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Mapping the Invisible Ties: A Network Analysis of Institutional Partnerships of Short-Term Study Abroad Programs in Chinese 985 Universities

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Abstract: This study aims to explore the dynamics of the network of short-term study abroad (STSA) programs among Chinese "985 Project" universities by employing the method of social network analysis (SNA). With the application of a two-mode network framework (comprising Chinese universities and foreign partner institutions), archival data from 39 official university websites were collected and analyzed to map the patterns of STSA program collaborations. Key metrics include network centrality, clustering, and core-periphery structure. The results show that the STSA programs among Chinese "985 Project" universities are generally rich in number and diversity. It displays a centralized structure in regard to the collection of foreign universities: the network is highly connected in general, with an apparent sign of core and periphery members in the network. Its short average path length and high clustering coefficient align with the character of small-world network in the academic community. It also indicates that when Chinese 985 universities are choosing their foreign STSA program partners, there is a high similarity among their choices since English-speaking countries are in the dominant position.

Keywords: short-term study abroad programs, social network analysis, higher education, Chinese university

1. Introduction

Within all educational activities and services in transnational higher education, in recent years, there has been a notable shift to shorter and more intensive study abroad programs, making short-term study abroad (STSA) programs increasingly popular. In general, Chinese university students are interested in STSA programs because of their relatively shorter duration, greater flexibility, and easier accessibility [1, 2]. Apart from these objective factors, students' perceptions towards STSA programs are also significant reasons for them to participate in the programs [3, 4]. Among all, most existing studies emphasize individual-level outcomes, such as students' intercultural competence and learning experiences.

However, although there is plenty of research studying the influence of STSA programs and their contribution to study mobility and global internationalization, little attention has been paid to the institutional-level collaboration dynamics of these programs. Also, regarding research methods and

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theories, mainstream research conducts qualitative methods such as surveys and interviews without supported theories. To fill this research gap, this study focuses on the collaboration across Chinese and foreign universities by applying social network analysis to provide a novel perspective on the broader systemic interactions in international higher education. Also, by quantifying and visualizing the STSA patterns, this research demonstrates how institutional ties are formed and maintained and highlights the patterns of connectivity that may otherwise remain obscured in previous research.

2. Literature review

2.1. STSA program

The term "short-term study abroad (STSA) program" is situated within the framework of transnational higher education. Liu et al [5]. adopt the definition of "higher education of learners who are located in a country different from that where the awarding institution is based" [6], which is derived from UNESCO's conceptualization of transnational education. This definition emphasizes educational exchanges between nations and regions. Spencer and Harman [7] provide a more specific time frame, defining STSA programs as those lasting between one and eight weeks. Common forms of STSA programs include summer semesters abroad, international service-learning, internships, volunteering, and student exchange programs [8].

In the context of Chinese higher education, research indicates a growing interest among Chinese students in STSA programs over the past two decades [5]. Most current studies on STSA programs focus on individual-level outcomes, such as students' attitudes, challenges, and benefits. In Goldstein's [9] comprehensive literature review, which analyzed 904 articles and 68 studies, the emphasis on the enhancement of intercultural competence among participants is analyzed. These benefits span cognitive (e.g., intercultural awareness, global mindedness), affective (e.g., intercultural sensitivity), and behavioral domains (e.g., cross-cultural adaptability, intercultural communication).

Despite the abundance of research outcomes, prior studies in this field tend to be predominantly descriptive, with limited application of theoretical frameworks in research design and interpretation. According to Iskhakova and Bradly [1], only 29% of STSA-related research papers incorporate theoretical grounding in their findings. Doyle et al.'s study [3], for instance, serves as a typical example of purely empirical research without a theoretical foundation, relying instead on related studies to discuss findings. This lack of theoretical rigor has been described as "surprising" [1], who call for a stronger theoretical basis in STSA program research.

2.2. Social network analysis

In STSA-related studies that apply theoretical frameworks and methods, cross-cultural theories, learning theories, and social theories frequently appear [1]. Methodologically, most STSA research relies on self-reported surveys with small sample sizes. According to Goldstein [9], approximately half of these studies involve fewer than 50 participants, who are predominantly Western, white, and female, often without an equivalent control group. Some studies have employed social network analysis (SNA) to explore the dynamics of STSA programs, primarily focusing on how students establish social networks in new environments. For instance, DeJordy and Milevoj [10] examined the effects of friendship, advice, and communication networks on student learning outcomes, finding that all students, regardless of demographic differences, benefit from the short-term study abroad experience. Similarly, Paradowski et al [11]. utilized SNA to investigate social relationships and

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second language acquisition, demonstrating the critical role of peer interaction in language learning contexts.

In the context of institutional cooperation, SNA has been used to analyze publication and citation patterns. For example, Jing and Hua [12] investigated the clinical research publication networks among China's "double first-class" construction medical universities, while Guan et al [13]. focused on interdisciplinary collaboration at Tsinghua University. Their findings revealed that departments within similar disciplines tend to form stronger connections, and interdisciplinary cooperation significantly promotes the development of new disciplines and departments.

As for two-mode networks, relevant studies are fewer than other SNA methods. Instead of directly analyzing the two-mode network itself, most of them are often transformed into weighted one-mode networks through projection, a process of transferring the structure and information of a two-mode network into a weighted one-mode network [14]. To capture the structural characteristics of the STSA collaboration network, we focused on three key sets of metrics: centrality (to identify influential nodes) and clustering (to detect cohesive subgroups of collaborating institutions). These metrics were selected because they effectively reveal how collaborative resources are distributed, how local collaboration patterns are formed within subgroups, and how efficiently information or resources can flow across the network [15].

3. Research questions

1. What are the key structural features (e.g., centrality, clustering, core-periphery pattern) of the network?

2. What kind of foreign universities do Chinese universities prefer to establish STSA programs with?

4. Methodology

4.1. Data collection

The information on STSA programs of each Chinese university in the "985 project" (N = 39) is collected from the universities' official websites based on the framework of a binary two-mode educational innovation network. Posts and announcements in the latest academic year (2024-2025) are gathered, which mainly include STSA programs such as summer and winter exchange programs. Basic information, such as the names of the exchange programs and the universities, is collected.

To obtain deeper insight into the dynamics of the network, the information about the attributes of the network nodes is also gathered. In particular, the foreign universities are categorized based on geographic location, for example, the location of continents. Online programs are excluded from the data since they involve no physical exposure to an intercultural environment during the data collection process. It should be noticed that in this study, only the programs allowing Chinese students studying abroad are taken into consideration and analyzed because many universities do not provide summer schools for foreign countries, and for those having such programs, the collaborating institutions are not specified. In other words, this study only focuses on Chinese students going to other countries instead of the opposite way.

4.2. Data analysis

In weighted networks, degree is often calculated by summing the weights of a node's connections [16]. To better analyze this factor, I projected the two-mode network into a weighted one-mode

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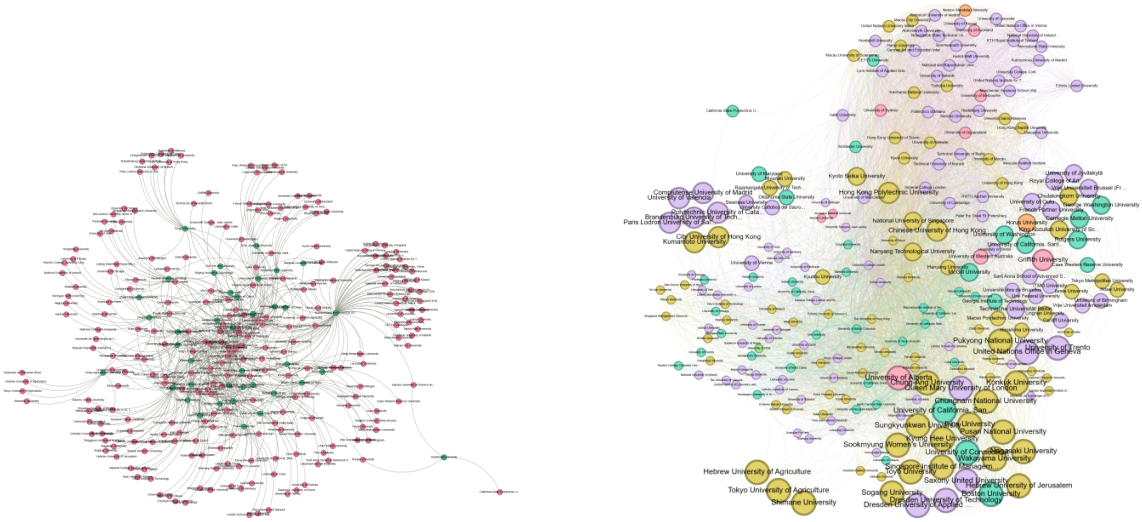
network, following Newman's projection method, which assumes stronger ties between actors sharing smaller collaborative groups. In other words, if two foreign universities are collaborating with the same Chinese university, they are more likely to be in the same cluster. Calculations were carried out using the packages in Gephi [17].

4.3. Two-mode and projection network

As for the two-mode network, there are 289 nodes, including 39 Chinese universities and 250 foreign universities, and 632 edges in total, as demonstrated in Figure 1 (a). The green nodes represent Chinese universities in "985" projects, and the red nodes are foreign universities. The average degree of each Chinese university is 16.21, indicating that for every Chinese university in the "985 project", the average number of STSA programs is 16 during the whole academic year of 2024-2025.

The projection of a one-mode network of foreign universities, as presented in Figure 1 (b), comprises 250 nodes, connected by 5,932 undirected edges. The different colors of nodes are set based on the continents where the universities are located (purple for Europe, yellow for Asia, blue for North America, pink for Oceania, orange for Africa, and green for South America). The projection reveals a densely interconnected system, with an average degree of 47.46, indicating extensive collaboration patterns among participants. The network density of 0.19 suggests moderately selective tie formation, while the remarkably short diameter (N=3) and average path length (N=1.84) demonstrate efficient knowledge transfer potential across the entire network.



(a) The two-mode network (b) The one-modeprojection

Figure 1. The two-mode network and its one-mode projection of foreign universities of institutional collaboration of STSA programs in the 2024-2025 academic year

For community detection, the modularity score is 0.28, indicating discernible but not exceptionally strong subgroup divisions. The high average clustering coefficient (0.83) suggests that collaborative relationships tend to form tightly knit connections among academic groups, making up to one of the key characteristics of small-world networks [18].

As for centrality analysis, it reveals a distributed influence structure rather than a strictly hierarchical one. While the presence of nodes with substantially higher-than-average degree suggests some concentration of collaborative activity, the overall network demonstrates resistance to

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single-point control. While a subset of nodes emerges as more central, the moderate modularity and high clustering suggest that influence is distributed across multiple semi-autonomous hubs rather than concentrated in a single dominant core. This polycentric structure may enhance the network's resilience and adaptability, though it could potentially limit the coordination of large-scale collaborative initiatives. The sparse connections between peripheral actors (density = 0.03) represent both a challenge for inclusive knowledge dissemination and an opportunity for targeted intervention to strengthen bridging ties.

Table 1. Ranking of the degree of the top 10 foreign universities

Ranking	University	Degree
1	Oxford University	23
2	University of British Columbia	21
3	University of California, Berkeley	17
4	University College London	14
5	University of Cambridge	13
6	Nanyang Technological University	11
7	National University of Singapore	11
8	University of Texas at Austin	11
9	Yonsei University	11
10	University of California, Los Angeles	10

Table 2. Percentage of continents of foreign universities

Continent	Percentage (%)
Europe	41.91
Asia	35.68
North America	17.43
Oceania	3.73
Africa	0.83
South America	0.41

As for specific analysis for the patterns of foreign universities, Table 1 demonstrates the top 10 foreign universities that have the most collaborations with Chinese universities. The ranking of top foreign universities by collaboration degree (Table 1) reveals that Oxford University emerges as the most prominent collaborator with 23 direct connections, followed by the University of British Columbia (N=21) and the University of California, Berkeley (N=17). This hierarchical distribution demonstrates a steep decline in partnership intensity, suggesting a strongly centralized structure in international collaborations.

The ranking is dominated by Western institutions, which comprise seven of the top ten positions, while three Asian universities (Nanyang Technological University, National University of Singapore, and Yonsei University) appear in the lower half of the table. This pattern aligns with the continental distribution data in Table 2, where European (41.91%) and North American (17.43%) institutions together account for nearly 60% of all foreign partners, far exceeding their Asian counterparts (35.68%) and other regions. Such geographical concentration reflects long-standing

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academic collaboration traditions and underscores the enduring influence of English-speaking research hubs in global higher education networks, as observed in similar international exchange program analyses [19].

5. Conclusion and discussion

In conclusion, the analysis of the network demonstrates a core-periphery structure with moderate modularity, where a select group of highly connected institutions, particularly universities in English-speaking countries, serve as central hubs in the global collaboration network. This finding aligns with previous studies highlighting the preferential attachment mechanism in academic networks, where established research institutions tend to accumulate more collaborations over time. It also resembles the core-periphery structure in the Farabi exchange programs, where 47% of maximum connections are concentrated in central universities [20].

The dominance of English-speaking institutions reflects preferential attachment mechanisms, where established hubs attract more collaborations, which is consistent with the idea that "well-connected components in social networks accumulate more ties," noted by Ugander et al [20].. Despite subjective factors, students' perceptions are also important, as Chinese universities have shaped student mobility preferences by framing Western education as a "status improvement" tool [21, 22]. However, the small-world properties offer resilience potential, as observed in educational innovation networks where short paths facilitate knowledge diffusion despite uneven connectivity.

As for implication, universities seeking to enhance their international collaboration should prioritize partnerships with high-degree hubs while also developing connections with mid-ranked institutions to avoid over-reliance on a few central players. However, it should be noted that the concentration of collaborations among elite institutions may exacerbate existing inequalities in global knowledge production. To address this, universities can diversify partnerships, such as echoing the "decolonial model" [23] that centers marginalized voices and reduces reliance on dominant hubs.

For future research, the relationship between these structural characteristics and research outcomes warrants further investigation into institutional attributes such as global ranking, citation impact, and innovation rates. Additionally, longitudinal studies could reveal how collaboration patterns evolve in response to changing global research landscapes and policy interventions. The findings suggest that while the global research network exhibits some hierarchical characteristics, the polycentric structure and small-world properties may offer a balance between efficiency and resilience. Strategic efforts to strengthen bridging ties while maintaining existing strong collaborations could optimize the network's knowledge diffusion potential.

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