Game Analysis of Cross-boundary Collaborative Teaching in Higher Vocational Education-- Based on the Perspective of Cultural Communication

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ABSTRACT. *Cross-boundary collaborative teaching is an effective method and approach to carry out internationalization of higher vocational education. In practice, because of different interest subjects and interest demands, the participants of collaborative teaching are in the game mechanism. Analyzing game equilibrium, it is found that both sides of the game participants' probability is related to the cost of cooperation and the responsibility of cultural communication. Therefore, the development of cross-boundary collaborative teaching in higher vocational education requires close cooperation, assume the responsibility of cultural communication, and make full use of resources and the international cooperation environment, in order to cultivate technical talents that meet the needs of the international market.*

KEYWORDS: *higher vocational education; Cross-border; Collaborative teaching; Game; Cultural communication*

1. Introduction

Under the background of economic globalization, the internationalization of education is gradually coming into people's view [1], which speeds up the movement of capital and Labor in the global scope and promotes the flow and allocation of talents [2], it is also one of the stages of the development of higher vocational education in China [3]. China is developing and exploring the internationalization of education at all stages from primary education to higher education, striving to cultivate professionals with international standards, global vision and international market competition. In cross-border collaborative teaching, domestic and foreign institutions have different interest subjects and different interest demands, which makes the game between the subjects inevitable. The interest main body adjusts the relations, allocates the resources, and makes the decision in the game. It is of great practical significance to analyze the game of higher vocational colleges at home and abroad in order to promote the international development of colleges and universities and co-educate people.

2. Static game of cross-border Collaborative Teaching in higher vocational colleges at home and abroad

2.1 Basic Assumption

Game participants: domestic higher vocational colleges and foreign higher education institutions. Both of them are in the game mechanism, and they make decisions on whether to cooperate or not.

Game strategy: (positive, negative).

Both sides of the game have a certain level of knowledge and make their own decisions, so this process can be regarded as a static game of complete information.

The traditional teaching benefit of domestic universities is r_A, the cost of maintaining teaching order is c_A, the extra cost of participating in cross-border collaborative teaching is c_a, the extra benefit is r_a. The traditional teaching benefit of foreign universities is r_B, the cost of maintaining teaching order is c_B, and the extra cost of participating in cross-border collaborative teaching is c_b, and the extra payoff is r_b. The construction of the game matrix is shown in Table 1.

Table 1 Game Matrix of cross-border Collaborative Teaching in higher vocational colleges at home and abroad

		Domestic institutions	
		positive (y)	negative (1-y)
Foreign Institutions	positive (x)	$r_B + r_b - c_B - c_b$, $r_A + r_a - c_A - c_a$	$r_B + kr_b - c_B - c_b$, $r_A - c_A$
	negative (1-x)	$r_B - c_B$, $r_A + hr_a - c_A - c_a$	$r_B - c_B, r_A - c_A$

Only one party actively participates in the international collaborative teaching process, because the other party is passive, the benefits of cooperation will be affected. Therefore, when foreign institutions take an active part in it, and when domestic institutions do not take an active part in it, the extra income coefficient obtained by foreign institutions is k; when domestic institutions take an active part in it and foreign institutions do not take an active part in it, the extra income coefficient obtained by domestic institutions is h, and $0 < h < 1$, $0 < k < 1$.

2.2 Game Analysis

(1) Analysis of Pure Strategy Nash Equilibrium

If foreign institutions want to actively participate in the cross-border collaborative teaching process, whether they participate or not depends on the difference $(r_a - c_a)$ between the additional benefits and the additional costs of active participation, if $r_a - c_a > 0$,, then the domestic institutions choose to participate actively, and vice versa. Similarly, if domestic institutions participate actively, and foreign institutions participate or not depending on the difference $(r_b - c_b)$ between the extra benefit and the extra cost of participation, if $r_b - c_b > 0$, then foreign institutions choose to participate actively, instead, choose to be passive. There is no stable equilibrium in pure strategy.

(2) Analysis of Mixed Strategy Nash Equilibrium

The probability of negative participation is (1-x) if foreign institutions participate actively with probability x, and the probability of negative participation is (1-y) if domestic institutions participate actively with probability y. The maximum expected return for domestic institutions is:

$$E_1 = y[(r_A + r_a - c_A - c_a)x + (r_A + hr_a - c_A - c_a)(1-x) + (1-y)[(r_A - c_A)x + (r_A - c_A)(1-x)] \tag{1}$$

For (1) partial derivative, the optimal first-order condition is partial derivative $0, \frac{\partial E_1}{\partial y} = 0$, $x^* = \frac{c_a - hr_a}{(1-h)r_a}$, the probability of active participation of foreign institutions is greater than $\frac{c_a - hr_a}{(1-h)r_a}$, the choice of domestic institutions is active participation, if the probability of active participation of foreign institutions is less than $\frac{c_a - hr_a}{(1-h)r_a}$, the choice of domestic institutions is passive participation. According to the result, the value of x is positively correlated with the additional cost C of active participation in domestic. The expected maximum returns for foreign institutions are:

$$E_2 = x[(r_B + r_b - c_B - c_b)y + (r_B + kr_b - c_B - c_b)(1-y)] + (1-x)[(r_B - c_B)y + (r_B - c_B)(1-y)] \tag{2}$$

The optimal first order condition is partial Derivative $0, \frac{\partial E_2}{\partial x} = 0$, $y^* = \frac{c_b - kr_b}{(1-k)r_b}$, the probability of the active participation of the domestic institutions is higher than $\frac{c_b - kr_b}{(1-k)r_b}$, which will attract the enthusiasm of the foreign institutions for collaborative teaching and active participation, if the probability of active participation of

domestic institutions is less than $\frac{c_b-kr_b}{(1-k)r_b}$, foreign institutions will react negatively. The value of y is positively correlated with the additional cost c_b of foreign active participation.

Therefore, the mixed Nash Equilibrium of the model is $(x,y) = (\frac{c_a-hr_a}{(1-h)r_a}, \frac{c_b-kr_b}{(1-k)r_b})$. The probability of $\frac{c_a-hr_a}{(1-h)r_a}$ for domestic institutions to participate in cross-border collaborative teaching is $\frac{c_b-kr_b}{(1-k)r_b}$ for foreign institutions.

3. The game of cross-border collaborative teaching in colleges and universities at home and abroad based on cultural communication

Cultural diffusion, refers to the interaction of culture from one society to another, from one region to another and from one group to another [4].The communication and exchange of culture is the characteristic of the Times of globalization and the inevitable requirement under the background of economic globalization. Cultural Communication and communication can develop empathy and remove barriers to communication. It can enhance cultural understanding and eliminate misunderstanding. It can help people to understand themselves and eliminate conflicts and conflicts. For example, the internationalization of Russian Higher Education clearly puts forward the promotion of Russian language and culture as one of its three major purposes [5].

As an important combination of the first productivity of science and technology and the first resource of talents, colleges and universities play an important role in the process of cultural communication, cultural exchange and cultural inheritance. The opening sentence of Confucius< The Great Learning> "the way of university, in people-character, in the people-friendly, in the ultimate good". points out the way to do great learning, universities are the places where people learning knowledge and learning kindness , and also the stage for spreading knowledge, it is also a bridge to exchange knowledge, so colleges and universities should assume the responsibility of passing on knowledge, spreading knowledge and exchanging knowledge.

With the active participation of colleges and universities at home and abroad, this paper makes a game analysis of the responsibility of colleges and universities to disseminate culture abroad, so as to analyze the role of this responsibility in the collaborative teaching. r_2 is the responsibility of foreign institutions to spread culture abroad and r_1 is the responsibility of domestic institutions to spread culture abroad, the game matrix is set up as follows:

Table 2 Game Matrix of domestic and foreign universities based on cultural communication

		Domestic institutions	
		positive (y)	negative (1-y)
Foreign Institutions	positive (x)	$r_B + r_b - c_B - c_b - r_2,$ $r_A + r_a - c_A - c_a - r_1$	$r_B + kr_b - c_B - c_b - r_2$, $r_A - c_A$
	negative (1-x)	$r_B - c_B$, $r_A + hr_a - c_A - c_a - r_1$	$r_B - c_B, r_A - c_A$

The maximum expected payoff of institutions at home and abroad is:

$$E_3 = y[(r_A + r_a - c_A - c_a - r_1)x + (r_A + hr_a - c_A - c_a - r_1)(1-x) +$$

$$(1-y)[(r_A - c_A)x + (r_A - c_A)(1-x)] \quad (3)$$

$$E_4 = x[(r_B + r_b - c_B - c_b - r_2)y + (r_B + kr_b - c_B - c_b - r_2)(1-y) +$$

$$(1-x)[(r_B - c_B)y + (r_B - c_B)(1-y)] \quad (4)$$

$x^{**} = \frac{c_a - hr_a + r_1}{(1-h)r_a}$, $y^{**} = \frac{c_b - kr_b + r_2}{(1-k)r_b}$, so $\frac{c_a - hr_a + r_1}{(1-h)r_a}$, $\frac{c_b - kr_b + r_2}{(1-k)r_b}$ are the probability of the active participation of domestic and foreign institutions in collaborative teaching under the responsibility of cultural communication. It is easy to get $x^{**} > x^*, y^{**} > y^*$ by calculation. The probability of the active participation of foreign colleges and universities is increased from $\frac{c_a - hr_a}{(1-h)r_a}$ to $\frac{c_a - hr_a + r_1}{(1-h)r_a}$ after the schools take up the bridge of cultural transmission.

At the same time, the probability of active participation of domestic institutions is also increased from $\frac{c_b - kr_b}{(1-k)r_b}$ to $\frac{c_b - kr_b + r_2}{(1-k)r_b}$. Therefore, from the results of the analysis, we can see that cultural communication plays a positive role in the construction of cross-border collaborative teaching, which is not only conducive to improving the cultivation of students' international competitiveness, international cultural exchanges and scientific research and innovation exchanges have also been strengthened.

4. Strategies for strengthening cross-border collaborative teaching in domestic and foreign universities.

4.1 Establishing multi-dimensional cooperation, appropriately increasing the cost of collaborative teaching

Through the model calculation and analysis, the probability of cross-border collaborative teaching is positively related to the extra cost of both sides. The cost includes not only the hardware and software cost, but also the time cost of the staff, the activity cost of the project and the planning and organizing cost. Multi-level, multi-type multi-domain and multi-dimensional cooperative teaching can not only promote the cultural exchange, the school's attention, the student participation enthusiasm, but also increase the overall cost of collaborative teaching, enhance the probability and enthusiasm of cross-border collaboration between domestic and foreign universities.

4.2 Make good use of the international situation and increase the benefit of cooperative teaching

The construction of "Belt and Road" has achieved a lot in the past five years. The next stage of work is to promote the transformation of "Belt and Road" to high-quality development. According to data from the Ministry of Education, as of the end of April 2019, China has signed agreements on mutual recognition of higher education degrees and academic qualifications with 24 countries along the "Belt and Road", and 60 universities in China have launched overseas operations in 23 countries along the routes, the aim is to cultivate multi-cultural vision, open and inclusive spirit and critical thinking, globalization of the compound talents. Carrying out cross-border collaborative teaching is an effective way to adapt to the international situation, meet the needs of international market development, and cultivate talents with international vision. The macro-level talents can not only participate in the country's foreign economic construction, but also provide suggestions for the interconnection between countries. The micro-level can not only enhance the individual international literacy, but also enhance the international reputation of the school. No matter from which analysis of collaborative teaching has greatly improved the benefits of the cooperative schools, prompting both sides in the game strategy tends to (positive, positive).

4.3 Strengthen cultural communication and assume the responsibility of cultural exchange

The sense of responsibility of cultural communication and cultural exchange plays a positive role in promoting the construction of cross-border collaborative teaching. Carrying out teaching activities in a cross-border and cross-regional context not only enables students to have a deeper understanding of the national culture, so that the national culture can be passed on, but also enables them to carry forward their country's outstanding culture to the outside world, let the national culture can be spread around the world, more can understand the local conditions and customs of foreign countries, for strengthening interregional economic cooperation and other cooperation has laid a solid cultural foundation.

5. Conclusion

The above countermeasures are based on the model and the author's experience in teaching practice. Because the model simplifies the practical problems, it may not be able to completely solve the complex problems of managers, because many factors are not taken into account in the simplification of the model, the degree of agreement between the model and the actual problem is affected. However, through theoretical research, it can provide theoretical support and basis for the implementation of cross-border collaborative teaching strategies, and may also bring some thinking and inspiration to related work.

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