Curriculum and Teaching Methodology (2022)
Clausius Scientific Press, Canada

DOI: 10.23977/curtm.2022.051308
ISSN 2616-2261 Vol. 5 Num. 13

Exploring the Teaching Reform Practice of Cross-Fertilization in Applied Talent Cultivation Mode

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Keywords: Applied Talents, Cross-Fertilization, Teaching Reform, Evaluation System

Abstract: Universities are the main suppliers of applied talents and play an increasingly prominent role in talent cultivation (TC). Interdisciplinary cross-fertilization (CF) is an important means for higher education to fight against the increasingly complex real-life problems. How to better reform the current teaching mode and cultivate AT in line with the needs of the times in the context of interdisciplinary integration has become an important issue facing the development of higher education. In this paper, we establish the evaluation system of cross-disciplinary AT cultivation, analyze the degree of influence of each index on talents cultivation according to their weights, and propose the teaching reform of cross-disciplinary integration in AT cultivation. The evaluation system studied in this paper also cannot be used as a standardized system to adapt to all models, but it can provide a reference model and guidance model for evaluation of all aspects of TC.

1. Introduction

In recent years, interdisciplinary disciplines have been widely emphasized in various fields, and the demand for talents in the situation of CF has gradually increased. At present, many universities and related departments also pay more and more attention to the construction of interdisciplinary disciplines. Interdisciplinary CF integrates integrality, diversity, adaptability and uniqueness, and vigorously promoting the cultivation of AT in interdisciplinary disciplines is a mission that must be adhered to by major universities in China, as well as a driving force of higher education reform.

After realizing the trend of integrated interdisciplinary development and the important role played by interdisciplinary disciplines in modern society, the relationship between interdisciplinary disciplines and TC in colleges and universities has become a widely debated topic in academic circles. Some scholars believe that the current education model cannot meet the needs of education development, and advocate strengthening the construction of cross-disciplinary degree points, adding cross-disciplinary categories in the discipline specialties catalog and establishing a strict evaluation mechanism of cross-disciplinary degree points [1]. Some scholars point out the problems in the cultivation of talents and academic innovation in cross-disciplinary disciplines, and put forward constructive opinions on building cross-disciplinary platforms, upgrading the setting level of cross-disciplinary majors, and building academic teams in cross-disciplinary disciplines in

response to the existing problems [2]. Some scholars suggested that scientific research ability is important to improve the quality of AT cultivation and optimize cultivation initiatives, and used ANOVA and multiple regression to compare the scientific research ability of cross-disciplinary graduate students with that of traditional single-disciplinary graduate students, pointing out that cross-disciplinary graduate students have significant advantages in scientific research ability [3]. In conclusion, universities should respond to the new round of teaching reform and should effectively support the transformation of teaching mode to achieve the task of new applied TC goals.

This paper first analyzes the teaching reform path under the CF of disciplines, then uses the AHP fuzzy comprehensive evaluation method to establish the applied TC system, analyzes the weight coefficients of 5 primary indicators and 18 secondary indicators that affect the CF applied TC, and finally puts forward the teaching reform suggestions for the applied TC.

2. Teaching Reform Based on Cross-Disciplinary Integration

With the continuous innovation of the concept of interdisciplinary higher education, the construction of new engineering not only requires the establishment of interdisciplinary curriculum system, but also requires the establishment of teaching mode to match it. Although the curriculum setting of domestic new engineering majors is in the initial stage, there are a large number of majors involving three or more colleges in the talent training curriculum system [4]. In the face of such a large and complex curriculum system, the teaching design and faculty construction based on the traditional large one discipline are likely to cause the piling up of knowledge points, making it difficult for students to comprehend the inner logic between knowledge points. Therefore, the key to interdisciplinary teaching is integration. For the integration of teaching styles of different disciplines so that students can view complex problems from multiple perspectives and levels; for the integration of teachers from different colleges so that the teaching styles of different disciplines can be integrated and students can gradually form a unique thinking structure [5]. Only for the integration of curriculum and teaching materials obviously cannot form a deep interdisciplinary crossover, interdisciplinary teaching should be distinguished from the previous multidisciplinary teaching, to effectively integrate teaching styles and teaching teams at a higher level, and this integrated teaching reform is seen as a continuum of integration, where teachers need to teach students to apply their knowledge, rather than just receive it, so that students can view and solve problems in an integrated way[6].

The shift in the paradigm of knowledge production has allowed universities to play a role in society that is not only limited to a base for knowledge dissemination but also a factory for knowledge creation [7]. Teaching is the core of knowledge dissemination and knowledge creation, and the CF and interpenetration among disciplines are indispensable for the realization of the goal of cultivating innovative, complex and application-oriented talents in higher education, which leads to the change of teaching mode. Acquiring knowledge will not be the only starting point of teaching objectives, and the classroom is not only for spreading definite knowledge. Teachers should become the designers of teaching activities and the promoters of knowledge production, and a broader teaching unity will be formed, which will also bring teachers into a broader field [8-9]. In addition to the pedagogical activity of knowledge transfer, it is more important to integrate the production of knowledge into the pedagogical objectives and to expand the classroom function to explore uncertain knowledge. The reformation of instructional design and the integration of teaching teams effectively promote CF between disciplinary paradigms and scientific subjects [10]. Figure 1 shows the path of pedagogical reform based on CF of disciplines.

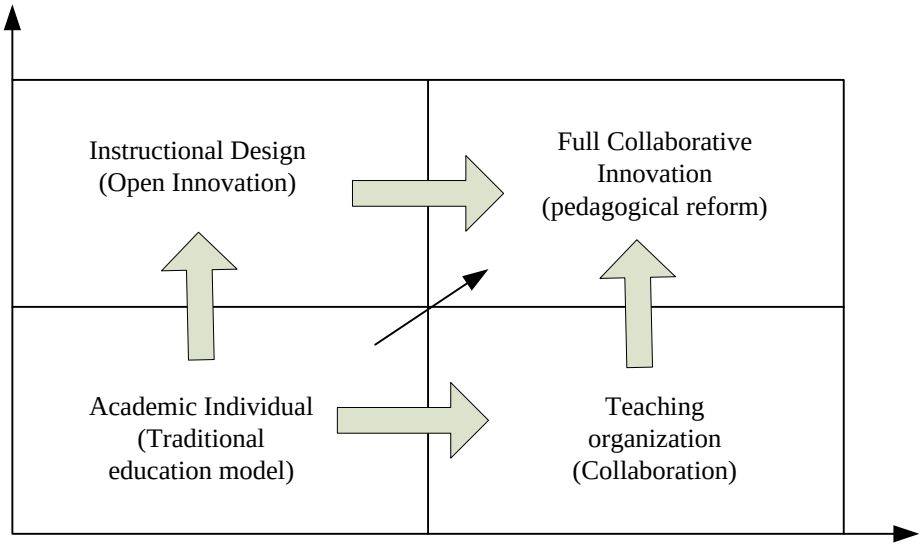

Figure 1: Teaching reform path

3. Construction of the Evaluation System of Applied TC Based on CF

3.1 Principle of AHP-Fuzzy Comprehensive Evaluation

This method is a new evaluation method formed by combining hierarchical analysis method and fuzzy evaluation method. The evaluation of cross-disciplinary TC involves a wide range, and the evaluation of each influencing factor is influenced by people's subjective evaluation, and the evaluation results will lack objectivity [11]. Therefore, quantitative analysis must be added. the AHP-fuzzy comprehensive evaluation method has the advantages of two single methods and can overcome the shortcomings of both methods to ensure the scientificity of evaluation results.

When constructing the evaluation system, the relative importance of individual rating indicators is described and the judgment matrix A is determined, and then the set of evaluation indicators D:D=(D1, D2, ... , Ds), and select several evaluation sets to form the indicator set evaluation set K:K=(K1, K2,... , Ks). A number of experts are asked to fuzzy evaluate each index to get the evaluation matrix R, i.e., a fuzzy comprehensive evaluation model (D, k, R) is obtained.

$$A = (a_{ij})_{m\times n}, (i, j = 1,2,...,n) \tag{1}$$

$$R = (r_{ij})_{m\times n}, (i, j = 1,2,...,n) \tag{2}$$

3.2 Selection of Indicators

To establish the evaluation system of AT, this paper selects 5 primary indicators, namely, curriculum construction, teaching resources, students' ability, research achievements and supervisory team; and 18 secondary indicators, 3 under "curriculum construction", 3 under "teaching resources", 5 under "students' ability", 3 under "research achievements" and 4 under "supervisory team". There are 3 under "curriculum construction", 3 under "teaching resources", 5 under "student ability", 3 under "research achievements" and 4 under "supervisory team".

4. Experimental Results and Suggestions

4.1 Evaluation Results

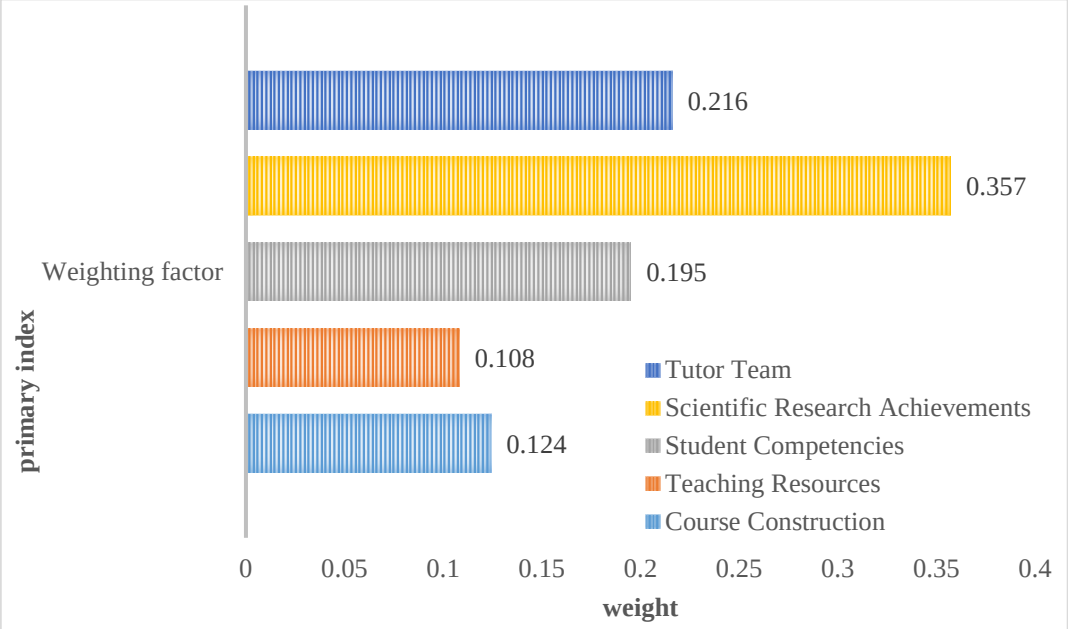

Figure 2: Weight coefficients of the first-level indicators on the cultivation of cross-disciplinary AT

As shown in Figure 2, scientific research achievements have the greatest influence on the cultivation of AT in interdisciplinary disciplines, accounting for 35.7%, followed in order of influence by tutor team (21.6%), student ability (19.5%), curriculum construction (12.4%) and teaching resources (10.5%).

Table 1: Weighting coefficients of secondary indicators

Primary index	Secondary index	weight coefficient
Course Construction	Curriculum	0.63
	Teaching Method	0.25
	Application-oriented training objectives	0.12
Teaching Resources	Investment in scientific research	0.34
	Facilities and Equipment	0.52
	Interdisciplinary Academic Exchange	0.14
Student Competencies	Interdisciplinary Integration Capability	0.07
	Interdisciplinary research competence	0.19
	Ability to practice across disciplines	0.43
	Innovation ability	0.22
	Teamwork ability	0.09
Scientific Research Achievements	Quality of results	0.54
	Impact of results	0.35
	Degree of cross-cutting of results	0.11
Tutor Team	Tutor Team Structure	0.46
	Teacher ability of tutor group	0.24
	Competence	0.12
	Tutor team multidisciplinarity	0.18

Combining Figure 2 and Table 1, the following analysis can be made on the factors influencing the cultivation of AT in interdisciplinary disciplines:

(1) Output of scientific research results in interdisciplinary disciplines

Among the secondary indicators of "scientific research results", the quality of results has the greatest influence on the cultivation of AT, reaching 54%, and the proportion of results also reaches 35%. The quality and impact of the research results can reflect the scientific research level of the interdisciplinary disciplines and the role of the interdisciplinary disciplines to the domestic and foreign academia and society. We should not only pursue quantity, but also high quality.

(2) Construction of the supervisory team

In the secondary index of "supervisory team", the most important factor affecting the cultivation of talents is the structure of supervisory team, accounting for 46%, followed by the ability of supervisory team, accounting for 24%. Universities should strengthen the construction of the supervisory team of graduate students, and require the supervisors to improve themselves and their own research level, and improve the team structure of the whole supervisory team to make it multidisciplinary and adapt to the characteristics of interdisciplinary TC. Only when the construction of the supervisory team is more perfect, it is conducive to promoting the sustainable development of graduate students themselves.

(3) Exercise of students' abilities in various aspects

Among the secondary indexes of "students' ability", the influence of interdisciplinary practical ability on TC is the greatest, accounting for 43%, while the influence of interdisciplinary scientific research ability and innovation ability on TC also reaches 19% and 22% respectively. In cultivating students' abilities in all aspects, universities should not only focus on classroom performance and professional knowledge, but also focus on cultivating students' practical ability, scientific research ability and innovation ability, aiming to cultivate composite talents.

(4) Construction of curriculum system

Among the secondary indicators of "curriculum construction", the influence of curriculum setting on TC is the greatest, with a proportion of 63%; the influence of teaching methods on TC is 25%. Colleges and universities should continue to pay attention to the construction of curriculum system. Curriculum teaching is the most direct way to cultivate students, so the top-level design of the curriculum system should be strengthened, not only to provide students with rich and diversified forms of teaching activities, but also to combine the characteristics of interdisciplinary disciplines to provide students with relevant compulsory courses and elective courses, especially in the practical aspects should be given strong support to ensure the cultivation of internship practice links.

(5) Teaching resources allocation

Among the secondary indexes of "teaching resources", the proportion of facilities and equipment allocation to TC is 52%. The influence of research funding and interdisciplinary academic exchanges on TC also accounts for 34% and 14% respectively. When universities carry out the cultivation of AT in interdisciplinary disciplines, they should pay continuous attention to the hardware support such as facilities and equipment and laboratories required by the discipline, and at the same time, they should pay more attention to the investment in research funds to ensure the successful completion of research projects. Finally, more academic exchange activities should be organized to build a sound academic exchange platform for students and cultivate various qualities of graduate students.

4.2 Suggestions for Teaching and Reform of Interdisciplinary Integration in the Cultivation of AT

(1) Cultivate interdisciplinary teaching thinking

Interdisciplinary thinking plays an important role in major breakthroughs and significant discoveries in scientific research. Generally speaking, the research method or important principle of a discipline grows more and more mature with the growth of this discipline, and when the research method or principle of this discipline is successfully transplanted to another research city for scientific exploration, it often helps further scientific breakthroughs and discoveries, prompting the emergence of new research topics, disciplinary growth points or scientific frontier problems.

(2) Strengthen the construction of interdisciplinary courses

To track the frontier of contemporary science and technology and cultural development, carefully study and analyze the trend of disciplinary differentiation and synthesis, and lose no time in setting up cross-disciplinary majors, cultivating cross-talent, and seizing the high ground of science and technology and cultural development and personnel training, and new disciplines. For emerging, cross and marginal disciplines, we will set up new interdisciplinary majors when we see that they are accurate or reliable, and strive to become first-class majors. In the setting of new majors, we should act according to our ability, combine with the school situation, and have the basic conditions for running the school.

(3) Emphasize the logic of teaching application

The cultivation of socially and industrially oriented AT needs to pay attention to practical problems, and the cultivation of such AT cannot be separated from the teaching design which emphasizes the application logic. The complexity of social practice problems determines that TC needs to be interdisciplinary, and the difference between the application of knowledge in practice and theoretical learning also determines that the teaching design needs to be supplemented with appropriate application knowledge logic. The traditional teaching design is limited by the academic value of the subject teachers, who are mostly oriented to practical problems and highlight the logic of teaching application. By introducing industry experts and adopting teaching methods such as virtual imitation and scenario simulation, the applied logic of students' knowledge is imparted to realize the transformation from linear theoretical teaching to scenario-based applied teaching.

5. Conclusions

At present, there are still many problems in the TC mode, curriculum structure setting and academic innovation of interdisciplinary disciplines, and the reasons of unclear professional orientation and unclear target positioning of interdisciplinary disciplines all make the interdisciplinary disciplines marginalized. In this paper, we study the current existence of cross-disciplinary AT cultivation, so as to get a perfect model of cross-disciplinary graduate talents cultivation, which is important for the improvement of cross-disciplinary AT cultivation mechanism in colleges and universities. It also plays a role in promoting the discipline construction of universities and cultivating more application-oriented emerging talents.

Acknowledgement

This work was supported by Construction Project of Ideological and Political Teaching Team in Undergraduate Colleges of Henan Province (Education Department [2020] No.531)

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