Research on Diversified Characterization of Interdisciplinary Graduate Education Mode in World-Class Universities

Fei Li(✉), Shuang Ying, and Jian Cao

Harbin Institute of Technology, Harbin, China
eatea120@163.com

Abstract. Many issues in the field of graduate education have been paid attention to, including diversification or interdisciplinary. We found that interdisciplinary has the natural characteristics of diversification, which is an effective way to realize the diversification of graduate education. This has received little attention. In addition, interdisciplinary originated from world-class universities, the paper describes diversified characterization of interdisciplinary graduate education mode in World-Class Universities, and provides reference for relevant practice and research.

Keywords: Diversified · Interdisciplinary · Graduate Education Model · World-class Universities

1 Introduction

Diversification has become an important topic in the field of graduate education. The existing research mainly focuses on the important role or influence of diversification, such as help to improve the quality of graduate training such as entrepreneurial ability [1], and even affect the fairness, fairness and inclusiveness of the future workplace. [2], as well as the different fields of graduate education diversity, such as medicine [2], business education [3], etc. Most studies discuss this in terms of approval, and there are certainly few studies questioning or opposing diversification [3]. But anyway, it suggests that diverse graduate education is worth exploring. The key is that people focus on improving the quality of postgraduate education.

Since the 1980s, more and more attention has been paid to interdisciplinary subjects in the field of higher education. In particular, the discipline development of many world-class universities has shifted from the past "top-down, project-led, separation of science and education" to the present "focusing on top-level design, interdisciplinary integration, integration of science and education, integration of teaching and research". Harvard University, THE Massachusetts Institute of Technology, the University of Oxford, Peking University and other universities have strengthened interdisciplinary construction. Relevant studies show that interdisciplinary disciplines have great advantages in cultivating outstanding talents [4]. Taking the Nobel Prize as an example, from 1901 to 2000, taking 25 years as a period, the proportion of the winners with interdisciplinary knowledge

Y. Yau and F. Hage Chehade (Eds.): DESD 2022, ASSEHR 691, pp. 256–263, 2023.
https://doi.org/10.2991/978-2-494069-37-4_33

background in the four periods was 30%, 39%, 41% and 49% respectively, showing a significant steady upward trend. From 2001 to 2010, the proportion had risen to 75%. This is the main reason why universities attach importance to interdisciplinary construction.

It can be said that the interdisciplinary have natural advantages in diversification. Compared with traditional disciplines, interdisciplinary usually refers to the new science produced by the theories and methods of more than two or more different traditional disciplines in the process of mutual penetration, mutual reference, and fusion and symbiosis. This can precisely provide composite knowledge structure support for the cultivation of innovation ability, provide knowledge of related disciplines, help to think and solve problems in different ways of thinking, and finally improve the innovation ability and qualities of graduate students [5].

Existing studies have explored issues related to interdisciplinary graduate training, involving the overall model [6], exploring from the perspective of socio-physics how the interdisciplinary academic community operates internally [7], and how to improve or guarantee the quality of interdisciplinary graduate training, such as introducing concepts of standardization [8], team concept [9], etc. At the same time, people have found that the Humanities and science generally does not involve a mutual enrichment but Rather a Overseeing of the fundamental premise of the Humanities. So, interdisciplinarity is best understood as being enacted in projects in situated ways, rather than as a homogenous form [10]. It reminds interdisciplinary operation should be flexible in practice. We think that involves diversification, few research discuss the interdisciplinary graduate education model from this perspective. This study attempts to describe diversification of interdisciplinary graduate education mode in World-Class Universities (IDEM-WCU).

The rest of the paper is organized as follows. In the next section, we discuss the theoretical basis of graduate education mode and interdisciplinary disciplines of world-class universities. Subsequent sections consecutively describe diversified characterization of IDEM-WCU. The paper concludes with a discussion about our research.

2 Concepts

2.1 Graduate Education Mode

Graduate, as the educated group at the high level of higher education, are an important force that needs to be cultivated and can participate in scientific research. To realize the cultivation of postgraduates, we will in turn define graduate education model from three aspects of value, goals and implication of graduate education, shown in Table 1.

2.1.1 Graduate Educational Value

Graduate educational value shows that why graduate education exists, which pointed out the direction of graduate education. We explore the value connotation from the history of developing graduate education in five countries of Germany, UK, USA, Japan, China.

Graduate education from the emergence to continuous development, these countries which have developed graduate education have their own unique background, but each country is almost based on the needs of their own country or society [11]. Germany pioneered graduate education, put forward the unification of scientific research and teaching

Table 1. The characterization factor of Graduate Education Mode

Graduate education mode			Characterization factor
Concept	-	-	Concept
Objectives	Knowledge	-	Knowledge
	Thinking	-	Thinking
	Ability	-	Ability
Implementation	Process	Curriculum setting	Curriculum setting
		Teaching methods	Teaching methods
		Scientific research training	Scientific research training
		Academic exchange	Academic exchange
		Tutorial system	Tutorial system
	Organizational system	Academic organization	Academic organization
		Management organization	Management organization
	Resource allocation	Platform	Platform
		Capital	Capital

to create a university focus on scientific research; Britain became a mecca for overseas study during the Second World War. Due to its tradition of academic freedom, it formed the idea of maintaining elite education in diversified development, focusing on high quality and creativity. The United States learned from Germany and Britain and created the graduate school system, focusing on innovation ability; Japan first learned from Germany and then the United States and adopted practical ideas, emphasizing scientific research and application ability. At present, the development of graduate education in the world tends to develop taked into account industry, university, research and application. In development process, no matter how the education model changes, the common concept has been highlighted, that is, the value orientation of graduate education in each country is to contribute to their own country's or society's development.

2.1.2 Graduate Educational Objectives

Usually the goal of higher education has three dimensions, namely knowledge, thinking and ability. The same goes for graduate education. The difference is that postgraduate education is at a higher level, with higher requirements in various dimensions. In terms of knowledge, the major is deeper and the vision is wider; the thinking is more critical and scientific, and the ability emphasizes discovery, analysis and solve the problem. Here, we confirm that the goal of postgraduate education is expressed in three dimensions: knowledge, thinking and ability.

2.1.3 Graduate Educational Implementation

Three aspects of the implementation of education are confirmed, process including: curriculum setting, teaching methods, scientific research training, academic exchange and tutorial system; The organizational system mainly investigates the academic organization and the management organization form; Resource allocation involves platform and capital.

To sum up, in the Graduate Education Model, what can be directly represented are defined as characterization factors, shown as the structure of graduate education model in Table 1. Those form the base to construct Interdisciplinary Graduate Education Mode in World-Class Universities.

2.2 Interdisciplinary Disciplines of World-Class Universities

The mode of knowledge production determines the characteristics of the development and change of knowledge system, which has great influence on the form of discipline in world-class universities.

Under the traditional discipline institutions, the world-class universities take research as the orientation, take knowledge production as their own responsibility, and establish various departments and schools based on disciplines. The knowledge production mode at this time is called Mode I, and people have been constantly exploring subdivision of the world, so knowledge production is reflected in differentiation, and the development of knowledge system is more and more detailed. Its disadvantage is that the communication between disciplines is more and more difficult, which is not conducive to solving practical problems. The traditional colleges established on the basis of such traditional disciplines are knowledge production-oriented and follow the logic of disciplines or scientific research.

Scholars have found that since the mid-1980s, revolutionary academic transformation has been taking place in western academic circles, and the knowledge production mode of world-class universities has quietly changed into Mode II. The mode II emphasizes the interdisciplinary cooperation between related disciplines on the basis of problems, and generates new knowledge through the integration of multiple disciplines in the process of solving problems. The corresponding institutional forms in the university are the characteristic colleges established on the basis of multi-disciplines, are guided by practical problems, and knowledge application and innovation, and follow the needs of the country and society.

During the transformation, it is the historical responsibility and social mission of a world-class university to respond to major social needs and solve major practical problems, mainly reflected and realized through interdisciplinary.

3 Framework of Diversified Characterization of IDEM-WCU

We construct the diversified characterization of IDEM-WCU based on the concepts discussed above. The basic factors of IDEM-WCU: Concept, Goal and implementation. And the corresponding diversified characterization can be expressed as Table 2.

3.1 Diversified Characterization of Graduate Educational Value of IDEM-WCU

To undertake the task and mission of the world-class university's interdisciplinary, as well as the concept of postgraduate education mode, the essence of the value is confirmed to respond to the major needs of the society, and to solve the major practical problems as the orientation, training interdisciplinary talents. The diversified characterization can be embodied as different area, such as Circuit science and engineering mainly involve science, engineering, while national security, based on law, engineering, management and military science. They cultivate interdisciplinary talents for distinct fields.

3.2 Diversified Characterization of Graduate Educational Objectives of IDEM-WCU

The knowledge dimension of objectives emphasizes the knowledge structure of multi-disciplines, the thinking dimension emphasizes dialectical thinking and logical thinking, and the ability dimension emphasizes learning ability, knowledge integration ability, innovation ability and cooperation ability.

3.2.1 Diversified Characterization of Graduate Education Implementation of IDEM-WCU

For the factor of the process, the curriculum is designed to emphasize the interdisciplinary integration, the teaching method is based on multidisciplinary teacher team, the scientific research training adopts the combination of curriculum and scientific research training, academic exchanges pay attention to the exchange opportunities of multidisciplinary fields, and the tutorial system adopts the multidisciplinary teacher team that breaks through the boundaries of school, department and specialty.

In terms of institutional structure, there are three forms of academic organization: entity department organization, semi-entity organization and virtual organization. Each university may choose according to its own situation. In terms of management organization, interdisciplinary academic committees and related work leading groups are usually established at the university level. In other levels, either the department management structure is adopted or an independent project management organization is established.

In terms of resource allocation, there are two types of platforms: experimental/practical platform related to each discipline and interdisciplinary technology platform; And funds - interdisciplinary special funds.

Practical Education Platforms are important links in the process of cultivating applied talents, and an important means to improve their application ability and innovation ability. For example, in engineering education, in order to cultivate high-level application-oriented talents, a research group has built a diversified high-level engineering education practice platform integrating digital analysis and simulation, intelligent manufacturing and testing, and virtual simulation of production process [12], being aimed at the current situation of college students' lack of digital and intelligent knowledge. It improves students' ability of innovative thinking and solving practical problems, and improves their level of intelligent manufacturing and intelligent detection, and make them meets the social demand for such technical compound talents.

Table 2. Diversified Characterization of interdisciplinary Graduate Education Model in World-class Universities

Characterization factor	Diversified Characterization			
Value	To train interdisciplinary talents by responding to the major needs of the society, and solving the major practical problems as the orientation			
Knowledge	Knowledge structure of multi-disciplines			
Thinking	Dialectical thinking	Logical thinking		
Ability	Learning ability	Knowledge integration ability		Innovation ability
	Cooperation ability			
Curriculum setting	Interdisciplinary integrated curriculum			
Teaching methods	Multidisciplinary teacher team			
Scientific research training	Analyzing problem from multi multidisciplinary			
Academic exchange	Exchange opportunities of multidisciplinary fields			
Tutorial system	Multidisciplinary teacher team			
Academic department	Entity department	Semi-entity department		Virtual department
Management department	Interdisciplinary academic committees		Related work leading groups	
	Department management	Independent project management organization		
Platform	Experimental/practical platform	Interdisciplinary technology platform		
Capital	Special fund			

4 Conclusion

Based on the definitions of graduate education mode and interdisciplinary of world-class universities, we describe the diversified characteristics of interdisciplinary graduate education mode of world-class universities from nine aspects, including value, knowledge, thinking, ability, curriculum, teaching methods, scientific research and training, tutorial system, academic department, and management department. It is hoped to provide some references for interdisciplinary graduate educational practice and related research.

Acknowledgments. The work is financed by the Major Project on Graduate Education Research from Association of Chinese Graduate Schools (ACGS02-2020003) and Higher Education and Teaching Reform Research Project of Heilongjiang Province of China (SJGY20200250).

Authors' Contributions. Fei Li: Research Topic, Supervising Overall Research, Writing - Original Draft

Shuang Ying: Research Topic, Supervising Information about Graduate Education

Jian Cao: Research Topic, Supervising Information about Interdisciplinary Graduate Education.

References

1. Cherwitz, R.A., Diversifying Graduate Education: The Promise of Intellectual Entrepreneurship. Journal of Hispanic Higher Education, 2005. 4(1): pp. 19–33. DOI: https://doi.org/10.1177/15381927-04270901
2. Ghanney, S.E.C., Diversifying Graduate Medical Education & the Urology Workforce: Reimagining our Structures, Policies, Practices, Norms & Values. Urology, 2021. 162: pp. 128–136. DOI: https://doi.org/10.1016/j.urology.2021.06.011
3. Jung, J. and T. Shin, Learning Not to Diversify: The Transformation of Graduate Business Education and the Decline of Diversifying Acquisitions. Administrative Science Quarterly, 2019. 64(2): pp 337–369. DOI: https://doi.org/10.1177/0001839218768520
4. Huang junping, Chen Qiuyuan and Qu Yizhen, Exploration and Practice of interdisciplinary Talent Cultivation model: a case study of Peking University. Academic Degree and Graduate Education, 2017(05): pp. 39–42 DOI: https://doi.org/10.16750/j.adge.2017.05.008
5. Badenoch, D., An Interdisciplinary Approach to Developing Graduate Qualities in Higher Education. The International Journal of Knowledge, 2008. 10(7): pp. 49–60. DOI: https://doi.org/10.18848/14479524/CGP/v07i10/50439
6. E.McKee Kelsey, Daniel.Serrano, et al., An integrated model for interdisciplinary graduate education: Computation and mathematics for biological networks. PLoS ONE, 2021. 16(9): pp. e0257872. DOI: https://doi.org/10.1371/journal.pone.0257872
7. Meara, K.O. and D. Culpepper, Fostering collisions in interdisciplinary graduate education. Studies in Graduate and Postdoctoral Education, 2020. 2(11): pp. 163–180. DOI: https://doi.org/10.1108/SGPE-08-2019-0068
8. Borrego, M., D. Boden and L.K. Newswander, Sustained Change: Institutionalizing Interdisciplinary Graduate Education. The Journal of Higher Education, 2014. 85(6): pp. 858–885. DOI: https://doi.org/10.1080/00221546.2014.11777350
9. Wallen, K.E., et al., Integrating team science into interdisciplinary graduate education: an exploration of the SESYNC Graduate Pursuit. Journal of Environmental Studies and Science, 2019. 9(2): pp. 218–233. DOI: https://doi.org/10.1007/s13412-019-00543-2
10. Harpham. G.G., Defending disciplines in an__ interdisciplinary age. College Literature, 2015. 42(1): pp. 221–240. DOI: https://doi.org/10.1353/lit.2015.0018
11. Yanli Guo, Comparison and Enlightenment of Foreign Graduate Education Concepts. Degree and Graduate Education, 2011(08): pp. 72–78. DOI: https://doi.org/10.16750/j.adge.2011.08.008
12. Xi, Wang, Jian, Liu, Xiaojun, Zhang, Zhengkun, Xue, The Establishment and Exploration of Diversified High Level Engineering Practice Education Platform. Higher Education Research, 2021. 6(5), pp. 138–141. DOI: https://doi.org/10.11648/j.her.20210605.17