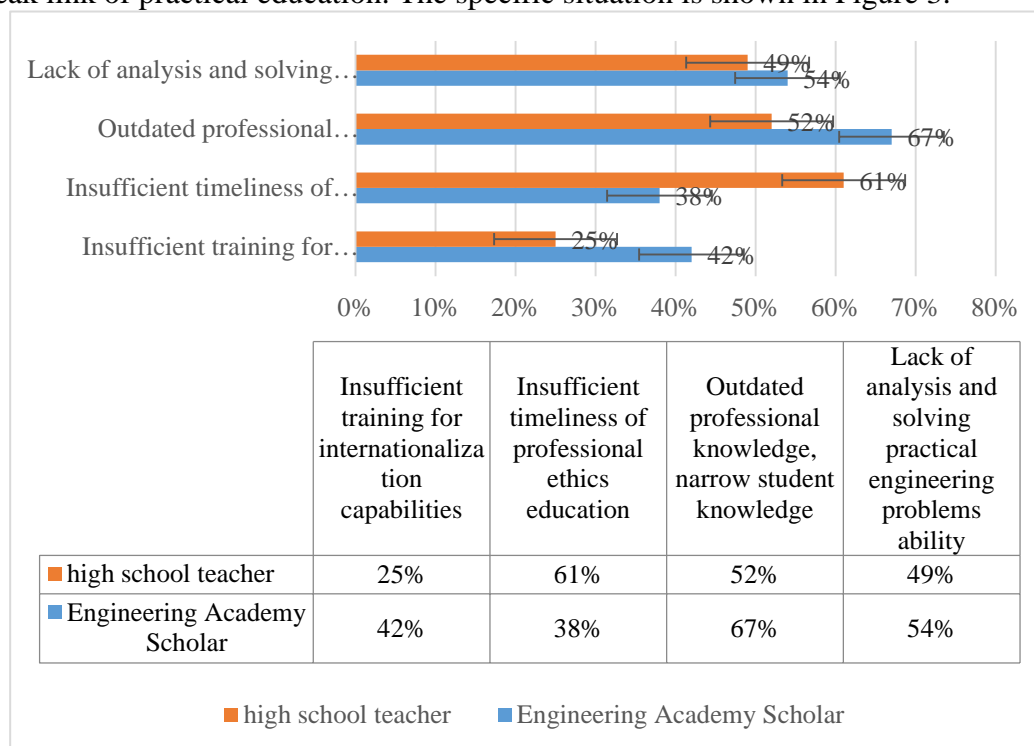


Figure 3: Survey results of major problems in the quality of EE in China.

5. Conclusion

Although my country has become a major industrial country in the world, there is still a big gap between my country's EE and foreign countries, so we still have to carry out reforms steadily. From the perspective of EE professional certification, the educational plan for engineering professionals reflects the leap of EE to a new industry. At the same time, with the background of traditional EE we inspire our country to learn the lessons of modern EE. Modern engineer education paved the way. Aiming at the key issues in the current training of engineering teachers in my country, this paper proposes methods of using data collection, interview analysis and research, such as unclear target positioning, insufficient student innovation ability, low comprehensive quality, and weak practical ability. According to engineering practice, we will clarify education goals, implement curriculum reforms, optimize education models, expand professional capabilities, strengthen general education, and strengthen practical education. To further develop and improve the quality of human resource training in our country's engineering colleges, we will strengthen practical education and reforms School-enterprise cooperation and other aspects have been reformed.

Acknowledgements

This work was supported by The 13th Five-Year Plan of Educational Science in Henan Province (No.2020YB0199), Classroom Teaching Mode Reform Project of Nanyang Normal University (No.2019-JXYJKT-22), Undergraduate First-class Course Teaching Quality Engineering Project of Nanyang Normal University (No.2019-YLKC-005), 2021 Key Project of Higher Education Teaching and Research of Nanyang Normal University (No.2021-GDJY-ZDXM-009), 2021

First-class Course Ideological and Political Course Project of Nanyang Normal University (No.2021-YLKC-SZXM-007), Henan Province 2020 Undergraduate College Curriculum Ideological and Political Project (Craftsmen in Big Countries: Ingenuity to Build Dreams; Water Supply and Drainage Engineering Structure)

References

- [1] Xiaobo Y. *Research and development of OA enterprise management system and its optimization and demand on business talents [J]. Agro Food Industry Hi Tech*, 2017, 28(1):787-791.
- [2] Zhang W, Haile M A , Song X . *Cultivation of Innovation Ability of Students in the Discipline of Food Science and Engineering from the Perspective of Engineering Professional Certification[J]. Asian Agricultural Research*, 2017(02):75-79.
- [3] Tomic B, Brkic V. *Customer satisfaction and ISO 9001 improvement requirements in the supply chain [J]. Tqm Journal*, 2019, 31(2):222-238.
- [4] Zhang J, Wang R , Guan W , et al. *Three Years' Achievements and Expectations of Top Talent Training Program in Basic Sciences[J]. University Chemistry*, 2019, 34(10):146-150.
- [5] Y Zhu, Hong W , Xia H , et al. *Exploration and Practice of the "Top Talent Training Program of Chemistry" in Xiamen University[J]. University Chemistry*, 2019, 34(10):8-13.
- [6] *Exploration on Laboratory Teaching System of Top Talent Training of Chemistry in Shandong University[J]. University Chemistry*, 2019, 34(10):85-89.
- [7] Y Liu, Chemistry D O, University T . *Construction and Teaching Practice of Chemical Biology Laboratory for Top Talent Training Majored in Chemistry[J]. University Chemistry*, 2019, 34(10):110-114.
- [8] Tansley C, Hafermalz E, Dery K. *Talent development gamification in talent selection assessment centres[J]. European Journal of Training and Development*, 2016, 40(7):490-512.
- [9] Mayfield M, Mayfield J, Wheeler C. *Talent development for top leaders: three HR initiatives for competitive advantage[J]. Human Resource Management*, 2016, 24(6):4-7.
- [10] *Pacing and Self-Regulation: Important Skills for Talent Development in Endurance Sports[J]. International Journal of Sports Physiology and Performance*, 2017, 12(6):831-835.
- [11] Tw A, MD A, Djib A , et al. *An exploration of young professional football players' perceptions of the talent development process in England[J]. Sport Management Review*, 2020, 23(3):536-547.
- [12] Schreuder R , Noorman S . *Strategic talent development – making the best people in crucial positions better[J]. Strategic HR Review*, 2019, 18(6):263-267.
- [13] P Olszewski - Kubilius , Subotnik R F , Davis L C , et al. *Benchmarking Psychosocial Skills Important for Talent Development[J]. New Directions for Child and Adolescent Development*, 2019, 2019(168):161-176.
- [14] Subotnik R F, Stoeger H , Luo L . *Exploring Compensations for Demographic Disadvantage in Science Talent Development[J]. New Directions for Child and Adolescent Development*, 2019, 2019(168):101-130.
- [15] Jensen S, Zawalski S . *Seizing "Teachable Moments": Talent Development in Case Management[J]. Prof Case Manag*, 2018, 23(2):92-94.
- [16] Marina, O, Latukha. *Talent Development and Its Role in Shaping Absorptive Capacity in Emerging Market Firms: The Case of Russia[J]. Advances in Developing Human Resources*, 2018, 20(4):444-459.
- [17] Bratton, Andrew. *The role of talent development in environmentally sustainable hospitality[J].*

Worldwide Hospitality and Tourism Themes, 2018, 10(1):69-85.

- [18] Zhang Y E, Nesbit P L . *Talent development in China: human resource managers' perception of the value of the MBA*[J]. *The International Journal of Management Education*, 2018, 16(3):380-393.
- [19] Hjort A, Henriksen K , L Elbæk. *Player-Driven Video Analysis to Enhance Reflective Soccer Practice in Talent Development*[J]. *International Journal of Game-Based Learning*, 2018, 8(2):29-43.
- [20] Dalai R, Akdere M. *Talent development: status quo and future directions* [J]. *Industrial and Commercial Training*, 2018, 50(6):342-355.
- [21] Guo W L , Qi Z C , Zhang X D , et al. *Teaching research of Molecular Pharmacognosy for talent development in industry of Chinese medicinal materials under new situation*[J]. *Zhongguo Zhong yao za zhi = Zhongguo zhongyao zazhi = China journal of Chinese materia medica*, 2017, 42(2):226-230.
- [22] Storm L K , Ronglan L T , Christensen M K . *Comparing the organisational cultures of efficient talent development environments in handball in Scandinavia: Between values of productivity and loyalty*[J]. *Journal of Dental Research*, 2017, 61(5):681-685.
- [23] Aimee, Edwards, Alexandria, et al. *NYCDEP Focuses on Recruitment and Talent Development*[J]. *Proceedings of the Water Environment Federation*, 2016, 2016(5):5975-5982.
- [24] Hjort M . *feature article: Talent development and capacity building in small nations: On the twinning of filmmakers*[J]. *Journal of Scandinavian Cinema*, 2016, 6(2):81-100.
- [25] Gyarmathy E , Senior J . *The Inclusion of Multiple Exceptional Gifted Students in Talent Development Programmes Interaction synthesis of both provision form and content*[J]. *Gifted Education International*, 2016, 34(1):47-63.