

Assessing Collaborative Teaching Under the Impact of COVID-19 Pandemic: Instrument Development in the Context of the SECI Model

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Abstract

This paper aims to develop and validate a SECI model (socialization, externalization, combination and internationalization) instrument to assess collaborative teaching quality under the impact of COVID-19 pandemic on transnational education in China. Although Chinese universities responded to this education disruption in emergent response, lockdown due to the COVID-19 brings pandemic pedagogy to transnational higher education. Collaborative teaching responds to this situation by updated practices to tackle pedagogical and contextual differences in transnational education. This research updates Cheng's 21-item model (2022) by adding information technology utilization and cultural context factors to validate the joint knowledge production. This study finally explored a SECI knowledge-creation model with new factors discussing of collaborative teaching quality during COVID-19. It was also found that collaborative teaching management can be linked to on multidimensions of knowledge generation, such as resource exchange, culture, and technology.

Keywords: Collaborative Teaching, COVID-19 Impact, SECI Model

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1. Introduction

Knowledge creation and transfer is the primary aim of higher education institutions (HEIs). The huge changes in the technical support, the social needs for higher education, and fierce competition at both national and international level drive HEIs to tackle more with when confronted deciding how to produce, manage and transit knowledge. Moreover, the growing call for improvement and quality also boosts HEIs to improve the knowledge creation and transfer process. Cultural differences (Heffernan et al., 2010), political and educational policy gaps (Mok, 2021), as well as social-demographic changes are challenging that higher education institution need to confront with when it seeks global partnerships (Xu, 2019). Cheng applied the SECI knowledge conversion model developed by Nonaka (1995) as an analytical tool to explain how knowledge can be created and transferred among teaching team members by collaborative lesson planning (Cheng, 2022). As a result of increasing needs in knowledge management (KM) in transnational higher education, growing research have been devoted in enhancing KM technologies (Annabi & Wilkins, 2016), producing, and sharing academic knowledge (Li et al., 2014), mapping and measuring knowledge (Kleibert et al., 2020), as well as fostering learning and education (Hautala, 2011).

However, whereas numbers of studies have investigated the indications of KM on transnational education. Research on KM for transnational education COVID-19 pandemic still lacks comprehensive understanding. This lack has been made worse by the fact that, there are some attempts to provide insights for international students' experiences, but this review is limited only to students' anxiety to studies and future career (Hari et al., 2021). However, such big challenge to physical mobility of international resources deserves a depth investigation to trace what have been done and what will do in the future, considering the unique forms of accountability and multifaceted impact on TNE landscape.

This paper analyses the collaborative teaching from SECI model perspective, in order to understand how KM maintain TNE partnerships and teaching quality during COVID-19 pandemic in Chinese universities. The starting point of this research was the assumption that collaborative teaching quality in transnational education can be assessed by an instrument developed from SECI model. To testify this assumption, the research investigated (1) how and what extent do collaborative teaching team members share their knowledge during COVID-19? (2) how do knowledge attributes influence knowledge transfer and knowledge creation within transnational education during the COVID-19 pandemic?

This paper is structured as follows. Following the literature review, it will present the methodology and analytical framework. Next, the main findings of instrument exploration and validation will be presented. From these findings, it will that link collaborative teaching management to multidimensions of knowledge generation and transfer. Finally, some conclusions and limitations are drawn from the main findings.

2. Literature review

2.1 Transnational education during COVID-19

COVID-19 pandemic has an unprecedented impact on the landscape of transnational higher education from physical mobility of scholars and students, which is the most frequent cross-borders mode of knowledge transfer in HE (Zentrum, 2004). The policy differences between national system during COVID-19 is also a barrier to international cooperation and mobility.

Because there is a risk that a partnership university could interpret the difference as an indication of reluctance to engage in exchange, cooperation, and mobility (Zentrum, 2004). Even students are in the education provider country, they still must take online courses, as campus and classrooms are predominantly closed. Except the uncertainties, many students who are in joint programme tend to defer or cancel their plans of abroad study. Therefore, the pandemic drives the educational operators carefully balanced interests with university strategies and overseas exchanges.

2.2 Collaborative teaching

The collaborative teaching is a dynamic process, starting from individual levels and finally reach out through interactions that surpass individual, team and organizational ranges. The active interaction among academics encourages team members to share ideas and give suggestions to improve teaching quality (Sengpoh, 2019). It not only boosts confidence of both teachers and students, but also creates quality teaching performance because the cooperative interaction in learning is more effective compare with individual study. In transnational education, collaborative teaching builds a global curriculum for sustainable development (Caniglia et al., 2018). It provides an opportunity to teach academic knowledge by emphasizing the global and local nature of sustainability. Cheng (2022) explored a 21-item model to assess teachers collaborative planning practices under the SECI knowledge conversion processes. The instrument verified in his research has devoted in practices of assessment and monitoring collaborative teaching practices in school. Collaboration in team teaching during COVID-19 takes more time and efforts for teachers to work together in planning, teaching and assessment. ("Impact of Covid-19 Pandemic on Higher Education," 2020) However, no further research has mended the gap between TNE and SECI model from collaborative teaching perspective.

2.3 Academic knowledge in collaborative teaching

Collaborative teaching involves academic explicit knowledge and tacit knowledge transfer for learning and instruction from an individual to a group and vice-versa (Cheng, 2022). In higher education (HE), Eleni (2003) classifies knowledge into two types: academic or scholarly knowledge and non-academic organizational knowledge. The production and dissemination of academic knowledge represents the primary purpose of HE. Thus, in this research, knowledge refers to academic knowledge, whether explicit or tacit. This is the conceptual framework to knowledge in transnational education in this study. The explicit knowledge is classified to curriculum outline, teaching slides, textbooks, assessment strategies, and tacit knowledge is classified to delivery, teaching style-learning by doing, course design, as well as course management (Li et al., 2014). From collaborative teaching in TNE, teaching knowledge include knowledge of subjects, methods of teaching, knowing of students learn methods and outcomes, the ability to apply and practice, an understanding of teaching and learning effectiveness assessment, and knowledge of quality assurance and improvement. Tacit academic knowledge supports collaboratively pedagogical practices (Quarichioni et al., 2020).

2.4 SECI model in knowledge management

Knowledge management involved knowledge sharing, creation, validation, and application. (Bhatt, 2011) It also emphasizes the integration of technologies (Gurteen, 1998) SECI model is a knowledge creating process featured in spiral form. It is a two-dimensional matrix

depicting four possible scenarios for interacting or converting tacit and explicit knowledge (Nonaka & Takeuchi, 1995). This model includes four knowledge conversion processes, they are socialization, externalization, combination and internationalization. In collaborative teaching, these four processes are elaborated as following:

Socialization is a knowledge conversion mode that convert tacit knowledge through interaction between individuals (Nonaka, 1994). In collaborative teaching context, individual tacit knowledge in teaching experiences and practices can be shared with and absorbed by other team members. In collaborative class preparation meeting during COVID-19, tutors within a team can share the teaching material design, teaching pedagogical ideas, and reflection on assessment standard.

Externalization mode captures tacit knowledge and expands into explicit knowledge through mutual interaction (Nonaka, 1994). In collaborative teaching, it happens where tutors' tacit pedagogical thinking and actions converted into explicit pedagogical knowledge, expressing in teaching belief, methodologies or academic knowledge during collaborative class preparation activities (McGill & McGill, 2007). Pedagogical ideas exchanges during unprecedented COVID-19 may be ambiguous or vague, however, it will be clearer by verbal or image communication. Finally new ideas for teaching materials, class management and pedagogical implementation will be created.

Combination involves the use of social processes to combine different bodies of explicit knowledge held by individuals (Nonaka, 1994). This process creates new explicit knowledge from the existed explicit knowledge. In collaborative teaching scenario, tutors within a teaching team exchange their explicit knowledge in teaching materials, curriculum outline and assessment strategies in external mechanism, such as joint class preparation meetings, assessment standardization meeting, email communication. Tutors create new academic knowledge by sorting, adding, recategorizing the existed knowledge from teaching material and assessment materials.

Internalization is very similar to traditional definition "learning". It is a conversion mode that transfer the organizational knowledge into individual tacit knowledge (Nonaka, 1994). It associates with team learning and emphasizes the process of new tacit knowledge creates. In collaborative teaching scenario, internalization refers to incorporating knowledge into the teaching to achieve better learning results from students, including teaching style-learning by doing, internalizing team knowledge into personal knowledge.

3. Research methodology

3.1 Participants

This study will use factor analysis method. Since tutors in the TNE need to implement course outline, teaching materials, assessment criteria, which are defined as explicit knowledge in TNE. They also need to deliver knowledge, teach style-learning by doing, design course and manage course in an accumulated way, which are defined as tacit knowledge in TNE. Thus, the 240 participants are randomly selected from 10 joint programme in China, 4 in Dalian, 2 in Beijing, 2 in Shanghai and 2 in Xiamen. The participants received an invitation by email and consented to take part in the research survey. 150 participants are Chinese citizens while the rest are non-Chinese citizens.

3.2 Questionnaire design

All the items in the questionnaire were developed from the literature on knowledge conversion in TNE and SECI model. (Cheng, 2022; Li 2012) During COVID-19, technological support and culture factors play an important role in collaborative teaching. Since the lack of physical mobility from tutors and students, hybrid teaching mode are very common in TNE. Thus, the items expanded to information technology utilization and cultural context factors categories were supplemented by in-depth interview with TNE administrative. The final items in questionnaire include statements that assess SECI processes, knowledge transfer and technological support during COVID-19 pandemic. Items measuring collaborative teaching during the Covid-19 pandemic were modified based on the interviews with module leaders' suggestion. Participants can make choice on a 6 Likert-scale method, from 1 which represents totally disagree to 6 which equal to totally agree.

3.3 Data analysis

The total number of questionnaires collected is 432, and 12 samples were excluded because of invalid answers. A total of 420 participants were used in this research. The sample, which is n=420 are randomly equally divided into 2 groups, 210 for exploratory factor analysis and 210 for confirmatory factor analysis. To find the four factors influencing variables and analyze which variables are correlated, this research first used exploratory factor analysis, assembling common variables into descriptive data of the collaborative teaching. Analysis of EFA and CFA will be conducted by SPSS Statistics 26.

4. Results and discussion

4.1 Exploratory factor analysis

The randomly selected half of the sample(n=120), the KMO=.908, which is over 0.6, and Bartlett's test $p < 0.05$, indicating the sample is adequate for factor analysis. Based on the questionnaire items and SCEI model, Factors 1 represents socialization, Factor 2 represents externalization, Factor 3 represents combination, and Factor 4 represents internalization. It can be seen from the Table 1 that the absolute value of the factor loading cutoff to all research items is greater than 0.4, indicating that there is a strong correlation between the research items and the factors.

Table 1 Exploratory factor analysis of 21 items

Items	Factor 1	Factor 2	Factor 3	Factor 4
1. I can reach agreement with other members in course outline of the collaborative teaching team.	0.855	0.058	0.059	0.111
2. The whole teaching team can prepare course outline effectively and collaboratively during weekly collaborative material preparation	0.659	0.116	0.125	0.135
3. Members of the collaborative teaching team can share their teaching slides weekly in pursuit of professionals and academic knowledge to improve students learning results.	0.757	0.065	0.071	0.047
4. The textbooks on blackboard and shared E book have a depth understanding by both students and tutors.	0.743	0.059	0.016	0.105
5. When a tutor from collaborative teaching teams	0.768	0.014	0.052	0.139

has questions and consults with other team members, they will endeavor to answer the questions, no matter in China or outside China.				
6. When members try to discuss about the academic knowledge input, they will attempt to provide them own opinions during the online class preparation meeting or email exchanges.	0.739	0.1	-0.051	0.039
7. Majority of team members can express them opinions about course design and academic knowledge teaching plan very clearly and understandably.	0.729	0.035	0.013	0.068
8. When tutors from the collaborative teaching team fail to get others point of view, I can often try to explain with proof and information flow among teams' members which are quite successful.	0.089	0.118	0.099	0.859
9. I can convert the curriculum theories into understandable verbal description assists the delivery among team members in the aspect of course design, course management and assessment criteria.	0.287	0.114	0.069	0.773
10. I can organize my hybrid model and share my teaching reflections and teaching belief with others.	0.156	0.173	0.069	0.829
11. I often listen to other team members and adopt their opinions when I agree with, which can help enhance my teaching content, teaching skill and assessment criteria understanding.	0.077	0.816	0.209	0.127
12. I often organize and generalize other team members' opinions from weekly online preparation meeting and daily email exchanges.	0.114	0.734	0.266	0.107
13. I will compare the newly appeared teaching methods which created from hybrid mode with my existed experience.	0.106	0.703	0.263	0.107
14. I will dare to ask when I have questions with others' opinions on material designing, teaching methods, course design and course development skills.	0.104	0.764	0.187	0.013
15. I will exchange my ideas with others to figure out whether I have made improvement for my students during hybrid teaching period.	0.034	0.711	0.255	0.123
16. I often try to apply opinions collected from collaborative preparation meeting when I encounter difficulties in my own teaching.	0.032	0.796	0.212	0.101
17. I have a deep cognition of the teaching aims and assessment criteria of academic subjects through class preparation and standardization meeting.	0.13	0.152	0.845	0.08
18. Collaborative teaching team members develop better teaching skills in style learning by doing.	0.052	0.353	0.699	0.014
19. Collaborative teaching team members can fully link up, as well as adopt the hybrid teaching knowledge and hybrid teaching experience through class preparation meeting and email communication.	0.04	0.304	0.747	0.031
20. The class implementation after collaborative meeting and team member communication can support me in internalizing other members' teaching knowledge into my own knowledge.	0.06	0.282	0.714	0.114
21. Collaborative class preparation helps me integrate my own knowing and experience to collaborative teaching team, which will finally	-0.041	0.262	0.747	0.067

improve the hybrid teaching quality.

The internal reliability of Cronbach are .880, .818, .888, .863, which shows the items in questionnaires are correlated.

Table 2 Cronbach of four factors

Factor	AVE	CR
Scl	0.514	0.880
Ext	0.600	0.818
Cmb	0.570	0.888
Int	0.558	0.863

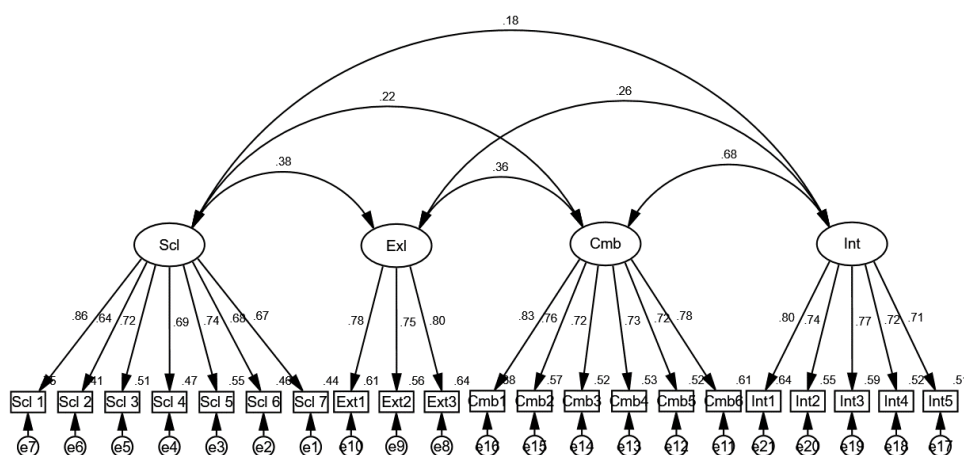


Figure1. Four Factor Model of socialization, externalization, combination, and internalization

4.2 Confirmatory factor analysis

The other half sample is tested the four-factor model for CFA by using 21-item questionnaire identified in EFA. The four-factor model shows good model fit with the following data, the CRI=0.981, TLI=0.978, RMSEA=0.032, SRMR=0.04.

Table 3 Fit indices of confirmatory factor analysis

χ^2/df	GFI	AGFI	RMSEA	RMR	CFI	NFI	TLI	IFI	SRMR
1.437	0.946	0.932	0.032	0.047	0.981	0.939	0.978	0.981	0.04

Table 4 Confirmatory factor analysis

Items	Estimate	S.E.	C.R.	Lower	Upper
1. I can reach agreement with other members in course outline of the collaborative teaching team.	0.864	0.021	41.143	0.814	0.901
2. The whole teaching team can prepare course outline effectively and collaboratively during weekly collaborative material preparation.	0.638	0.035	18.229	0.562	0.699
3. Members of the collaborative teaching team can share their teaching slides weekly in pursuit of	0.717	0.028	25.607	0.656	0.767

professionals and academic knowledge to improve students learning results.					
4. The textbooks on blackboard and shared E book have a depth understanding by both students and tutors.	0.688	0.03	22.933	0.624	0.744
5. When a tutor from collaborative teaching teams has questions and consults with other team members, they will endeavor to answer the questions, no matter in China or outside China.	0.74	0.028	26.429	0.679	0.786
6. When members try to discuss about the academic knowledge input, they will attempt to provide their own opinions during the online class preparation meeting or email exchanges.	0.682	0.03	22.733	0.61	0.732
7. Majority of team members can express their opinions about course design and academic knowledge teaching plan very clearly and understandably.	0.666	0.03	22.200	0.605	0.724
8. When tutors from the collaborative teaching team fail to get others point of view, I can often try to explain with proof and information flow among teams' members which are quite successful.	0.779	0.031	25.129	0.712	0.835
9. I can convert the curriculum theories into understandable verbal description assists the delivery among team members in the aspect of course design, course management and assessment criteria.	0.746	0.029	25.724	0.678	0.797
10. I can organize my hybrid model and share my teaching reflections and teaching belief with others.	0.798	0.033	24.182	0.725	0.856
11. I often listen to other team members and adopt their opinions when I agree with, which can help enhance my teaching content, teaching skill and assessment criteria understanding.	0.827	0.018	45.944	0.788	0.859
12. I often organize and generalize other team members' opinions from weekly online preparation meeting and daily email exchanges.	0.758	0.027	28.074	0.701	0.803
13. I will compare the newly appeared teaching methods which created from hybrid mode with my existed experience.	0.718	0.03	23.933	0.657	0.771
14. I will dare to ask when I have questions with others' opinions on material designing, teaching methods, course design and course development skills.	0.731	0.03	24.367	0.663	0.782
15. I will exchange my ideas with others to figure out whether I have made improvement for my students during hybrid teaching period.	0.722	0.029	24.897	0.662	0.777
16. I often try to apply opinions collected from collaborative preparation meeting when I encounter difficulties in my own teaching.	0.78	0.025	31.200	0.727	0.826
17. I have a deep cognition of the teaching aims and assessment criteria of academic subjects through class preparation and standardization meeting.	0.8	0.023	34.783	0.751	0.84
18. Collaborative teaching team members develop better teaching skills in style learning by doing.	0.739	0.03	24.633	0.674	0.79
19. Collaborative teaching team members can fully link up, as well as adopt the hybrid teaching knowledge and hybrid teaching experience	0.765	0.028	27.321	0.707	0.815

through class preparation meeting and email communication.

20. The class implementation after collaborative meeting and team member communication can support me in internalizing other members' teaching knowledge into my own knowledge.	0.718	0.033	21.758	0.644	0.774
21. Collaborative class preparation helps me integrate my own knowing and experience to collaborative teaching team, which will finally improve the hybrid teaching quality.	0.711	0.032	22.219	0.639	0.766

4.3 Discussion

This study aims to mend the research gap in knowledge management within collaborative higher education partnerships from academic knowledge perspective during COVID-19 Pandemic. It applies the SECI model into TNE research, and it also validates an instrument assessing collaborative teaching in hybrid mode. The results from exploratory factor analysis identified the four factor processes, including socialization, externalization, combination, and internalization. The CFA further verified these four processes identified in EFA.

The knowledge socialization factor measures how the collaborative teaching team share their tacit knowledge and teaching experiences in hybrid mode during class preparation meeting. Tutors can exchange their experiences and practices clearly. The higher the scores are, they more they can explain their tacit knowledge to others understandably. During the COVID-19 pandemic, there are many creative activities and practices in teaching materials and knowledge delivery mode. They need to accept the original ways of tacit knowledge in teaching. Also, they need to upgrade their pedagogies and teaching believes to reduce students' study difficulties from lack of physical mobility during the pandemic. This result indicates that socialization in collaborative teaching can help tutors well prepare with curriculum pedagogies and teaching materials. This result echoes the research of Lim, the effectiveness of collaborative teaching is affected by the peers in the team (Lim, 2019).

The knowledge externalization dimension measure how tutors can transform the pedagogical belief into perspectives for sharing and interpreting with texts, words or concepts. Tutors can codify the existed teaching resources and improve other tutors' understanding of how to apply academic knowledge into their class. Team members reflect on their teaching materials and curriculum pedagogies in explicit form by class preparation meeting and email exchange. This sharing of preliminary ideas with team members help to improve tutors' recodification of knowledge in academic knowledge transfer process. This finding validates the study of Guzman, emphasizing the diverse nature of knowledge and knowledge transfer process to fit special needs (Guzman, 2011).

The knowledge combination dimension weighs how the participants organize and generalize their collective-achieved teaching experience, which are vague, to share with others. During the preparation meeting and email exchange, they listen to other tutors' opinions and observe others' reflection on the changes of teaching materials and pedagogies. Tutors also share different viewpoints with team members to tackle with the newly occurred difficulties caused by pandemic. The frank and open attitude pave the way for academic knowledge transfer and erase the impedance from the pandemic. This validates the finding from Lim, indicating that attitude of the team members influences the effectiveness of collaborative teaching (Lim, 2019).

The knowledge internalization process weighs the extent to which tutors can internalize and apply the collectively prepared teaching materials into individual teaching practice, how they can adopt to facilitate knowledge sharing through learning by doing (Smith & Bereiter, 2002). Course outlines, assessment criteria and teaching material are easy to share among members. By email exchanges and online class preparation, sharing the teaching of art sometimes is difficult. Moving teaching staff to educational receivers is one of the main forms of sharing tacit academic knowledge. Though the pandemic has blocked the moving of teaching staff physical mobility, the networks moving is supported by information technology utilization.

By the identified items in EFA and CFA, this research summarized that transnational higher education partners are motivated by acquiring and transferring knowledge through collaborative teaching. Partnerships are willing to share and create academic knowledge through developing course outlines, teaching materials, assessment criteria collaboratively in explicit knowledge. For tacit knowledge conversion, teaching style-learning by doing has already been impacted a lot by the immobility of tutors and students. Tutors strive to collaborate with others by email exchanges and collaborative class preparation. The more codifiable and transferable knowledge they share during these processes, the more likely their knowledge will be shared and learned. This also verifies the finding from Kogut & Zander (1993). Thus, compared with other two processes, socialization and internalization processes are more interactive and fruitful for tutors. And, due to the inconveniences by pandemic, tutors are reluctant or difficult to share tacit knowledge. Because tacit knowledge can only be displayed and demonstrated face to face. Also, sharing tacit knowledge needs to common socio-cultural scenario. Although information technology utilization aims to eliminate immobility difficulties and achieve information flow, tacit knowledge is still more difficult to share and transfer during the COVID-19, especially in practice courses. Cooperation and collaboration in higher education are negatively affected by lack of physical mobility.

During COVID-19 pandemic, explicit knowledge shared among tutors include slides, notes, outline, online teaching materials, assessment criteria. Tutors also have online communication by weekly video meeting or email exchange on teaching experiences. However, academic knowledge sharing online also have inconvenience during pandemic. Because of Great Wall on Internet, Chinese universities use different teaching software or conference tool from outside partners. The differences in IT support also raise the protection of knowledge as a problem for both sides. Not only the courses delivered by both sides resembles the same features from partners, but there is also a different acknowledgement of the importance of tacit academic knowledge to facilitate the explicit academic knowledge. This made socialization, internalization, externalization or combination cannot guarantee the local tutors interprets knowledge the same as it tends to deliver. This is especially common for the courses with high degree of taciturnity. In this case, explicit knowledge is hard to share without tacit understanding, which means knowledge processes are hard to reach spiral process. Because perspectives on the same academic knowledge may be greatly interpreted differently among tutors within China and around the world.

5. Conclusion and limitations

The results of this empirical research interpret the four processes of SECI model to enhance knowledge transfer and knowledge conversion in the context of transnational higher education. As the theoretical and analytical tool in this research, SECI model provide new perspective for transnational education research in the COVID-19 pandemic. It indicates collaborative teaching can promote knowledge transfer and knowledge conversion, though

pandemic has brought impedance to physical mobility of students and tutors. The findings also highlight the implications for both knowledge management and collaborative teaching quality in transnational higher education in hybrid teaching mode. Tacit knowledge in university courses is difficult to codified, however, with positive attitude, effectiveness of collaborative teaching and information technology utilization, both tacit knowledge and explicit knowledge can be captured in higher education partnerships.

Despite the findings of instrument exploration and validation, there are also some limitations for future research to break through. First, participants are randomly selected from transnational higher education institution in China, which may not symbolize samples from other areas. And this research built the instrument from academic knowledge perspective. Future research can also explore a four-factor instrument from organizational knowledge perspective.

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