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REPOSITIONING IN INTERNATIONAL STUDENT FLOW - A NETWORK ANALYSIS APPROACH

A NEMZETKÖZI HALLGATÓI MOBILITÁS VIZSGÁLATA – HÁLÓZATELMÉLETI MEGKÖZELÍTÉS

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ABSTRACT

International student flows, which study the cross-border movement of students for educational purposes, is a dynamically developing field of research. The aim of our research is to identify the central actors among the receiving and sending countries participating in student mobility based on various central indicators, and our aim is to identify the groups or clusters and their composition between the countries that appear in the network. The research is looking for an answer to the question of which of the receiving and sending states participating in international student mobility have a central role in the network. Our further research question: What structure and composition of clusters can be identified in the network? During our investigation, we use the methods of network analysis and graph theory. The results of our study confirmed the central role of the United States, the United Kingdom, France and Germany, which had already been highlighted in previous literature. However, this study provides two novel insights into the topic of international student mobility, which previous studies have not yet addressed. Our first result is that we have identified the composition of clusters between states participating in student mobility. Our second result is that we conducted an investigation and identified the central countries based on the weighted indegree and weighted outdegree indicators. In the course of subsequent research, it is worthwhile to examine the dynamics of the changing role of regional hubs. Therefore, it is advisable to compare the data of several periods and create a dynamic network using graph theory. In connection with this, we can perform analyzes not only on the change in the role of regional nodes, the so-called "hubs", but also on the development of emerging regional hubs (emergent regional hubs/ERG).

ABSZTRAKT

A nemzetközi hallgatói áramlás, amely a hallgatók oktatási célú, határokon átnyúló mozgását vizsgálja, dinamikusan fejlődő kutatási terület. Kutatásunk célja, hogy azonosítsuk a hallgatói mobilitásban résztvevő fogadó és küldő országok közül a központi szereplőket különféle központi mutatószámok alapján, továbbá célunk, hogy azonosítsuk a hálózatban megjelenő országok közötti csoportosulásokat, klasztereket és azok összetételét. A kutatás arra a kérdésre keresi a választ, hogy a nemzetközi hallgatói mobilitásban résztvevő fogadó és küldő

államok közül mely országoknak van központi szerepük a hálózatban. További kutatási kérdésünk: A hálózatban milyen szerkezetű és összetételű klasztereket tudunk azonosítani? Vizsgálatunk során a hálózatelemzés és a gráfelémélet módszereit alkalmazzuk. Tanulmányunk eredményei igazolták az Egyesült Államok, Egyesült Királyság, Franciaország és Németország központi szerepét, melyre már korábbi szakirodalmakban is rávilágítottak. Ez a tanulmány azonban két újszerű betekintést nyújt a nemzetközi hallgatói mobilitás témakörébe, melyre a korábbi tanulmányok még nem tértek ki. Első eredményünk, hogy a hallgatói mobilitásban résztvevő államok közötti klaszterek összetételét azonosítottuk. Második eredményünk, hogy a súlyozott befok és kifok mutatók alapján vizsgálatot végeztünk és azonosítottuk a központi országokat. Későbbi kutatások során érdemes megvizsgálni a dinamikát a regionális csomópontok szerepének a változásában. Tehát célszerű több időszak adatát összevetni és a gráfelmélet alkalmazásával egy dinamikus hálózatot létrehozni. Ennek kapcsán nem csak a regionális csomópontok, az úgynevezett „hub"-ok szerepének változására, hanem a kialakulóban lévő regionális csomópontok (emergent regional hubs/ERG) alakulására is elemzéseket tudunk végezni.

INTRODUCTION

International student mobility is the movement of students from a country to another for educational purposes. This movement can be temporary, such as for study abroad programmes, or permanent, such as for students who move to another country to complete their studies. The reasons for mobility can be different, however some common motivations are as follows (Janik & Naárné Tóth, 2021a):

1. Access to quality education: Students may choose to study abroad because their home institutions do not offer the programme or level of education they are looking for.
2. Career opportunities: Some students may think that studying abroad can improve their career prospects by giving them valuable international experience and exposure to different cultures.

3. Cultural exchange: Study abroad can also provide students with the opportunity to learn about diverse cultures, improve their language skills and gain new perspectives.

The number of international students has increased steadily in recent years. The United States, the United Kingdom and Australia were the most popular destinations for students. In recent years, however, other countries such as Canada, Germany and France have also attracted increasing numbers of international students.

International student mobility may have a significant impact on the students, on the countries, and on institutions. It can contribute to cultural exchanges, economic growth and increased diversity in education and the workforce. However, it can also present challenges such as language barriers, cultural differences, and adaptation to new environments (Muchiri et al., 2022; Janik & Naárné Tóth, 2021a).

The aim of the research is to identify the central actors among the receiving and sending countries participating in student mobility based on various central indicators, and our aim is to identify the groups or clusters and their composition between the countries that appear in the network. The research is looking for an answer to the question of which of the receiving and sending states participating in international student mobility have a central role in the network. Our further research question: What structure and composition of clusters can we identify in the network? During our investigation, we use the methods of network analysis and graph theory.

The purpose of network analysis of international student flow is to study of the relationships and interactions between the different actors involved in the cross-border movement of students for educational purposes. The analysis can include universities hosting international students, countries and regions sending students abroad, organisations and institutions supporting student mobility, and students themselves. Network analysis approach aims to understand mobility

patterns, identify key actors and influencing factors, and explore the dynamics and motivations of international student flows. It is important to understand this complex and rapidly evolving field and to be informed by policies and practices that support the development of sustainable and equitable international education systems.

International student flows, which study the cross-border movement of students for educational purposes, is a dynamically developing field of research. Although significant progress has been made in understanding the factors influencing international student mobility, there are still research gaps that need to be addressed.

The first research gap relates to the factors that influence the decision-making process of international students. (Janik & Naárné Tóth, 2021a). While much research has focused on the factors that attract students to a country, such as the quality of education, the availability of scholarships and employment opportunities, less attention has been paid to the decision-making process itself. More research is needed to understand how students weigh up different factors when deciding where to study and how these factors interact.

Another research gap relates to the experiences of international students (Janik & Naárné Tóth, 2021a). While there is some research in the literature that examines the challenges and opportunities that international students face in the host country, more research is needed to understand how these experiences vary by country of origin, field of study and other demographic factors. More research is also needed to examine the long-term outcomes of international student mobility, such as the impact on career opportunities and global mobility.

The third research gap relates to the impact of international student mobility on the host country (Janik & Naárné Tóth, 2021a). While there is some research that examines the economic impact of international students, more research is needed to understand the social and cultural impacts of international student mobility. For example, how do international students contribute to diversity on campus

and in the wider community, and how does this impact on social cohesion and intercultural understanding?

Overall, our research focuses on addressing these gaps, so that it can help to develop a deeper understanding of international student mobility and to design policies and practices that support the success of international students and their host countries and institutions.

Bibliometric snapshot

In our research, the authors used the Web of Science literature database. The publications and bibliographic data closely related to the topic were collected using the TS = (international student mobility) AND (network analysis) algorithm and analysed in Bibliometrix-Biblioshiny.

Bibliometrix-Biblioshiny software helps users to create interactive visualisations of bibliographic data. By representing complex data with visual elements, thematic maps can help users quickly identify patterns and trends and facilitate the communication of data to a wider audience.

An analysis of the data from the bibliometric analysis shows that the first thematic study was published in 2009 and most articles were published between 2019 and 2023. There is a significant focus on the literature reviewed and the authors have identified a number of literature sources that now form one of the foundations of the database under review.

In our research, our objective is to form clusters of different topics based on the co-occurrence ofrelevant terms and to place these clusters on a two-dimensional plane. One dimension of this is the centrality of the topic, i.e., the extent to which different sources in the literature cite the topic and problem under study. Furthermore, to what extent is this problem at the centre of interest, and to what extent can the problems addressed by the various authors be considered of fundamental, epistemological importance. In other words, to what extent do the clusters created form the basis of the functioning of the other clusters, in terms of the knowledge they contain. The other dimension measures the inter-

referencing of publications within a given issue area, called density. This refers to the intensity of the dialogue between the contributors to a given issue, and the extent to which they refer to each other. It is interesting, because there are obviously some topics that are dealt with in isolation by researchers in a given field, so there is not an intense dialogue between researchers in that field, and there could be several reasons for this. On the one hand, the topic is new and specific that researchers are examining it in isolation and there is no intensive dialogue between them. On the other hand, the topic is considered so marginal that the scientific community does not debate the issue or debates it in other disciplines. It is possible, for example, that in higher education there is a sociological issue or an issue that examines gender aspects of the issue, which is considered marginal on the basis of the corpus of texts and publications on higher education, but which may still be relevant in social pedagogical and social psychological research that deals with the same social science phenomenon from other aspects. It follows that, if the two dimensions under consideration are examined simultaneously and uniformly, a planar representation is possible, in which the relationship between the two dimensions is measured by applying them simultaneously.

By projecting the two dimensions under study (centrality and density) onto a single plane, it is possible to determine the relative position of the various themes along the density values. On the basis of density and centrality, it has become a practice in the international literature to group the different clusters around four themes: 'motor' themes, 'niche' themes, 'emerging or declining' themes, and 'basic' themes.

- 'Motor' themes (Q1, upper-right quadrant): These themes are both well developed and important for the structure of the research field.
- 'Niche' themes (Q2, upper-left quadrant): Well-developed internal ties but unimportant external ties and so, they have a marginal role for the development of the scientific field.

- 'Emerging or declining' themes (Q3, lower-left quadrant): They are both weakly developed and marginal.
- 'Basic and transversal' themes (Q4, lower-right quadrant): They are important for a research field but are not developed.

In case of 'motor' themes, both centrality and density are very high. On the one hand, they are very intensively referred to not only by literature sources within the cluster but also by literature sources outside the cluster. A common characteristic of the 'motor' themes is, on the one hand, the emergence of concepts as a fundamental paradigm for scientific research and, on the other hand, the very intense scientific dialogue between the authors of publications in the cluster, as shown by the high citation and density values within the cluster.

There are clusters where the centrality value is lower, but the density is significant. These may include topics that are not yet considered an integral part of the research canon by the scientific community as a whole, but there is already a community that is very intensively involved in this area, and there is an intense dialogue within this community, which explains why the density value is high and the centrality value is relatively low.

There are also clusters where both the centrality and the density values are low, and this can be explained by two things. Firstly, the topic is so new that there has been very little discussion even among researchers within the field and, secondly, the topic is already out of the focus of scientific interest.

Finally, there are also topics that are characterised by a high degree of centrality and a low degree of density, which are generally considered to be fundamental. These are those topics within a theme where scientific understanding has reached a level where the knowledge communicated can be considered as the basis of scientific research and where the dialogue between researchers is of relatively lower value, but the reference to it is higher.

The 'motor' themes (Q1, upper-right quadrant in Figure 1) deal with student mobility, migration and student perspective. Basically, China appears here as a separate element, the key role of this country will be discussed later in our study. Less intensively researched topics include the corpus topic of our article, network analysis, comparative advantage, regionalism, and the set of EU topics.

As it can be seen in Figure 1, the importance of each theme is roughly proportional to the size of the circles, with network analysis as our main theme of relatively low importance, but it is expected to be a special 'niche' theme (Q2, upper-left quadrant in Figure 1) that could conceivably become a driving theme in the coming decades.

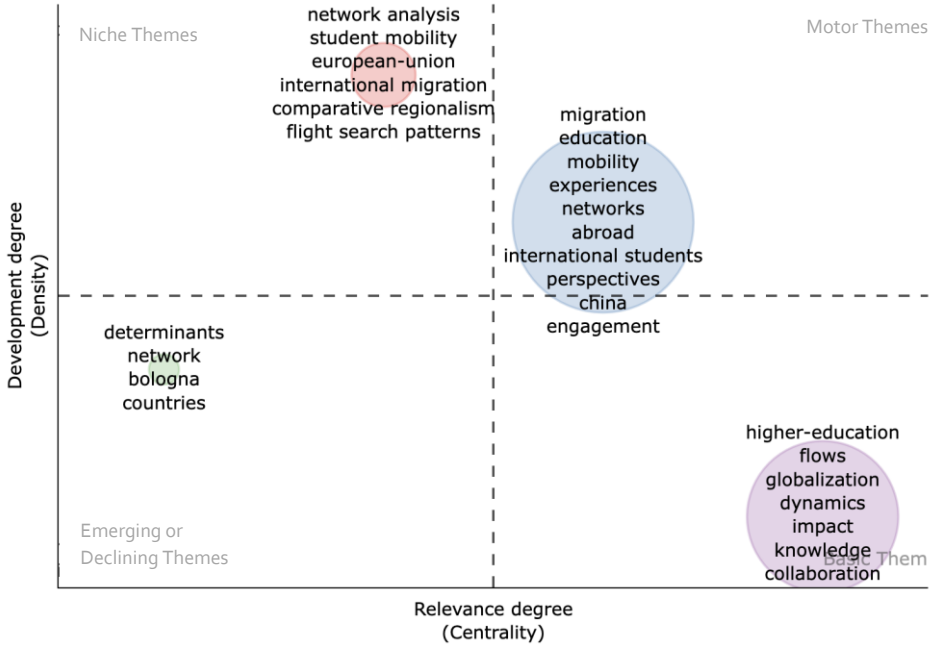

Figure 1. Thematic map of keywords appearing in scientific works published on the subject of international student mobility (Bibliometrics-Biblioshiny)

Source: author's work

There are also 'emerging or declining' themes (Q3, lower-left quadrant in Figure 1) which are not yet the focus of interest today and the number of citations in

this corpus is relatively low. This raises issues such as the Bologna process, the study of the international network as a whole.

There are some topics where the theme is central, with a significant number of quotes on the subject, but relatively little dialogue between researchers on the topic. These topics can be considered as 'basic and transversal' themes (Q4, lower-right quadrant in Figure 1), and include studies of students' experiences abroad, and the dynamics and flows of student mobility abroad, both from the perspective of the sending and the receiving country. It also includes issues related to globalisation that affect both student mobility and student well-being. These factors have been given a lower density value partly because they are less related to the research corpus of network analysis.

LITERATURE REVIEW

As the volume of student mobility increases, its economic importance is unquestionable. In addition to attracting talent, generating revenue is now a key issue for universities in recruiting students from abroad. Much research shows that in general the presence of foreign students brings economic benefits for the university, the host city, and the destination country (Janik & Naárné Tóth, 2021b).

There are both vertical and horizontal dimensions to higher education mobility. The vertical dimension is where a student travels from a place – e.g., their place of birth – to another in order to gain knowledge that is not available in their place of origin. The horizontal dimension refers to the equal access of students to education in different regions, cultures, theoretical orientations, and practical knowledge (Teichler, 2003). Fernex and co-authors (2016) highlight a similar trend, in that the process is significantly affected by the increasing uniformity of education.

Student mobility is one of the most visible elements of the internationalisation of education (Byram & Dervin, 2009; Kovács & Tarrósy, 2017). Its fundamental

aim is to strengthen and raise awareness of European identity and citizenship, to promote European cultural diversity and multiculturalism (King & Ruiz-Gelices, 2003), and to make more effective use of the knowledge of workers with experience abroad (Honvári, 2012). Study abroad brings the following significant benefits for students' learning and competence development (Bracht et al., 2006):

- Acquiring theoretical knowledge that is not available or is available at a lower level in the sending institution.
- Social, economic, and cultural experience in the host country.
- Successful studies in disciplines and professions that are essentially transnational (e.g., international law, international business, etc.).
- Acquisition of internationally comparable views.
- Broaden and refine horizons through experiences of learning about different cultures.
- Acquiring intercultural communication techniques and developing intercultural competences.

Larsen (2016) proposed an analysis using spatial, network and mobility theories to broaden the theoretical framework for analysing the internationalisation of higher education. He argued that there are significant problems in distinguishing internationalisation at home and abroad. According to their research, to work within this binary framework is to adhere to the view that some internationalisation strategies are effective in local contexts and others are ineffective. Mobility theories, in particular, combine social, spatial and anthropological research, combining some of the purely 'social' concerns of sociology (inequality, power, hierarchies) with the 'spatial' concerns of geography (territory, boundaries, scales) and the 'cultural' concerns of anthropology and media studies (discourses, representations, schemas), while influencing each with a relational ontology of the co-construction of subjects, spaces and meanings. Spatial theory is based on the concept of distance. In short, spatial theories are

concerned with how spatiality is transformed by human activity, and how human activity is altered and shaped by spatial arrangements (Wu et al., 2020). The international scene is constructed within local universities, which in turn are constructed through the very international phenomena that influence and shape their identity (Larsen, 2016). In relation to network theories, Castells (2000) argued that the space of places is based on the interconnected continuum of practice, meaning, function and locality, while the space of flows is composed of the material arrangements that allow for the simultaneity of places. These theories of space and networks provide a perspective through which to illuminate the complexity of problem of students' global mobility, while providing a broader and multifaceted perspective for understanding this issue.

For further analysis of trends, it is worth highlighting the role of world languages in the recruitment of foreign students. Countries where the mother tongue is among the most widely used languages in the world, such as English, French, German, Russian and Spanish, are the most popular destinations for foreign students. It is becoming increasingly common for countries where English is not the mother tongue to offer courses in English (Denmark, Finland, the Netherlands, Sweden, and other European countries), except for universities in southern Europe (Spain, Italy, Greece), Austria, Russia, where there are almost no English language courses (De Wit, 2011).

In recent years, major universities have recognised that overseas outsourcing centres are an effective way to increase student numbers, strengthen their brand, and image globally. The branches operate under the name of the parent institution and issue degrees on behalf of the parent institution. The number of branch institutions is steadily increasing (Lakner et al., 2018; Wilkins et al., 2012). Choudaha (2012) introduces a new terminology that refers to students in outsourced training as 'glocal', who receive global training at the local level. This new student segment is set to grow significantly in the coming years and deserves special attention. Glocal students are committed to global studies, but they also

want to take full advantage of the benefits in their own region (Popp et al., 2021). They also want to receive a high-quality education in a foreign language, gain a labour market advantage through a high-prestige degree from a foreign institution, and do not want to leave their place of residence to achieve these goals (Vinogradov, 2020).

Taking into consideration different theoretical frameworks, Hou and Du (2020) argue that economic and higher education development in emerging countries and changes in economic and political relations between countries have led to new patterns of international student mobility. The results show that international student mobility has not been limited to a few Western developed countries, as is generally believed. It was found that the clustering coefficient of the international student mobility network has steadily declined over the period under study and that the degree of community differentiation has been very significant, indicating that regionalisation has become more significant. Indeed, the dominance of typical destination countries has declined, and some regional hubs have rapidly emerged (Hou and Du, 2020).

International student flows are undergoing significant transformations. The attractiveness of the main recruiting countries has been diluted by the emergence of new popular destinations around the world (regional international education centres in the Middle East and Southeast Asia, smaller European countries, etc.) (Sin et al., 2022).

In the future, institutions will need to innovate not only to increase international student numbers, but also balance international student numbers with appropriate support services that promote student success, including career and employability expectations (Choudaha, 2017).

Wu and Hou (2022) argue that a dynamic and processual approach is important for rethinking the aspirations and mobility of international students, as it not only identifies nuances that add more diversity to our understanding of what international education means for different individuals, especially those from less

privileged backgrounds in the Global South. It also bridges dichotomies such as imagination and reality, promise and uncertainty, and structural strength and agency, which are usually treated separately in the literature on international student mobility.

Glass and Cruz's (2023) results show that the overall density of the network has steadily increased year on year, with a threefold increase in the number of links between countries, as influence has been more widely and evenly distributed across the network with a larger number of central countries. As the number of universities in the ranked planned and emerging destination countries doubled, the structure of the network showed a shift towards multipolarity, with a more diverse group of countries exercising greater relative influence in the overall network. The results suggest that while the core-periphery dynamic in international student mobility persists, it has begun to shift slightly, with a larger and more diverse subset of planned and emerging education centres in Asia, South America, Africa, and the Middle East exerting a greater influence on the overall network (Glass & Cruz, 2023).

Some authors use different methodologies to research the topic. One of the methods is based on autoethnographic self-study to examine one's own conscious thoughts, feelings, and experiences (Kolnhofer, 2022). A different research case study approach is used (Madleňák et al., 2021).

International student mobility has followed an east-west axis, supporting a core-periphery distinction that has been prevalent for decades (Altbach, 2004; Kondakci et al. 2018; Waters, 2012; Wallerstein, 2004). The countries of origin and destination of migratory flows are unequal and tend to generate economic benefits that benefit the world's dominant economic and political powers (Cantwell et al., 2018; Waters, 2012). Traditional destination countries exist in a state of colonialism, which has led to deep hierarchical inequalities in historical patterns of international student mobility (Quijano, 2007; Sassen, 1996). The persistence of colonial ties and networks in international mobility also manifests

itself in disharmony such as the contradictions of international students being considered 'desirable' for their tuition and talents, but 'undesirable' for their migration policies and sense of student security (King & Raghuram, 2013; Yao, 2021). In fact, traditional destinations such as the US are so dependent on international students for tuition that an increase of just 1% in international student enrolment increased the likelihood of a shift towards personal reorientation by 18% during the global COVID-19 pandemic (Whatley & Castiello-Gutiérrez, 2021). However, the overemphasis on international student recruitment in traditional destinations in absolute terms tends to overshadow the growing importance of planned and emerging destinations in relative terms. Smaller networks exist and are often hidden within larger communities. Analytical approaches focusing on relative changes in migration flows are therefore needed to amplify the growing influence of planned and emerging regional hubs in international student mobility.

MATERIAL AND METHODS

Social Network Analysis (SNA) is widely used as an effective tool for identifying and dynamically modelling patterns. As an interdisciplinary approach, SNA provides conceptual and methodological tools for an in-depth analysis of the structure of relationship between interacting systems (Wasserman & Faust, 1994). The application of this analytical method to the study of international student mobility has brought new and more detailed understanding of the dynamics behind students' country choices (Barnett et al., 2015; Chen & Barnett, 2000; Kondakci et al., 2018).

SNA is used to identify patterns of international student mobility. International student mobility can be described as a network, where nodes are the countries that receiving and sending students and edges represent the students sent. Our network consisted of 7,032 links and 202 nodes, i.e., countries. It is a directed graph, i.e., students from one country arrive in another country, so the direction

of movement is important. We are analysing weighted edges; therefore our research has taken into consideration the number of students sent to a particular country. Among the global metrics of the network, we calculated the network diameter, the average path length, the average clustering coefficient, and the network density. In terms of local network metrics, we were interested in degree, indegree, outdegree, weighted degree, weighted indegree and weighted outdegree. In addition, betweenness centrality, closeness centrality, local clustering coefficient were calculated. Finally, analysis of modularity was performed to analyse clusters.

The primary source of data used for the analysis is from UNESCO and includes inbound students from a given country between 2000 and 2020 (UNESCO, 2020). UNESCO data are not unlimited. UNESCO (2020) defines international students as "students who have crossed a national or territorial border for education and are now enrolled outside their country of origin". Therefore, students participating in exchange programmes of one academic year or less are not included in our analysis, as students participating in short-term exchange programmes are not technically enrolled in an institution outside their home country.

Furthermore, UNESCO data is collected on a country-by-country basis, with each country has a different definition of who counts as an international student, and therefore different number of inbound and outbound students. For example, although most countries define international students by nationality, some countries define international students by country of residence. However, the effect of these definitional differences is minimal and is generally randomly distributed across the sample (Richters & Teichler, 2006). 101 countries did not provide inbound country data to UNESCO, most of them were smaller countries that traditionally do not host large numbers of international students. The limitations of the research also include that China, like other countries does not provide data on inbound students, only outbound students appear in the

database, which distorts the results. Finally, a few countries were not included in our sample because UNESCO or the country of origin did not provide bilateral international student flow data (e.g., Singapore, Lebanon, or Algeria).

The network visualisation and network analysis software Gephi 0.9.7 e was used (Bastian et al., 2009) to analyse the network, construct the trade network from the compiled database, calculate network metrics and create a network diagram.

RESULTS

Analysis of the network's global indicators

The nodes are the countries in the network. A link between two countries is established when one country sends students to the other. If a country has not sent students to the other, they have no edge. The global indicators of the network do not provide information about the role of individual nodes in the network, but about the network as a whole.

Our network consisted of 7,032 edges (links) and 202 nodes (countries). The network density was 0.173, which means that only 17.3% of all possible connections were made (Table 1). Since so few of the potential connections being realised, it can be concluded that there is likely to be significant clustering in the network. The clustering coefficient is 0.61. This indicator can be characterised as the average number of neighbours of each node in the network that are connected to each other is about 61%, which is generally considered a high value in social networks. The network is a coherent large component, i.e., there are no isolated smaller groups, which means that the network is coherent.

Table 1. Global indicators of the network

Global indicators of the network	Value
Number of nodes	202
Number of edges	7032
Network diameter	5
Average path length	1,788
Clustering coefficient	0,61
Network density	0,173
Connected components	0

Source: author's work

Analysis of the network's local indicators

The local network indicators do not provide us with information about the network as a whole, but about the role of individual nodes within the network. In this case, each country is analysed in terms of its role in the student mobility network.

The closeness centrality index can take a value between 0 and 1. The value is high if an actor reaches every member in the network in relatively few steps. Therefore, countries that send students directly to almost all countries and receive students from almost all countries in the network are considered central in the network. India, China, Nigeria, and the United States have by far the highest proximity centrality (Table 2).

Table 2. Local indicators of the network: Closeness Centrality

Country	Closeness centrality
India	0.774
China	0.772
Nigeria	0.765
United States of America	0.764
Germany	0.733
United Kingdom	0.711
Turkey	0.711
France	0.711
Russian Federation	0.700
Italy	0.700

Source: author's work

In terms of the number of edges, the United States, the United Kingdom, Germany, Canada, France, and Italy have the most connections. In the case of the network, this means that these countries have the most connections in the network overall, including sending and receiving students (Table 3).

Table 3. Local indicators of the network: Edge Count

Country	Number of edges
United States of America	277
United Kingdom	259
Germany	250
Canada	249
France	238
Italy	229
Turkey	216
Russian Federation	211
Spain	209
Japan	209

Source: author's work

The weighted degree considers weights as opposed to the number of edges. In our case, the weights are the number of students sent. If a country sends and receives many students, it has a high weighted edge. The United States, China, United Kingdom, India, Australia, Germany, Canada, and France have the most connections (Table 4). For the network we are looking at, this means that if we take into consideration the weights, i.e., the number of students, these countries have the most connections in the network overall, including sending and receiving students. The data shows that if the number of students is taken into consideration, the United States of America is still in first place, with China in second place and the United Kingdom in third place. The reason for this is that China does not provide outgoing data, thus distorting our results. It can also be said that China has many more students from relatively fewer countries and the UK has fewer students from relatively more countries. To analyse the values of the degree indicators, India and Australia do not even make it into the top ten

countries with the highest values. However, if the number of students is also taken into consideration, it is clear that India and Australia are ranked fourth and fifth respectively. Therefore, it follows that very few countries send and receive very large numbers of students to these countries. Subsequent cluster analysis shows that students are mainly coming from within their own clusters (country groups).

Table 4. Local indicators of the network: Ranking of weighted degree

Country	Rank of weighted degree
United States of America	1
China	2
United Kingdom	3
India	4
Australia	5
Germany	6
Canada	7
France	8
Russian Federation	9
Turkey	10

Source: author's work

Table 5. Local indicators of the network: Indegree

Country	Indegree
United States of America	195
United Kingdom	188
Canada	183
Germany	175
France	170
Italy	161
Japan	151
Turkey	146
Spain	145
Belgium	143

Source: author's work

To analyse the indegree indicators, it can be seen that almost the same countries are at the top of the ranking as for the degree indicator. The countries with the

highest indegree indexes are the United States, the United Kingdom, Canada, and Germany (Table 5). In our network, the indegree indicator shows the number of countries from which the country in focus has received students.

Table 6. Local indicators of the network: Ranking of weighted indegree

Country	Rank of weighted indegree
United States of America	1
United Kingdom	2
Australia	3
Germany	4
Canada	5
Russia	6
France	7
Turkey	8
Argentina	9
South Korea	10

Source: author's work

The weighted indegree considers weights, unlike the indegree indicator. In our case, the weights are the number of students sent. Thus, countries with a high weighted indegree are those with many students from many countries. The ranking changes compared to the indegree indicator, because if the number of students admitted is taken into consideration, Australia, not Canada, is third in the ranking (Table 6). Canada receives students from more countries than Australia, but Australia receives significantly more students from fewer countries. It can be observed that Germany is ahead of Canada in the ranking of the weighted indegree indicator, while in the ranking of the indegree indicator is behind. Belgium is not even in the top ten countries for the weighted indegree indicator. This is due to the relatively low number of students coming to Belgium from many countries. Russia is in a contrasting position, it is not in the top 10 for the ranking of the indegree, but already in sixth place for the weighted indegree indicator. This implies that Russia receives a significant number of students from relatively few countries.

The counterpart to the indicator indegree is outdegree, which shows how many countries the country under study has sent students to. The countries with the highest outdegree are China, the United States, India, Nigeria, Germany and the United Kingdom (Table 7). These countries send the most students to other destinations in the world.

Table 7. Local indicators of the network: Outdegree

Country	Outdegree
China	83
United States of America	82
India	82
Nigeria	79
Germany	75
United Kingdom	71
Russian Federation	70
Turkey	70
France	68
Italy	68

Source: author's work

The other counterpart of the outdegree indicator is the weighted outdegree, which shows how many countries the country under study has sent students to, after weights are taken into consideration. The weights are still the numbers of students. Countries with high outdegree values are those that send more students to many countries. China has the highest weighted outdegree value, but India comes in second place, instead of the United States of America, which is only in 6th place. The reason for this is that India may send students to fewer countries than the United States, but it sends a much larger number of Indian students to other countries around the world (Table 8).

Table 8. Local indicators of the network: Ranking of weighted outdegree

Country	Rank of weighted outdegree
China	1
India	2
Vietnam	3
Uzbekistan	4
France	5
United States of America	6
Germany	7
Nepal	8
Kazakhstan	9
Brazil	10

Source: author's work

The betweenness centrality indicator has also examined, which is a node acting as a mediator between two clusters. If the node has a significant mediating role in the network, it can be considered as central. In our research, this means that there are groups of countries that send and receive students mainly between themselves (e.g., the European Union); if there is a country that connects the group of countries with other groups of countries, this country is called the hub. In terms of the centrality indicator, the United States of America, Germany, the United Kingdom, India, France, and Canada are the key participants (Table 9).

Table 9. Local indicators of the network: Betweenness centrality

Country	Betweenness centrality
United States of America	2015.8
Germany	1215.9
United Kingdom	1202.3
India	1020.4
France	870.4
Canada	835.5
Italy	781.0
Tukey	695.9
Morocco	584.3
South Korea	538.6

Source: author's work

The clustering coefficient is calculated by multiplying the actual number of connections between the neighbours of the node under consideration by the total number of possible connections. The value is 1 if everyone is connected to everyone else, and 0 if neighbours are not connected. In the case of the network we are studying, this means that if the country under study sends students to other countries, then the partner countries are connected. If this relationship is significant, the indicator is high, otherwise it is low. The result is not surprising, as the first ranking is given to countries with small populations that are not significant in terms of student mobility in a global context (Table 10). Of the other countries ranking highly in the other indicators, Turkey and Egypt have significant clustering coefficients.

Table 10. Local indicators of the network: Clustering coefficient

Country	Clustering coefficient
San Marino	1.000
Cayman Islands	1.000
Vatican	1.000
Montserrat	1.000
Nauru	1.000
Monaco	0.976
Tuvalu	0.933
Papua New Guinea	0.932
Aruba	0.929
Anguilla	0.900

Source: author's work

Network modularity

The Louvain method (Blondel et al. 2008) has been integrated into the network analysis and visualisation software Gephi, which is designed to detect, analyse, evaluate and visualise clusters. The algorithm developed to detect clusters generates a modularity class value for each cluster, which is used to denote communities within the international student mobility network. The procedure

revealed six sub-networks, named after the countries with the highest centrality values.

The separated clusters are:

US community: the countries with the highest ranking in this sub-network (i.e., the most travellers) are the United States and the United Kingdom. The most important destinations to the US are Europe (mainly the UK (9,646), Germany (6,823), Spain (6,373) and France (6,096), West Asia (mainly Saudi Arabia), East Asia (China (343,761 students)), South Korea (46,996 students), Japan (14,166 students), South Asia (Indonesia (8,039 students)), Vietnam (25,183 students) and South America (Brazil (16,086 students)). In addition, due to the geographical location of the United States, there are also significant numbers of students from the Caribbean and Central America (e.g., Barbados, Belize, Dominica, Jamaica, Trinidad and Tobago and the British Virgin Islands). Interestingly, in a previous study (Kondakci et al., 2018), the UK had its own community. This has changed by 2020 and it has become embedded in the US community, although it is still the country with the second largest number of degrees. The UK continues to have significant links, hosting a significant number of students from countries of the former British Empire. For example, many international students come from Indonesia, Malaysia, and Nigeria. The UK is a popular destination for students from Saudi Arabia and other Gulf states such as the UAE, Qatar and Yemen. Of course, China and India also send significant numbers of students. It is also natural that Western European countries also send a significant number of students.

Turkish community: the most prestigious countries in this sub-network (i.e., the most travellers) are Turkey and Russia. Turkey is the central regional hub of West and Central Asia. Turkey receives by far the largest number of international students from two Central Asian and Turkic countries: Azerbaijan (21,069) and Turkmenistan (18,016). Students from the EU mainly come to Turkey from Germany (4,637 students) and Greece (2,874 students). As regards Russia, the

former CIS countries are the main source of students, but China, India and Portugal also receive a significant number of students.

Japanese community: in previous studies (Kondakci et al. 2018; Chen & Barnett 2000; Barnett et al. 2015; OECD 2015), Japan did not have its own community. The country with the highest ranking in this sub-network (i.e., the highest number of travellers) is Japan. Students come in large numbers mainly from Vietnam (40,633), Nepal (14,959) and Indonesia (4,722), but also from the United States, India and France.

French community: the country with the highest ranking in this sub-network (i.e., the most travellers) is France. It is mainly composed of students from the Francophone countries (Senegal 10,897, Cameroon 5,272, Benin 3,046, Belgium 2,202, Burkina Faso 1,705, Chad 1,443), but also a significant number of students from Southern Europe (Italy 8,428, Spain 4,288).

Spanish community: in previous studies (Kondakci et al., 2018; Chen & Barnett 2000; Barnett et al., 2015; OECD 2015), Spain did not have its own community. The country with the highest ranking in this sub-network (i.e., the highest number of travellers) is Spain. It is mainly students from Spanish-speaking countries who travel, but there are also significant numbers of students from other Southern European countries (e.g., France 9,794, Italy 6,738).

German community: the country with the highest ranking in this sub-network (i.e., the highest number of students) is Germany. As in the United States, students come from almost all over the world, with the highest numbers coming from China (39,281), India (25,130), Syria (15,769) and Austria (14,514).

Figure 2 shows the network of countries limited by weighted indegree. The figure clearly shows which countries belong to which cluster. The US cluster is shown in red, the Turkish cluster in purple, the Japanese cluster in blue, the French cluster in brown, the Spanish cluster in lemon yellow and the German cluster in green colour. The size of the clusters is determined by the weighted bins.

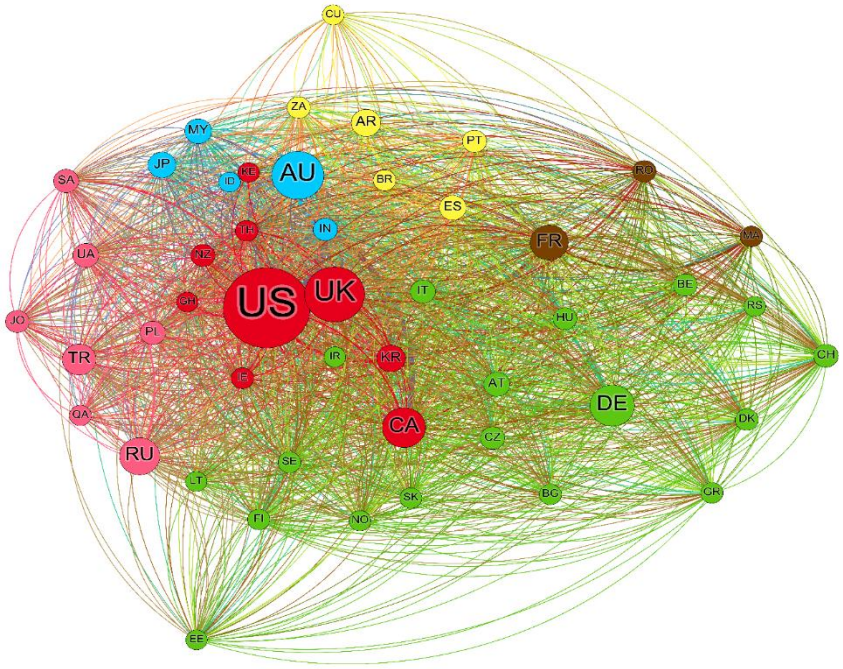

Figure 2. Most central countries (indegree range 100-202)
Source: author's work

DISCUSSION AND CONCLUSION

Our research results confirmed the central role of the United States, the United Kingdom, France, and Germany, which has been highlighted in several previous studies (Kondakci et al., 2018; Chen & Barnett 2000; Barnett et al. 2015; OECD 2015). However, this study provides two novel insights into international student mobility that have not been addressed in previous studies.

Our first new research result is that two new clusters have been formed and one has been eliminated by 2020 compared to previous years. Japan and its community became a separate cluster. This emergence was already predicted in previous studies (Kondakci et al., 2018; Chen & Barnett 2000; Barnett et al., 2015; OECD 2015), but has not yet been verified by network analysis tools. By 2020, the state of Japan as a regional cluster appeared in the data (Kondakci et al., 2018). Spain and its community emerged as a new cluster, and the UK and its community cluster disappeared compared to previous years (Kondakci et al.,

2018). Both Spain and the UK have significant inward value and a direct network that makes them suitable for a regional hub role. The UK's exit from the European Union and its closer ties with the United States may have contributed to its emergence as a separate cluster, making it part of a US-dominated cluster. Secondly, we also examined the weighted degree, weighted indegree and weighted outdegree values, which have not been addressed in previous studies. The weighted indegree indicator take weights into consideration, namely the number of students entering. Thus, countries with a high weighted indegree value are those with more students coming from many countries. If the number of students admitted is also taken into consideration, then Australia, rather than Canada, comes third in the ranking. So, Canada receives more students from more countries than Australia, but Australia receives many more students from fewer countries. Belgium is not even in the top ten countries in terms of weighted enrolment. This is because Belgium has a relatively small number of students from a relatively large number of countries. Russia is in a contrasting position, not ranked in the top ten for the ranking of the EFI, but already in sixth place for the weighted score. This implies that Russia receives a significant number of students from relatively few countries. It is highly likely that Russia will drop out of the top ten following its invasion of Ukraine as a result of sanctions imposed by Western countries. In particular, entry restrictions are likely to affect Russia's position in international student mobility. The weighted outdegree shows the number of countries to which the country under study has sent students, taking weights into consideration. The weights are still the numbers of students. So, countries with high outdegree values are those that send more students to many countries. China has the highest weighted outdegree value, but India comes in second place, instead of the United States, which is only in sixth place. The reason for this is that India may send students to fewer countries than the United States, but it sends a much larger number of Indian students to other countries around the world. The weighted degree is the sum of the weighted out and weighted in

for each country. If a country sends and receives many students at the same time, it has a high weighted living degree. The United States, China, the United Kingdom, India, Australia, Germany, Canada, and France have the most connections. In the case of the network we are studying, this means that these countries have the most connections in the network overall, including both sending and receiving students, if we take weights into consideration, i.e., the number of students. The data shows that if the number of students is taken into consideration, the United States is still in first place, with China in second place and the United Kingdom in third place. The reason for this is that China does not provide outgoing data, thus distorting our results. It can also be said that China has many more students from relatively fewer countries and the UK has fewer students from relatively more countries. If we analyse the values of the degree number indicators, India and Australia do not even make it into the top ten countries with the highest values. However, if the number of students is also taken into consideration, it is clear that India, and Australia are ranked fourth and fifth respectively. So, it follows that very few countries have very large numbers of students coming from and sending to these countries. The subsequent cluster analysis showed that students were mainly coming from within their own clusters (country groups).

Such an analysis may also identify other indicators that are contested or used, provided that it also critically discusses their limitations. If data on student mobility improve in the future, and if public interest in student mobility remains high or even increases, then there will certainly be a significant effort to agree and develop a broader set of indicators than those that can be established today. Future research should examine the dynamics of the changing role of regional hubs. Thus, it is useful to compare data from several periods and create a dynamic network using the SNA method. In this context, we can analyse not only the change in the role of regional hubs, but also the evolution of emergent regional hubs (ERGs).

REFERENCES

1. Altbach, P. G., 2004. Globalization and the university myths and realities in an unequal world. *Tertiary Education and Management*, 10, 3–25. https://doi.org/10.1023/B:TEAM.0000012239.55136.4b

2. Barnett, G.A., Lee, M., Jiang, K. & Park, H., 2015. The flow of international students from a macro per-spective: A network analysis. *Compare: A Journal of Comparative and International Education*, 46(4), 533–559. https://doi.org/10.1080/03057925.2015.1015965

3. Bastian, M., Heymann, S. & Jacomy, M., 2009. Gephi: an open source software for exploring and manipulating networks. https://doi.org/10.1609/icwsm.v3i1.13937

4. Blondel, V., Guillaume, J.L., Lambiotte, R. & Mech, E., 2008. Fast unfolding of communities in large networks. Journal of Statistical Mechanics: *Theory and Experiment,* 2008(10), P10008, 12 pp. https://doi.org/10.1088/1742-5468/2008/10/P10008

5. Bracht, O., Engel, C., Janson, K., Over, A., Schomburg, H. & Teichler, U., 2006. The professional value of Erasmus mobility. International Centre of Higher Education Research, University of Kassel, INCHER: Kassel. Germany: Final Report, International Centre for Higher Education Research, http://ec.europa.eu/education/programmes/socrates/ERASMUS/evalcareer.pdf, https://www2.uned.es/ciencias/erasmus-fisica/documentos/InformeImpacto_MovilidadErasmus.pdf

6. Byram, M. & Dervin, F., 2009. Students, staff and academic mobility in higher education. Cambridge Scholars Publishing, Cambridge. https://core.ac.uk/download/pdf/11040421.pdf

7. Cantwell, B., Marginson, S. & Smolentseva, A., 2018. High participation systems of higher education. Oxford University Press: 496. https://doi.org/10.1093/oso/9780198828877.003.0001

8. Castells, M., 2000. Materials for an exploratory theory of the network society. The British Journal of Sociology. 51, 5–24. https://doi.org/10.1111/j.1468-4446.2000.00005.x

9. Chen, T.M. & Barnett, G.A., 2000. Research on international student flows from a macro perspective: a network analysis of 1985, 1989 and 1995. Higher Education, 39(4), 435–453. https://doi.org/10.1023/A:1003961327009

10. Choudaha, R., 2012. The rise of 'glocal' students and transnational education. Support the Guardian. https://www.theguardian.com/higher-education-network/blog/2012/jun/21/opportunities-in-transnational-education

11. Choudaha, R., 2017. Three waves of international student mobility (1999–2020). Studies in Higher Education, 42(5), 825–832. https://doi.org/10.1080/03075079.2017.1293872

12. De Wit, H., 2011. Student Mobility between Europe and the rest of the world: trends, issues and challenges [PowerPoint slides]. Future of Higher Education – Bologna

Process Researchers Conference. Bukarest, 17-19. October 2011. http://fohe-bprc.forhe.ro/old/2011/templates/pdf/Mobility/5_FOHE-BPRC%20Bucharest%202011%20Hans%20de%20Wit.pdf

13. Fernex, A., de Vries, E., & Lima, L., 2016. Articulating perspectives on international and social mobility in higher education. *European Journal of Higher Education*, 7 (1), 3-14. https://doi.org/10.1080/21568235.2017.1265740

14. Glass, C.R. & Cruz, N.I., 2023. Moving towards multipolarity: shifts in the core-periphery structure of international student mobility and world rankings (2000–2019). *Higher Education*, 85, 415-435. https://doi.org/10.1007/s10734-022-00841-9

15. Honvári, J., 2012. Migrációs potenciál és a potenciális tanulási migráció. Hazai hallgatók külföldi tanulási szándékai. *Tér és Társadalom*, 26 (3), 93-113. https://doi.org/10.17649/TET.26.3.2058.

16. Hou, C. & Du, D., 2020. The changing patterns of international student mobility: a network perspective, Journal of Ethnic and Migration Studies, 48(1), 248–272. https://doi.org/10.1080/1369183X.2020.1797476

17. Janik, H. & Naárné Tóth, Zs., 2021a. A Stipendium Hungaricum program szerepe a magyar agrár-felsőoktatás nemzetköziesítésében=The Role of the Stipendium Hungaricum Program in the Internationalisation of Hungarian Agricultural Higher Education. *Külügyi Szemle*, 20 (4). 184-202. https://doi.org/10.47707/Kulugyi_Szemle.2021.4.8

18. Janik, H. & Naárné Tóth, Zs., 2021b. Macroeconomic indicators and student mobility: a case study of the African countries most actively involved in FAO student mobility, *Economic Annals* XXI. Vol. 190 (5-6(2)), 75–85. https://doi.org/10.21003/ea.V190-07

19. King, R., & Raghuram, P., 2013. International student migration: Mapping the field and new research agendas. *Population, Space, and Place*, 19(2), 127–137. https://doi.org/10.1002/psp.1746

20. King, R. & Ruiz-Gelices, E., 2003. International student migration and the European 'year abroad': Effects on European identity and subsequent migration behaviour. *International Journal of Population Geography*, 3, 229-252. https://doi.org/10.1002/ijpg.280

21. Kolnhofer-Derecskei, A., 2022. How did the COVID-19 restrictions impact higher education in Victoria? *Multidiszciplináris kihívások, sokszínű válaszok - Gazdálkodás- és Szervezéstudományi folyóirat* 50-72. https://doi.org/10.33565/MKSV.2022.01.03

22. Kondakci, Y., Bedenlier, S., & Zawacki-Richter, O., 2018. Social network analysis of international student mobility: Uncovering the rise of regional hubs. *Higher Education*, 75(3), 517-535. https://doi.org/10.1007/s10734-017-0154-9

23. Kovács, V. I. & Tarrósy, I., 2017. Internationalisation of higher education in a global world In: Egetenmeyer, R., Guimarães, P., Németh, B. (Eds.): J*oint Modules and Internationalisation in Higher Education. Reflections on the Joint Module Comparative Studies in Adult Education and Lifelong Learning*. Peter Lang International Academic Publishers, 39-52. https://library.oapen.org/handle/20.500.12657/27245

24. Lakner, Z., Kiss, A., Merlet, I., Oláh, J., Máté, D., Grabara, J. & Popp, J., 2018. Building Coalitions for a Diversified and Sustainable Tourism: Two Case Studies from Hungary. *Sustainability*, 10, P1090. https://doi.org/10.3390/su10041090

25. Larsen, M.A., 2016. *Internationalization of Higher Education: An Analysis through Spatial, Network, and Mobilities Theories*; Palgrave Macmillan: New York, USA. 196 pp.

26. Madleňák, R., D'Alessandro, S.P., Marengo, A., Pange, J. & Neszmélyi, G.I., 2021. Building on Strategic eLearning Initiatives of Hybrid Graduate Education a Case Study Approach: MHEI-ME Erasmus+ Project. *Sustainability* 13, 7675–7675. https://doi.org/10.3390/su13147675

27. Muchiri, M. K., Erdei-Gally, S., Fekete-Farkas, M. & Lakner, Z., 2022. Bibliometric Analysis of Green Finance and Climate Change in Post-Paris Agreement Era. *Journal of Risk and Financial Management*, 15(12), 561. https://doi.org/10.3390/jrfm15120561

28. OECD, 2015. Education at glance 2015: OECD indicators. OECD Publishing. https://doi.org/10.1787/eag-2015-en

29. Popp, J., Kovács, S., Oláh, J., Divéki, Z. & Balázs, E., 2021. Bioeconomy: Biomass and biomass-based energy supply and demand. *New Biotechnology*, 60, 76-84. https://doi.org/10.1016/j.nbt.2020.10.004

30. Quijano, A., 2007. Coloniality and modernity/rationality. *Cultural Studies*, 21(2-3), 168–178. https://doi.org/10.1080/09502380601164353

31. Richters, E. & Teichler, U., 2006. Student mobility data: Current methodological issues and future prospects. In Kelo M., Teichler U., Wächter B. (Eds.), *EURODATA: Student Mobility in European Higher Education*, pp. 78-95. Bonn: Lemmens Verlag & Mediengesellschaft.

32. Sassen, S., 1996. *Losing control? Sovereignty in an age of globalization. University seminars/Leonard Hastings Schnoff memorial lectures*. Columbia University Press. NY, US.

33. Sin, C., Tavares, O., Aguiar, J. & Amaral, A., 2022. More students and more diverse: new trends in international mobility to Portugal. *Tertiary Education and Management*, 28, 135-153. https://doi.org/10.1007/s11233-022-09090-y

34. Teichler, U., 2003. Mutual recognition and credit transfer in Europe: Experiences and problems. *Journal of Studies in International Education*. 7(4), 312-341. https://doi.org/10.1177/10283153032571

35. UNESCO 2020. Global flow of tertiary-level students. UNESCO Institute for Statistics, http://uis.unesco.org/en/

36. Vinogradov, Sz., 2020. A nemzeti versenyképesség puha tényezői, a társadalmi versenyképesség, In: Csath, M. (Eds.): *Versenyképesség: új elméleti és módszertani közelítések*, Dialóg Campus Kiadó, 109-138. http://hdl.handle.net/20.500.12944/16023

37. Wallerstein, I., 2004. *World-systems Analysis*. Duke University Press. P128. https://doi.org/10.2307/j.ctv11smzx1

38. Wasserman, S. & Faust, K., 1994. *Social network analysis: Methods and applications*. Cambridge University Press. https://doi.org/10.1017/CBO9780511815478

39. Waters, J.L., 2012. Geographies of international education: Mobilities and the reproduction of social (dis)advantage. *Geography Compass*, 6(3), 123–136. https://doi.org/10.1111/J.1749-8198.2011.00473.X

40. Whatley, M. & Castiello-Gutiérrez, S., 2021. Balancing finances, politics, and public health: International student enrollment and reopening plans at US higher education institutions amid the COVID-19 pandemic. *Higher Education*. https://doi.org/10.1007/s10734-021-00768-7

41. Wilkins, S., Balakrishnan, M.S. & Huisman, J., 2012. Student choice in higher education: Motivations for choosing to study at an international branch campus, *Journal of Studies in International Education*, 16(5), 413-433. https://doi.org/10.1177/1028315311429002

42. Wu, D.B. & Hou, S., 2022. International student mobility as "aspiration on the go": stories from African students at a Chinese university. Higher Education. https://doi.org/10.1007/s10734-022-00864-2

43. Wu, S.J., Chang, D. F., & Sun, F.R., 2020. Exploring College Student's Perspectives on Global Mobility during the COVID-19 Pandemic Recovery. *Education Sciences*, 10(9), 218. MDPI AG. http://dx.doi.org/10.3390/educsci10090218

44. Yao, C.W., 2021. Global positional competition and interest convergence: Student mobility as a commodity for U.S. academic imperialism. In J.J. Lee's (Eds.), *Critical International Higher Education and Power: How US Internationalization is Not Neutral.* New *Brunswick*, NJ: Rutgers University Press.

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