The Cultivation of College Students' Innovative Ability in the Field of Interdisciplinary Culture

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Abstract: Interdisciplinary culture has an influence on the cultivation of college students' disciplinary thinking and the improvement of their comprehensive quality. However, the single discipline culture can easily lead to educational routines of disciplinary thinking, which is inconducive to the cultivation of college students' thinking expansion and innovation ability. Divergent, associative, comparative, and structural thinking is a powerful tool for innovation, which should be strengthened by opening disciplinary boundaries, breaking disciplinary barriers, and carrying out disciplinary cultural dialogue to form an interdisciplinary cultural field, so as to cultivate students' cross-disciplinary thinking habits and innovation ability.

Keywords: Interdisciplinary; College students; Innovative ability

1. Interdisciplinarity and its cultural connotation

In the 1920s, interdisciplinarity was born in the United States. It is a process of exchange of academic ideas, research methods, and disciplinary terms between two or more different disciplines around a specific project, as well as the subsequent restructuring of knowledge fields and organizations [1]. After the middle of the 20th century, under the guidance of the concept of big science, the convergence and integration of disciplines attracted widespread attention. People tried to exert the joint efforts of disciplines to effectively solve some complex problems from multiple perspectives and adopt various methods, which laid the important position of interdisciplinarity in academic research. In the 1970s, interdisciplinary education developed into an international trend against the background of the social demand for cultivating multi-faceted and composite talents, making interdisciplinary education no longer just a means of cooperative research, but also a platform for cooperative education [2]. In this process, universities, as the core institutions of higher education and scientific research, have successively established interdisciplinary organizations such as interdisciplinary curriculum plans, interdisciplinary laboratories, interdisciplinary research centers, and interdisciplinary research groups, and actively carried out interdisciplinary knowledge production and interdisciplinary personnel training activities.

1.1. The basic meaning of interdisciplinary culture

Interdisciplinary culture is a cultural system including interdisciplinary knowledge system, value system, norm system, and behavior habit produced by the contact, collision, exchange, absorption, and fusion of originally different disciplinary cultures in the convergence and integration of two or more disciplines. We believe that interdisciplinary culture mainly includes three meanings: (1) It includes the culture of each discipline after sublimation, and it includes the new interdisciplinary mixed culture in the cross-disciplinary area. On the one hand, from the perspective of a single discipline culture, the interaction between the internal and external cultures of a discipline is an important driving force for its own generation, evolution, and sublimation. When the culture of a discipline collides with the culture of another discipline, new cultural elements will flow into it and gradually merge, and the culture of the original discipline will be sublimated. On the other hand, in the process of interdisciplinary crossing, the crossing area is equivalent to the trade exchange area, which "gives rise to a hybrid language and mixed language," which not only brings the mixing of knowledge systems but also "causes the mixing of professional roles," which gives birth to the interdisciplinary mixed culture [3]. (2) It includes both interdisciplinary knowledge culture and interdisciplinary organizational culture. Once the interdisciplinary knowledge culture is formed, it will promote the establishment of the interdisciplinary organization and is the knowledge phenomenological foundation of the interdisciplinary organizational culture. At the same time, the emergence of the interdisciplinary organizational culture is conducive to the enrichment and sublimation of the interdisciplinary knowledge culture. (3) It is a sign of the mature development of interdisciplinary organization, so not any interdisciplinary form will form an interdisciplinary culture. As far as interdisciplinary organizations are concerned, there are relatively stable interdisciplinary laboratories and interdisciplinary research centers that carry out interdisciplinary research and education, as well as highly flexible interdisciplinary research groups. The former will gradually form the corresponding organizational culture in the long-term development, and become the driving force for the operation of the interdisciplinary organization and the development of interdisciplinary knowledge. While the latter will usually dissolve with the completion of the project, so it cannot form the corresponding cultural system.

1.2. Conditions for the formation of interdisciplinary culture

Some scholars refer to the "desire to cooperate with other disciplines" shown by a certain discipline as "cultural desire" [4], that is, cross-disciplinary cultural desire. As we all know, "culture is a fluid phenomenon, it is difficult to limit it in a fixed boundary" [5]. Therefore, from the perspective of disciplinary culture, once the desire to cooperate between different disciplines is generated, various cultural elements of different disciplines will break through the original disciplinary boundaries to carry out disciplinary culture dialogue and transfer, thus promoting the formation of interdisciplinary culture to meet the needs of interdisciplinary culture in the development of disciplines. However, in general, it is impossible for a certain discipline to have the desire and demand to cooperate with any other discipline or all disciplines, so the formation of an interdisciplinary culture is conditional. Firstly, the close and distant relationship between disciplines is one of the important conditions for the formation of interdisciplinary culture. It is easier to overcome the incommensurability of discipline culture when interdisciplinary work is carried out among related disciplines, so as to form a unified interdisciplinary paradigm and relatively harmonious interdisciplinary culture. On the other hand, in the fields of natural sciences and humanities and social sciences, interdisciplinary work is carried out in distant regions, and the obvious boundary between disciplines will make it more difficult to overcome the incommensurability between disciplines and cultures, and it will be difficult to form a coordinated interdisciplinary cultural paradigm. Secondly, whether the discipline knowledge structure is strict or not is also one of the conditions for

the formation of an interdisciplinary culture. The looser the structure of discipline knowledge, the easier it is to be affected by other factors, the greater the openness of discipline culture, the greater the possibility of dialogue and transfer between discipline cultures, and the easier it is to form interdisciplinary culture.

1.3. The formation process of interdisciplinary culture

Under appropriate conditions, the boundary of discipline culture is open, and different discipline cultures will produce new elements through the process of conflict and integration, thus establishing a new interdisciplinary cultural structure. At the beginning of the encounter of two disciplinary cultures, it is inevitable to have disciplinary cultural conflicts because of maintaining the original boundary of disciplinary cultures and asserting their respective authority. However, in the process of people's efforts to maintain discipline boundaries, "the sensitivity to other disciplines weakened by discipline has also been unconsciously restored, and the opportunities for people to find the flaws in the existing discipline norms and break through their own boundaries have been increased" [6]. On the contrary, it is more conducive to the formation of knowledge growth points and new knowledge culture elements. It can be said that conflict is the primary link in the formation of interdisciplinary culture. However, it is a very difficult and long process for a multi-disciplinary culture to turn from conflict to integration, just as scholar Anbar put it, "because it is really not an easy task to keep a group of tigers in a cage and each plays its own role" [7]. Therefore, in the formation of an interdisciplinary culture, it is necessary to have a leader who can balance various forces in interdisciplinary fields and play the role of bridge and coordinator. In addition, interdisciplinary culture takes the establishment of an interdisciplinary knowledge system as its core element, and practice has proved that an isolated and single discipline cannot provide "new and insightful social knowledge." The establishment of a new interdisciplinary knowledge system "largely depends on the correct application of analogies and metaphors drawn from other research fields" [8]. Therefore, in the process of turning disciplinary culture from conflict to integration, the common approach is ingestion.

2. Interdisciplinary culture cultivates the advantages of college students' innovative ability

Interdisciplinary culture is the sum of the unique knowledge theory system, values, and behavior habits formed in the development of discipline knowledge and discipline organization [9]. It has educational functions for college students in the aspects of cultivating thinking mode and guiding behavior mode. Different disciplines in universities have varied cultural attributes, so the culture of each discipline is relatively closed from the perspective of the relationship between the culture of one discipline and the culture of other disciplines. Just as French sociologist Bourdieu said, this kind of relatively closed culture is also "overbearing." This kind of closed and arbitrary culture is an important factor that unconsciously trains college students into qualified discipline members and senior professionals, but it also easily causes the rigidity of the education mechanism and is even not conducive to the development of college students' innovative thinking and ability. We call the education limitation caused by this relatively closed discipline culture as the education set.

Since the middle of the 20th century, under the background of globalization, the social evaluation criteria for talent quality have changed from specialization to both expertise and broad communication, intelligence, and moral character. Bauman, a British scholar, pointed out that to become an outstanding intellectual, one needs to go beyond preference and focus on one's own profession or school, and really pay attention to some global issues. In fact, a "remarkable intellectual" is usually a person who is not limited by a particular disciplinary preference and has multi-disciplinary cultural elements, such as the famous painter and physicist Leonardo Da Vinci and the physicist, philosopher, and thinker Albert Einstein. In addition, "a study of the

reading habits of chemists and physicists revealed that they spend between a quarter and three-quarters of their time in journals from other disciplines. 65% of chemists and 40% of physicists said they read scientific journals because of 'undirected browsing'" [10]. Interdisciplinary culture is the result of the dialogue and transfer among multidisciplinary knowledge theories, disciplinary thinking, disciplinary values, and behavior habits. It has an advantage over single disciplinary culture in cultivating interdisciplinary talents with broad knowledge, perfect personality, and flexible use of thinking of different disciplines to analyze the development law of things. However, the key to the cultivation of creativity lies in the improvement of creative thinking skills, and cross-thinking is usually an important component of creative thinking skills. Generally, abstract logical thinking and analytical thinking are the result of the cultural education of natural science and technology, while the culture of humanities and social science often affects the cultivation of people's image thinking and intuitive thinking. The realistic thinking process is usually the combination of abstract logical thinking, analytical thinking, image thinking, and intuitive thinking, which is precisely the main advantage of interdisciplinary cultural education.

3. The cultivation path of college students' innovative ability in the field of interdisciplinary culture

The cultivation of innovation ability is the main advantage of interdisciplinary cultural education, and innovation ability comes from the formation of innovative thinking. The interdisciplinary knowledge system is an important cultural element that affects the formation of college students' mode of thinking, including the influence of the content and compactness of subject knowledge, as well as the shaping of the mode of thinking by subject methodology. Therefore, the establishment of an interdisciplinary knowledge system is the premise of the influence of interdisciplinary culture on the formation of college students' innovative abilities. It can be said that the interdisciplinary knowledge system has delimited the strict knowledge boundary for itself and established the discipline territory that is forbidden to be invaded by others. This kind of self-enclosed discipline knowledge establishes the development direction of specialization but also defines the development track of one-sided cognition and practice for people. However, driven by the big science idea of integrated knowledge development, people found that "the boundaries of disciplines and their knowledge production are not fixed and rigid, and in the production of scientific knowledge, the boundaries of knowledge will be constantly redefined" [11]. Only in the contradictory movement of both closed and open disciplinary knowledge boundaries can knowledge innovation be more effective by making efforts to open disciplinary knowledge boundaries, and even establish an interdisciplinary knowledge system to cultivate innovative talents with interdisciplinary perspectives and thinking.

3.1. Setting up comprehensive curriculum plans

We need to convert interdisciplinary research results into curriculum content, and set up courses based on the knowledge of two or more disciplines, such as "Philosophy and Mathematics" and "Economics and Engineering Science" at Oxford University; guide students to choose courses across disciplines, such as stipulating that natural science and technology science students should take no less than 20% of the total courses in humanities or social science courses, and humanities and social science students should also take about 20% of the total courses in natural science and technology courses.

3.2. Implementing an interdisciplinary enrollment system and a joint teacher training system

First of all, according to the actual situation of the discipline, we should recruit interdisciplinary students suitable for the development potential of the discipline. For example, the Department of Physics of Linkoping University in Sweden jointly set up an interdisciplinary research and talent training program named "Forum

Scientum" by experts in the fields of natural science, technical science, and biomedicine. It mainly recruits students from different disciplinary backgrounds to participate in the research [12]. Secondly, professors with different academic traditions or disciplinary backgrounds can cooperate to complete the teaching task of the same course, or a joint tutorial system can be implemented for graduate students. For example, interdisciplinary doctoral students at MIT generally receive joint guidance from more than three different professional tutors.

3.3. Opening the social boundaries of disciplines and promoting the establishment of interdisciplinary knowledge systems through interdisciplinary organizations and their cultures

Discipline is a combination of knowledge and organizational forms, so it is necessary to open the social boundary, that is, the corresponding disciplinary organizational boundary while opening the disciplinary knowledge boundary. Generally, disciplinary knowledge can easily cross disciplinary boundaries from pure discipline to applied discipline or from one pure discipline and applied discipline to another, thus resulting in knowledge innovation, but the interdisciplinary knowledge at this time is often sporadic and scattered. Only when the existing academic system "has the ability to expand and create new positions, in order to absorb the innovation and allow it to develop" [13], it is more conducive to the transformation of interdisciplinary knowledge from scattered to systematic, reflecting the tension between the relative openness of disciplinary knowledge culture and the stability and lag of organizational construction, and also indicating that it is necessary to have relatively stable interdisciplinary organization support in the process of establishing interdisciplinary knowledge system [14]. For example, the Superconductivity Research Center of the University of Cambridge across physics, chemistry, materials science, and geosciences, the Department of Civil Engineering and Applied Earth Science of the Technical University of Berlin in Germany, and the Institute of Micron and Nano Science Systems of Shanghai Jiao Tong University and other interdisciplinary organizations play a platform role in the construction of interdisciplinary knowledge system.

4. Conclusion

Interdisciplinary culture includes the new cultural elements generated by the mixed area of multiple disciplines as well as the sublimation of various disciplinary cultures in the dialogue of multi-disciplinary cultures, but the formation of a new interdisciplinary culture in the mixed area is difficult. For example, "a physics professor may know more about a physics lab on the other side of the earth than he knows about the chemistry lab in the next room" [14]. It not only needs the integration of multiple disciplines on the knowledge boundary, but also needs the support of interdisciplinary organizations. When we enter a strange cultural environment, it is easy to get lost, rejected, and afraid, which is called cultural shock by American anthropologist Oberg [15]. Therefore, the positive impact of interdisciplinary culture on college students' innovative ability not only relies on the formed interdisciplinary cultural system but also depends on the students' active integration of different disciplinary cultures.

Disclosure statement

The author declares no conflict of interest.

References

[1]   Li Y, 2018, Problem-Oriented: Disciplinary Boundaries, Humanities Research and Talent Training. China Higher

Education, 2018(2): 48–49.

[2] Zhang X, Liu B, 2023, Interdisciplinary Talent Training Mechanism: Theoretical Logic, Practical Problems and Optimization Path. University Education Science, 2023(6): 43–51.

[3] Kline JT, 2005, Across Boundaries: Interdisciplinary Knowledge [Jiang Z, Trans.], Nanjing University Press, Nanjing, 60.

[4] Reich SM, Reich JA, 2006, Cultural Competence in Interdisciplinary Collaborations: A Method for Respecting Diversity in Research Partnerships. Am J Community Psychol, 2006(38): 51–62.

[5] Zoreda M, 1997, Cross-Cultural Relations and Pedagogy. American Behavioral Scientist, 40(7): 923–935.

[6] Yan G, 2002, Understanding University—the Perspective of Organizational Culture, Educational Science Press, Beijing, 132.

[7] Bruhn JG, 1995, Beyond discipline: Creating a Culture for Interdisciplinary Research. Integrative Physiological and Behavioral Science, 30(4): 331–334.

[8] Belt P, 2002, Social Theory in the Twentieth Century [Qu T, Trans.], Shanghai Translation Publishing House, Shanghai, 267–268.

[9] Xiao N, Yang L, University Subject Culture and Its Mechanism of "Generation and Evolution." China Higher Education Research, 2010(12): 20–23.

[10] Crane D, 1988, Invisible Academy: The Diffusion of Knowledge in the Scientific Community, Huaxia Publishing House, Beijing, 99.

[11] Pinch T, 1990, The Culture of Scientists and Disciplinary Rhetoric. European Journal of Education, 1990(3): 295–304.

[12] Xue L, Gong X, 1998, European Subject Policy and Interdisciplinary Research. Science of Science and Management of S. & T., 19(8): 51.

[13] Crane D, 1988, The Invisible Academy: The Diffusion of Knowledge in the Scientific Community, Huaxia Publishing House, Beijing, 101.

[14] Wang E, 2002, Subject Construction in Universities—Dynamic Analysis of Subject Development. Science of Science and Management of S. & T., 2002(5): 34–37.

[15] Oberg K, 1960, Culture Shock: Adjustment to New Cultural Environments. Practical Anthropology, 7(4): 177–182.