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Araştırma Makalesi

Science Mapping the Knowledge Base on Student Retention in Higher Education: A Bibliometric Review of Research Papers from 1914-2022

Yükseköğretimde Öğrenci Tutunmasına İlişkin Bilgi Tabanının Bilimsel Haritalandırılması: 1914-2022 Yılları Arasındaki Araştırma Makalelerinin Bibliyometrik Bir İncelemesi

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Abstract: In this study, we systematically review existing research on college student retention. It utilizes a total of 5277 publications indexed either in Scopus or Web of Science from 1914 to 2022. The results show that most of the research on student retention has been conducted in English-speaking countries such as the United States, Australia, the United Kingdom, and Canada. The United States produces almost two-thirds of scholarly publications worldwide. The term 'retention' is commonly used alongside 'persistence,' 'attrition,' 'engagement,' and 'success.' Moreover, the term higher education is associated with dropout, completion, and academic performance, as well as new methodological terms like data mining, machine learning, learning analytics, and logistic regression. Retention is also studied in fields such as nursing, engineering, and STEM. Special attention is given to community colleges due to higher dropout rates. Unlike the United States, Australia, the United Kingdom, and Canada, where higher education research on retention is extensive, countries like China and India, which have recently expanded their higher education systems, show a comparatively limited volume of research output concerning student retention.

Keywords: student retention, persistence, dropout, attrition, success, higher education.

Özet:Bu çalışmada, üniversite öğrencilerinin tutunmasına ilişkin mevcut araştırmalar sistematik bir şekilde incelenmiştir. Çalışmada, 1914-2022 yılları arasında Scopus veya Web of Science veri tabanları tarafından dizinlenen toplam 5277 yayın ele alınmıştır. Bulgulara göre, öğrenci tutunması ile ilgili araştırmalar büyük ölçüde İngilizce konuşulan ülkelerde, özellikle Amerika Birleşik Devletleri, Avustralya, Birleşik Krallık ve Kanada'da gerçekleştirilmektedir. Ek olarak, dünya genelindeki akademik yayınların neredeyse üçte ikisi Amerika Birleşik Devletleri'nde üretilmektedir. 'Tutunma' (retention) terimi sıklıkla 'süreklilik' (persistence), 'bırakma' (attrition), 'katılım' (engagement) ve 'başarı' (success) terimleriyle birlikte kullanılmaktadır. Ayrıca, yükseköğretim terimi, okul terki (dropout), tamamlama ve akademik başarı gibi kavramlarla birlikte veri madenciliği, makine öğrenmesi, öğrenme analitiği ve lojistik regresyon gibi yeni metodolojik terimlerle ilişkilendirilmektedir. Tutunma, hemşirelik, mühendislik ve STEM gibi alanlarda da çalışılmaktadır. Daha yüksek okul terki oranları nedeniyle mahallî kolejlerde (community colleges) tutunmaya özel bir dikkat gösterilmektedir. Amerika Birleşik Devletleri, Avustralya, Birleşik Krallık ve Kanada gibi ülkelerde tutunma üzerine yükseköğretim araştırmaları geniş bir yer tutarken, yükseköğretim sistemlerini yakın zamanda genişleten Çin ve Hindistan gibi ülkelerde öğrenci tutunmasıyla ilgili araştırma çıktılarının görece sınırlı olduğu görülmektedir.

Anahtar Kelimeler: öğrenci devamlılığı, süreklilik, bırakma, terk, başarı, yükseköğretim.

1. Introduction

Higher education enrolment rates have dramatically risen over time, with near-universal access to higher education achieved in many countries of the Global North. The number of tertiary students in higher education has doubled in just two decades, reaching 235 million today (UNESCO, 2024; World Bank, 2021). Moving from

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elite to mass higher education (Trow, 1973) or to near universal participation, i.e., high participation systems (Cantwell et al., 2018), higher education institutions face new challenges due to the rapid increase in student numbers and the changing demographics of the student population (Marginson, 2016; Özoğlu et al. 2016). While these institutions aim to improve the quality of education they provide (Akalu, 2016; Noui, 2020), the diversity of the student body brings both benefits and challenges to the sector (Misra & McMahon, 2006; Shaw, 2009). A major concern resulting from this expansion is how to effectively retain students (Brown, 2007; Dumas-Hines, 2001), as there remains a significant gap in terms of "who and where students complete degree programs" (Swill, 2002, p. 15). On average, , the global higher education completion rate is approximately 68% (OECD, 2022), but various factors at both country and student levels significantly influence retention (De Wit et al., 2019). This figure leaves considerable room for governments and policymakers to address dropout rates and improve student retention in higher education.

Retention is a complex phenomenon, rendering it difficult to define. One challenge in defining student retention arises from the fact that higher education institutions often differ in how they define retention and attrition. These differences stem from varying perspectives on grade completion, alongside individual student factors, which complicates the development of a universally accepted definition (Seidman, 2004). Additionally, higher education systems across the world may use varying dimensions of criteria and definitions based on their policy agenda and interests. Seidman (2004) identifies three forms of retention: "student retention," "course retention," and the most used, "program retention," which is broadly defined as tracking a full-time student "to discover whether or not the student graduated in the intended major at entry" (p. 135). In this context, first-year students hold a special place in literature because they are particularly vulnerable to retention challenges, as they face difficulties transitioning from secondary education to higher education (Williams & Roberts, 2022).

While attrition has long been discussed by higher education researchers, the literature provides empirical data only after 1970, discussing the issue with an underpinning theoretical perspective (Aljohani, 2016). Among the various perspectives on retention, attrition, and dropout, some theoretical frameworks have received more attention and persisted, with their arguments being cited more frequently than others. According to Aljohani (2016), the six most-cited models in the literature include Spady's (1970) Undergraduate Dropout Process Model, Tinto's (1975) Institutional Departure Model, Bean's (1980) Student Attrition Model, Pascarella's (1980) Student-Faculty Informal Contact Model, Bean and Metzner's (1985) Non-traditional Student Attrition Model, and the Student Retention Integrated Model by Cabrera et al. (1992).

In the literature, institutional and individual characteristics related to college student retention are well documented (Oseguera, 2005). For instance, there is an association between students' ethnic background and their cultural capital, and having social and cultural capital is significantly related to their college completion (Wells, 2008). In this regard, most discussions focus on African American or Hispanic students' persistence in the United States (U.S.) though other groups are also covered to a lesser extent. As Grayson (1998) notes, "In the United States, it is well documented that graduation rates for Blacks, Hispanics, and American Indians are lower than for Whites and Asians" (p. 324). Although minority student attrition caught the attention of administrators and policymakers in the early 1980s, many stakeholders soon realized that the retention problem was not unique to minority groups but affected all college students (Lang, 2001). Additionally, Baker and Robnet (2012) underscore that, contrary to previous research, black students appear less likely to drop out of college than their counterparts, while Hispanic students are more likely to do so, consistent with earlier discussions (Longerbeam et al., 2004). Other studies highlight the gender roles of both faculty (Price, 2010; Robst et al., 1998) and students (Bowles & Brindle, 2017), online education persistence (Patterson & McFadden, 2009; Qayyum et al., 2019), and case studies that underpin the role of varying factors (Braxton et al., 1995; Fike & Fike, 2008), financial aid (Murdock, 1990), and review studies (Peltier et al., 2000) on college student retention.

Social, academic, demographic, and financial factors influence student persistence and attrition in higher education (McGrath & Braunstein, 1997). Although the number of students from diverse backgrounds accessing higher education has increased, inequality in retention and success continues to persist (Bowes et al., 2013; World Bank, 2017). Higher education institutions are in danger of losing student diversity, as economic circumstances are a major cause of dropout. Additionally, higher education institutions, states, and governments experience lower social and economic returns due to high dropout rates (Johnson, 2012; Schneider & Yin, 2011).

Although the retention literature is well documented in previous research (Aljohani, 2016; Burke, 2019), which primarily focuses on the theoretical foundations of the field, there is a need for more research that systematical-

ly analyzes the available knowledge base. Furthermore, with the continuous growth of knowledge across various academic fields, researchers need to consider the broader context rather than focusing solely on specific topics. As a result, there has been a significant rise in the use of bibliometric research (Jing et al., 2023) to help researchers more effectively analyze particular fields (Ghorbani et al., 2021). The purpose of this research is to provide an empirically grounded perspective on the evolution of the knowledge base regarding student retention in higher education since the publication of the first empirical work. In other words, this study aims to systematically review the existing research on student retention in higher education by conducting a bibliometric analysis of scholarly articles indexed in both Web of Science and Scopus databases. The following research questions are proposed:

Research Question 1: What is the volume, growth trajectory, and geographic distribution of the student retention literature from early articles to 2022?

Research Question 2: Which journals, authors, and articles have contributed the most to the development of a knowledge base regarding student retention in higher education?

Research Question 3: What are the key themes and keywords that dominated this line of research on student retention in higher education?

2. Key Features of Bibliometric Inquiry

The purpose of the present bibliometric study is to map the knowledge base in student retention in higher education from the date of first publication until 2022. However, before moving to the method section, it is important to provide a conceptual framework for this bibliometric review by clarifying the meaning of "the knowledge base." Following prominent scholars in the bibliometric method of systematic review (Hallinger & Kovačević, 2019; Hallinger & Suriyankietkaew, 2023), we used the four-dimensional model of the "knowledge base": size, time, space, and composition. The first dimension, "size" refers to the volume of published studies on the topic. This is almost a common practice and standardized among researchers conducting systematic reviews (Bellibas & Gumus, 2019; Gumus et al., 2018; Hallinger et al., 2020; Hallinger & Hammad, 2019). The second dimension "time" concerns the publication trajectories observed over designated timeframes, which can help visualize changes in knowledge production over time, such as by years or decades (Hallinger & Kovačević, 2019). This dimension aids in analyzing trends in authorship and topical focus (e.g., Castillo & Hallinger, 2018; Gumus et al., 2018; Hallinger et al., 2020). The third dimension, "space," refers to the geographic distribution of the knowledge base. This analysis provides unique insights into the global distribution of scholarly capacity (Hallinger & Kovačević, 2019; Hallinger & Suriyankietkaew, 2023). Finally, the "composition" dimension concerns the "intellectual structure" of the published documents. Intellectual structure refers to the research traditions within the scientific domain under review, including its disciplinary composition, key research topics, and interrelationship patterns (Zupic & Čater, 2015). This composition might be analyzed based on the distribution and impact of journals, authors, topics, and documents (Hallinger & Kovačević, 2019).

3. Methods

We employed bibliometric analysis to provide a scientific mapping of empirical research on student retention and attrition in higher education from 1914 to 2022. Bibliometrics is an academic field that quantitatively analyzes large sets of bibliometric data and tracks their evolution over time (Aria & Cuccurullo, 2017). It has been increasingly used in various scholarly fields to show trends and changes in scientific publications (Cheng et al., 2014; Fellnhofer, 2019; Gao et al., 2022; Ghani et al., 2022; Gülmez et al., 2020; Gümüş, Bellibaş, et al., 2020; Gümüş, Gök, et al., 2020; Hallinger, 2020; Zhang et al., 2022). While basic bibliometric analysis uses descriptive statistics to identify "topographical" trends within a body of knowledge, advancements in text mining and citation analysis tools have further enhanced the ability of bibliometrics to provide deeper and more comprehensive insights than was previously possible (Hallinger & Kovačević, 2019). In a broad sense, bibliometric analysis does not provide the detailed content of scientific publications but offers a method to review a vast array of such publications by their distribution according to author, year, country, source, and citation (i.e., Gümüş, Gök, et al., 2020).

3.1. Data Sources

This study utilizes a unique synthetic data set by combining all scholarly articles on college student retention indexed either in Scopus or Clarivate Analytics Web of Science. We obtained data from these databases by searching keywords related to college student retention from all years. The originality of this research lies in its synthesis of both SCOPUS and WoS due to "their reliable coverage of a wide range of studies from multiple disciplines" (Kaur et al., 2021, p. 1127). This approach allows us to overcome the coverage limitations of using either database alone. While many journals indexed by

WoS are also included in Scopus (Singh et al., 2021), "their coverages differ substantially" in sub-fields (Mongeon & Paul-Hus, 2016, p. 213) with Scopus offering significantly broader overall coverage. Previous research has also pointed out that "English-language journals are overrepresented to the detriment of other languages" in both Web of Science and Scopus (Mongeon & Paul-Hus, 2016, p. 213).

In addition, we limited our document search to articles or reviews only. To encompass all scholarly efforts, we included related terms such as retention, attrition, graduation, and dropout (Haydarov et al., 2013), and also considered completion and persistence from a broad perspective. We used the following syntaxes to obtain records from both Scopus and Web of Science respectively:

> *TITLE-ABS-KEY ("student retention" OR "college retention" OR "university retention" OR "higher education retention" OR "college dropout" OR "college drop-out" OR "freshmen retention" OR "university dropout" OR "university drop-out" OR "higher education dropout" OR "higher education drop-out" OR "student attrition" OR "college student attrition" OR "higher education attrition" OR "university attrition" OR "student departure" OR "college departure" OR "university departure" OR "student completion" OR "college completion" OR "university completion" OR "higher education completion" OR "student persistence" OR "college persistence" OR "university persistence" OR " higher education persistence" OR "higher education departure") DOCTYPE (ar OR re)*
>
> *(ALL=("student retention" OR "college retention" OR "university retention" OR "higher education retention" OR "college dropout" OR "college drop-out" OR "freshmen retention" OR "university dropout" OR "university drop-out" OR "higher education dropout" OR "higher education drop-out" OR "student attrition" OR "college student attrition" OR "higher education attrition" OR "university attrition" OR "student departure" OR "college departure" OR "university departure" OR "student completion" OR "college completion" OR "university completion" OR "higher education completion" OR "student persistence" OR "college persistence" OR "university persistence" OR " higher education persistence" OR "higher education departure")) and Article or Review Article (Document Types) and Emerging Sources Citation Index (ESCI) or Social Sciences Citation Index (SSCI) or Science Citation Index Expanded (SCI-EXPANDED) (Web of Science Index)*
>
> *WoS query link: https://www.webofscience.com/wos/woscc/summary/c3ac73fd-4feb-4469-b4d7-369825a961b3-f664d99b/relevance/1*

We obtained 3,861 records from Scopus and 3,750 records from the Web of Science databases, respectively, as of September 19–20, 2022. We then combined these records, resulting in a total of 5,277 entries using Bibliometrix, an open-source R library for comprehensive science mapping (Aria & Cuccurullo, 2017). Of these, 5,275 eligible articles were included in our bibliometric analysis (▶**Figure 1**).

3.2. Data Analysis

Visualizing bibliometric networks, often referred to as "science mapping" has been very popular among researchers (van Eck & Waltman, 2014). Bibliometrics has been increasingly used in scientific publications for conducting systematic literature reviews or analyzing bibliometric data from sources such as the Web of Science or Scopus (i.e., Linnenluecke et al., 2020). Using bibliometric data, network analysis helps researchers "examine all publications to identify the various networks, productivity, quality, and citations within a particular research field and evaluate its intellectual development" (Hassanein & Mostafa, 2022, p. 5). Additionally, keyword analysis examines the frequency of keywords used in a field through keyword co-occurrence, which refers to the appearance of keywords in the same article (Garrigos-Simon et al., 2018). When analyzing a topic using a collaboration network, it can help identify various structures such as regular study groups, hidden groups of scholars, influential authors, or higher education institutions (Bhat et al., 2023, p. 692). Co-citation analysis is a fundamental technique in bibliometrics, revealing the structure of a specific field through the connections between nodes (e.g. authors, papers, journals). The edges in this analysis can be interpreted differently depending on the network type, including co-citation, direct citation, and bibliographic coupling (Aria & Cuccurullo, 2017). The co-citation network displays a network of references that have been co-cited by a series of publications (Chen et al., 2014; Wei & Zhang, 2020). We used Bibliometrix to analyze and visualize the bibliometric data related to student retention literature in higher education. Bibliometrix models network structures by mapping interactions among authors, articles,

references, or keywords (Aria & Cuccurullo, 2017).

4. Findings

We provide descriptive statistics about publications based on the author's country and publication years. Then, we provide various network analyses including a network of keywords, institutional collaboration (top 40), and author collaboration (top 100). We also report on the most cited authors (top 20) and the most cited sources of publication (top 20).

Table 1 indicates that the first publication on college student retention appeared in 1914. The number of publications did not notably increase until the 1970s, when the first theoretical approach was introduced. While the academic interest in student retention began to grow in other countries during the 1980s and 1990s, the U.S. holds the status of the dominant producer in the field up to now with 5,304 authors among a total of 8,438 authors (about 63 percent). As ▶**Table 1** shows, researchers from English-speaking countries, Australia, the United Kingdom, and Canada, follow the U.S. in terms of the number of authors related to student retention. These countries are characterized by being leaders in the massification of higher education. In other words, these countries first expanded access to higher education and after the rapid expansion of higher education, student retention came to the fore in both practice and academic studies on higher education. Bibliometric findings on student retention shown in ▶**Table 1** are in line with this pattern. Some researchers from European countries such as Germany and France began to pro-

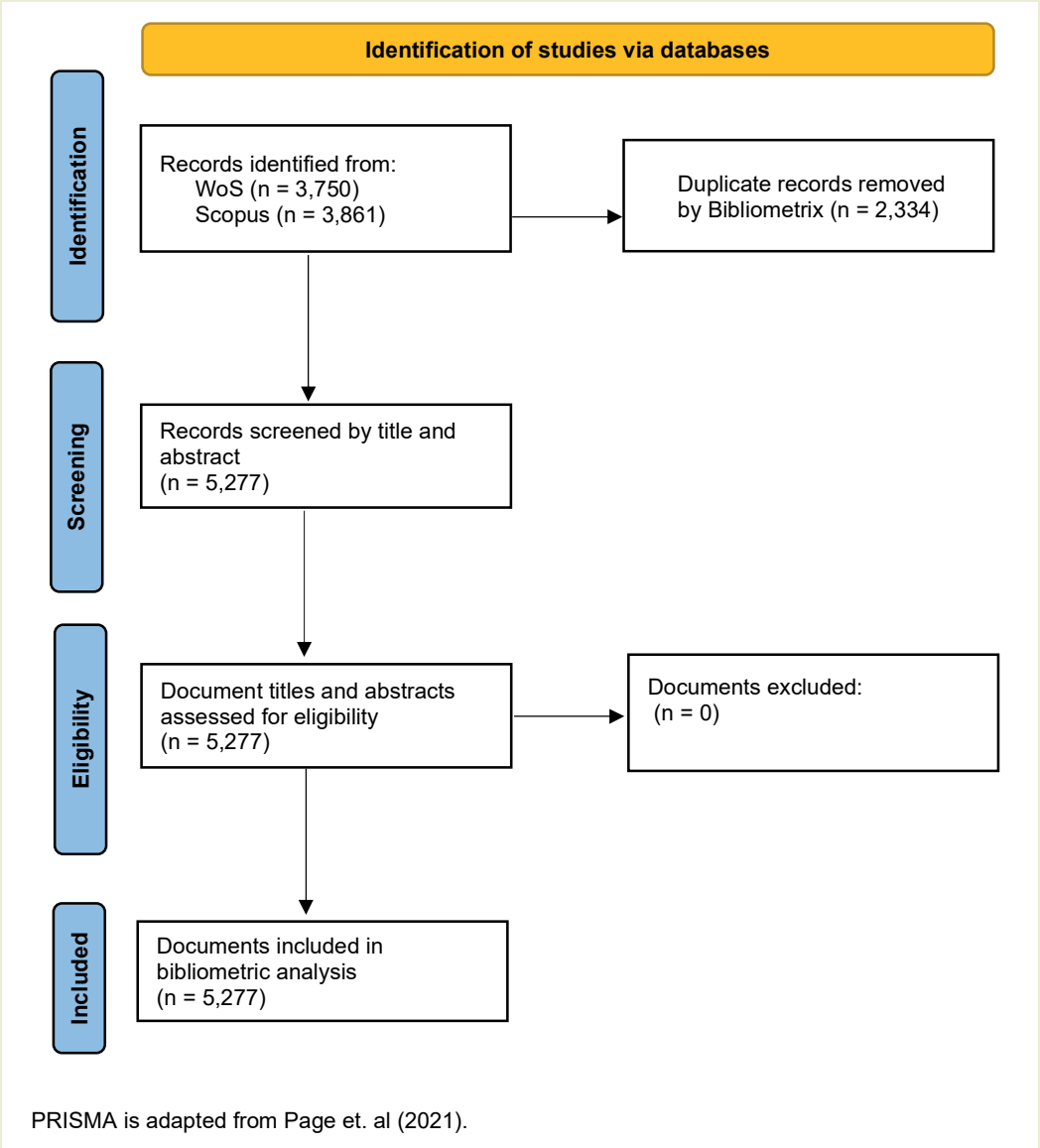

Figure 1. Identification of sources

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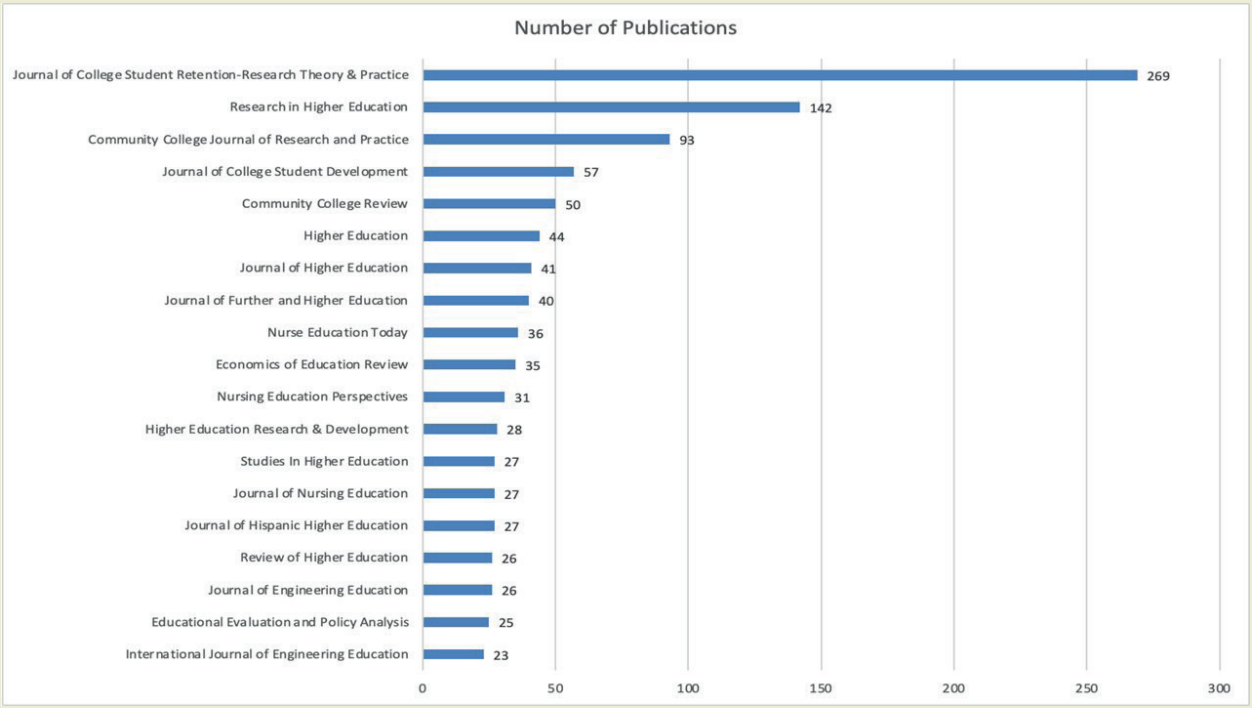

Figure 2. Top sources of publication (Top 20)

Table 1. Total number of authors by country and publication years

	1910s	1930s	1960s	1970s	1980s	1990s	2000s	2010s	2020s	Total
USA	1	1	19	18	99	205	749	3,158	1,054	5,304
Australia					3	6	46	328	125	508
United Kingdom						6	93	235	81	415
Canada					3	15	43	133	60	254
Spain						1	20	123	68	212
Germany							8	70	45	123
South Africa						3	2	79	34	118
Brazil							1	48	39	88
Italy						1	7	54	24	86
China							4	47	34	85
Chile							4	21	43	68
Netherlands						1	6	36	21	64
Colombia							3	41	19	63
New Zealand							11	38	7	56
Norway							5	36	7	48
Ireland							7	30	9	46
Mexico								18	21	39
Hungary							1	10	25	36
Portugal							3	21	12	36
Sweden						1	4	24	7	36
Malaysia							1	25	8	34
Korea							4	17	12	33
Türkiye							4	23	6	33
Indonesia								18	14	32
Romania								24	7	31
U Arab Emirates								14	16	30
India							6	14	8	28
Argentina								22	4	26
France							4	12	10	26
Peru								8	18	26
Others			1		1	3	35	268	146	454

Note. A total of 8,438 persons authored or co-authored a total of 5,277 publications.

duce articles on student retention after the 2000s. There might be two reasons for this finding. First, these higher education systems have had rather a relatively slow rate of expansion and thus there might have been little interest in student retention. Second, due to the coverage of Web of Science and Scopus, most articles are written in English and many European academics might have retained themselves back to write in their native or another European language. China, as a latecomer to the expansion of its higher education system, has only recently begun to produce many articles on the subject. Similarly, India, despite having a rapidly expanding higher education system, does not seem to produce as many publications as other countries.

In ▶**Figure 2**, the top 20 journals that publish research on college student retention are listed. As the graph highlights, the Journal of College Student Retention-Research Theory and Practice published 269 papers which are around one-fifth of the scholarly efforts throughout the years. It is crucial to note that the Journal of College Student Retention has a scope that specifically focuses on college student retention, so its dominance in production is understandable considering its dedication to the field. Research in Higher Education, as the second largest producer in the field, published 142 papers on college student retention. Community College Journal of Research and Practice, Journal of College Student Development, Community College Review, Higher Education, and Journal of Higher Education are the following journals that seem to have a balanced knowledge production in student retention considering their scope dedicated to a much broader field of higher education research. Among these, research on community college student retention is noticeable. Furthermore, studies on student retention that focus on specific fields, such as nursing, engineering, and Hispanic students, are also included in the body of knowledge produced on the subject.

▶**Figure 3** demonstrates the top-cited authors in the field. According to the graph, Vincent Tinto is the most cited author of all time, followed by Pascarella, Bean, Astin, and others in the retention literature. Tinto, who is among the first authors that propose theoretical underpinnings for student retention, seems to have maintained his dominance in the field throughout the years. This means that his "Institutional Departure Model" from 1975 is one of the most widely addressed theoretical approaches in college student retention. Other theoretical approaches by Pascarella, Bean, Astin, and

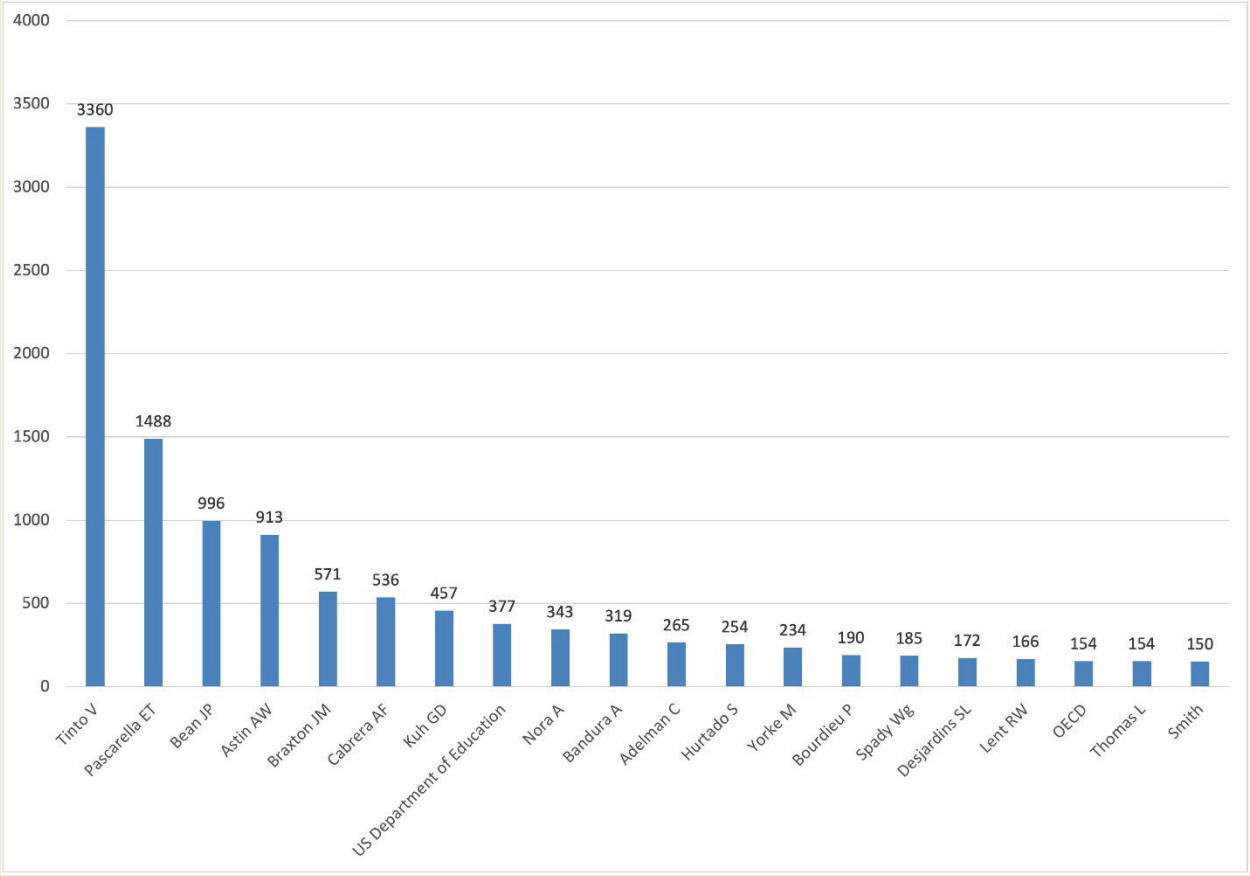

Figure 3. The most cited authors (Top 20)

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Cabrera also find a place in the most cited authors list. Additionally, the U.S. Department of Education and OECD were also referenced within the field along with a broader discussion of Albert Bandura, a prominent educational psychologist, and Pierre Bourdieu, a prominent sociologist who is one of the most influential figures in the sociology of education. This indicates that the authors have borrowed concepts from diverse fields.

▶**Figure 4** shows the primary network of keywords related to retention. There are four major clusters. The first cluster (red) shows the central themes around retention, i.e., persistence, attrition, and success. Moreover, retention has been studied in relation to satisfaction, mentoring, engagement, self-efficacy, and diversity. The second cluster (blue) shows two central themes (i.e., dropout and higher education). These two themes are related to methodological topics such as logistic regression, learning analytics, machine learning, and data mining. The third cluster (green) visualizes that retention has been studied in a variety of fields, including nursing, engineering, technology, and STEM. The fourth cluster (purple) shows keywords related to students such as achievement, motivation, gender, and attainment.

▶**Figure 5** summarizes the collaboration efforts among higher education institutions related to college student retention. As ▶**Figure 5** demonstrates, findings related to institutional collaboration echo the findings demonstrated in ▶**Table 1**. This means that since much of the research related to retention has been completed in the U.S., the collaboration among higher education institutions mostly occurred in the U.S. In other words, collaboration among colleges and universities on student retention is mainly among U.S. institutions. In our analysis, four major groups have emerged on the subject. On one side, the University of Colorado, the University of Connecticut, the University of Missouri, and Purdue University are at the center of the first group. In the second network, Columbia University, Stanford University, the University of Washington, and Ohio State University are at the center. The third is considered the most diverse group since it incorporates institutions from other countries as well. University of California, Davis, Harvard University, Harvard Medical School, University of Queensland, Barcelona University, and the University of Michigan are at the center of the group. Griffith and Curtin universities are also collaborating within this network. The last group of higher education institutions is gathered around the uni-

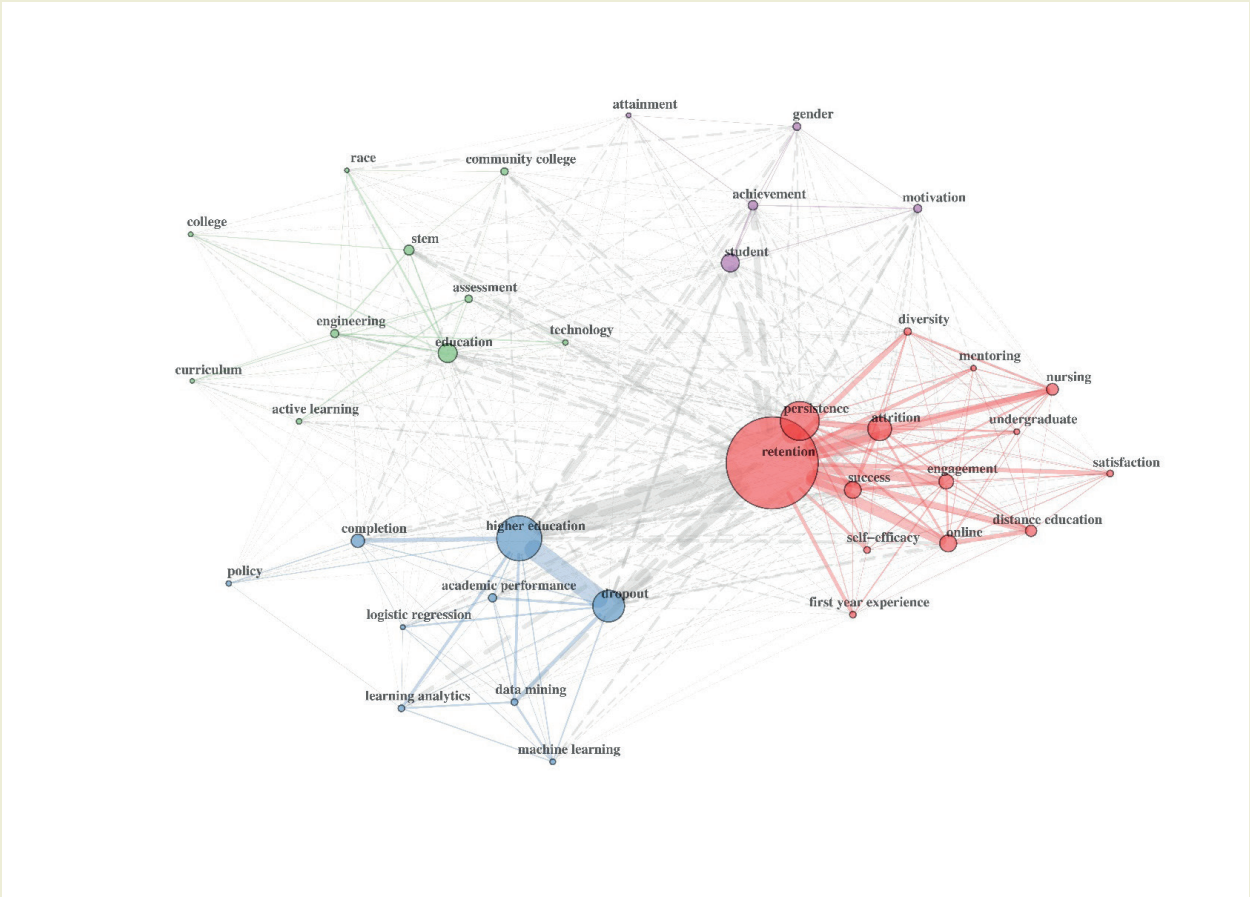

Figure 4. Network of keywords

versities such as the University of California-Los Angeles, Oklahoma State University, and Northwestern University.

Author collaborations on student retention are visualized in ▶**Figure 6**. ▶**Figure 6** underlines some research communities with close-knit relations among themselves in terms of author collaborations. For instance, one community is composed of such authors as Wang, Thompson, Bettella, and Dale. Most of them work in fields other than higher education such as psychiatry and psychology. Their main interest revolves around college completion. In addition, there are small and large author networks established around varying themes of college student retention. For instance, a network of Nora, Cabrera, Hagedorn, and Pascarella investigate student background characteristics namely gender and ethnicity's influence on student outcomes and persistence. While authors such as Esteban, Bernardo, Tuero, and others examine the variables that influence academic performance and university persistence within the European context, another network of authors including Cooper, Gin, Scott, and others' research mainly focus on life sciences student persistence. This means that various networks have been established, centering around different themes and levels of college student retention.

In ▶**Figure 7**, the graph shows the co-citation network analysis of the journals on student retention. The co-citation network analysis is one of the most important ways to determine the specific position of journals in a subject and to objectively examine journals by determining their place in the field. Since a cluster is defined as "a group of nodes in a network that is more densely connected to each other than to any other node in the network" (Chi & Young, 2013, p. 150), we observe that the journals on student retention are grouped into two major clusters of red and blue. In the red cluster, there are journals scoped mainly in higher education research such as Research in Higher Education, Review of Educational Research, Journal of Higher Education, and Journal of College Student Development. In this cluster, we also see some psychology-related journals. In the blue cluster, the Review of Higher Education is the major journal. In addition, there are journals related to the sociology of education,

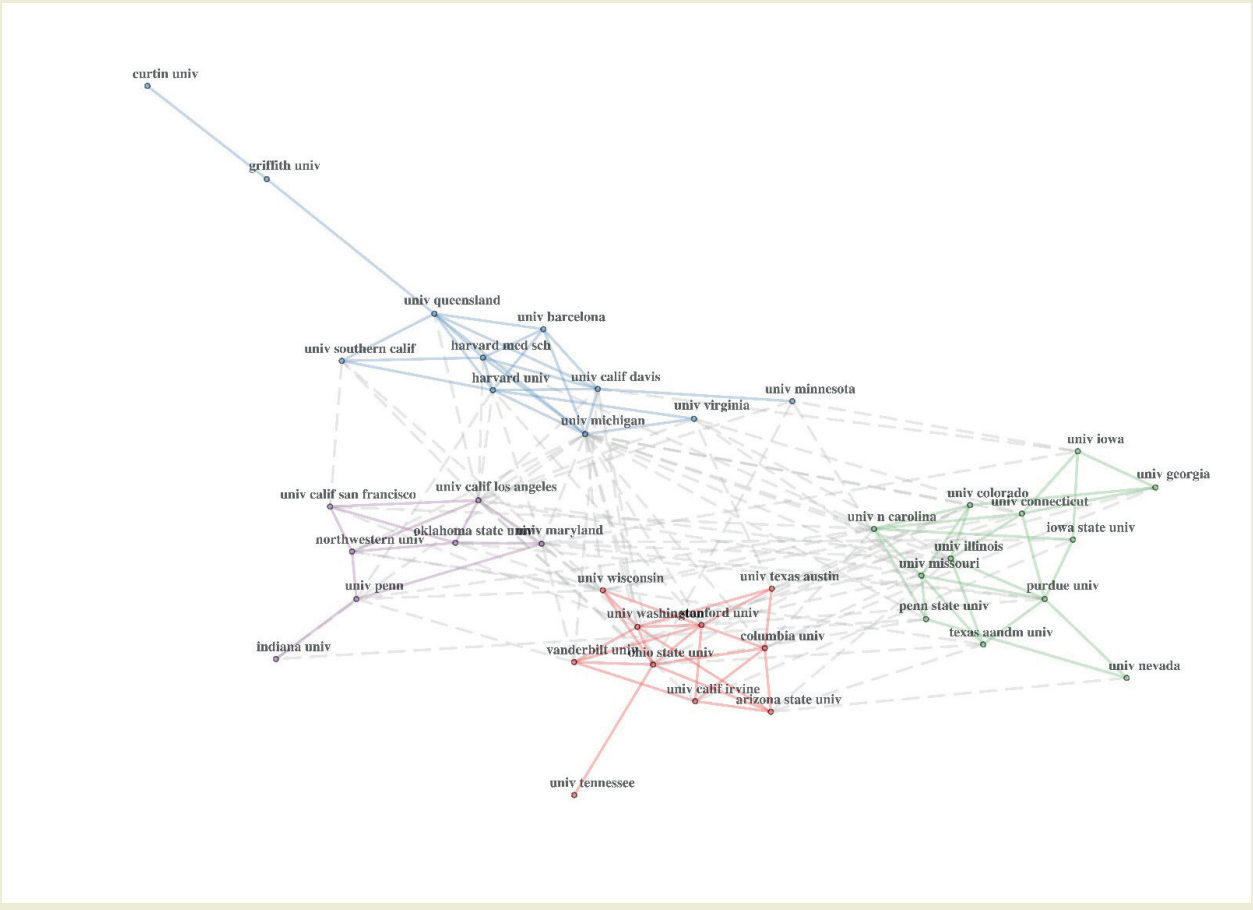

Figure 5. Institutional collaboration (Top 40)

Note: For the sake of simplicity in scale and avoiding confusion, we cleaned the data by removing Open University, University of Oviedo, and University of California.

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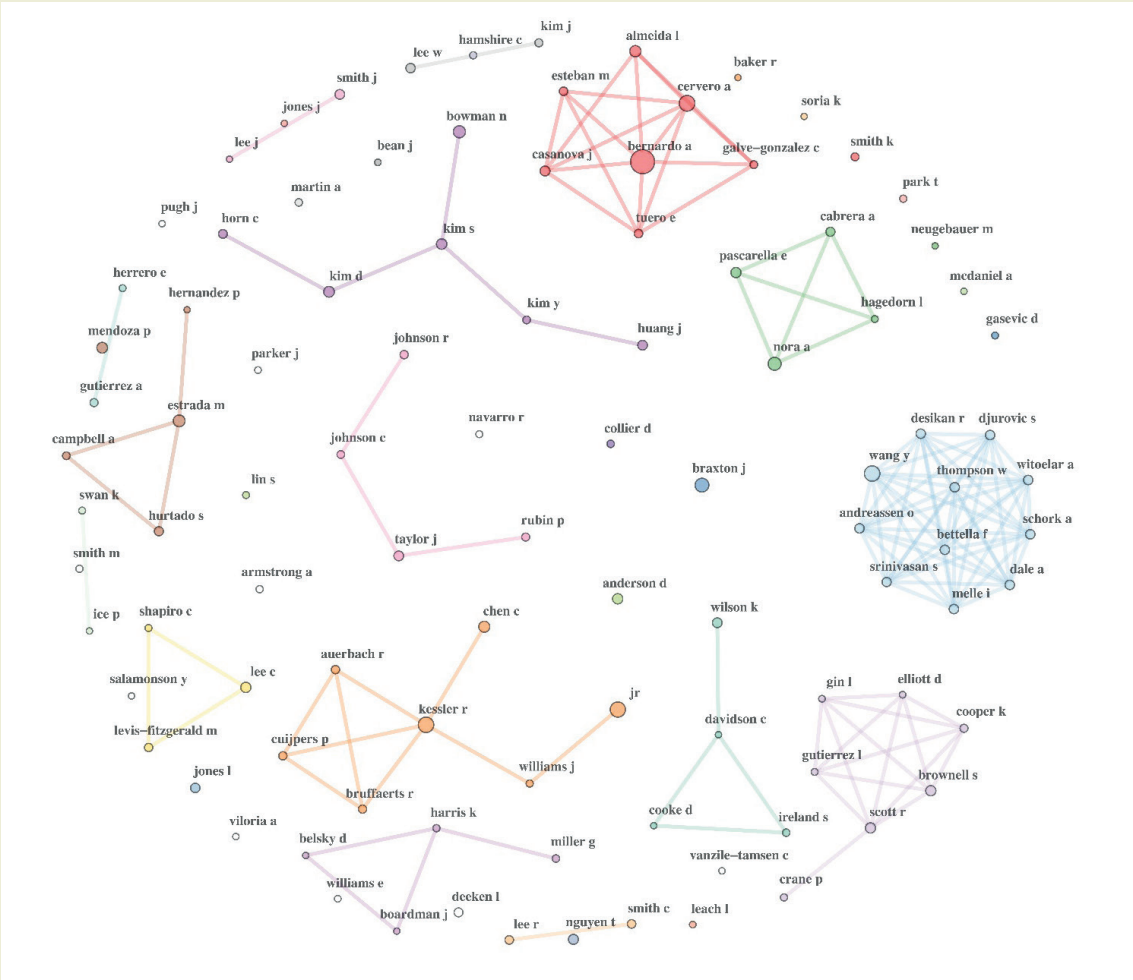

Figure 6. Author collaboration (Top 100)

Note: The following articles with too many co-authors were excluded from the analysis for the sake of simplicity: 32 co-authors (Auerbech *et* al., 2016; Auerbech et al., 2017) and 27 co-authors (King et al. 2014).

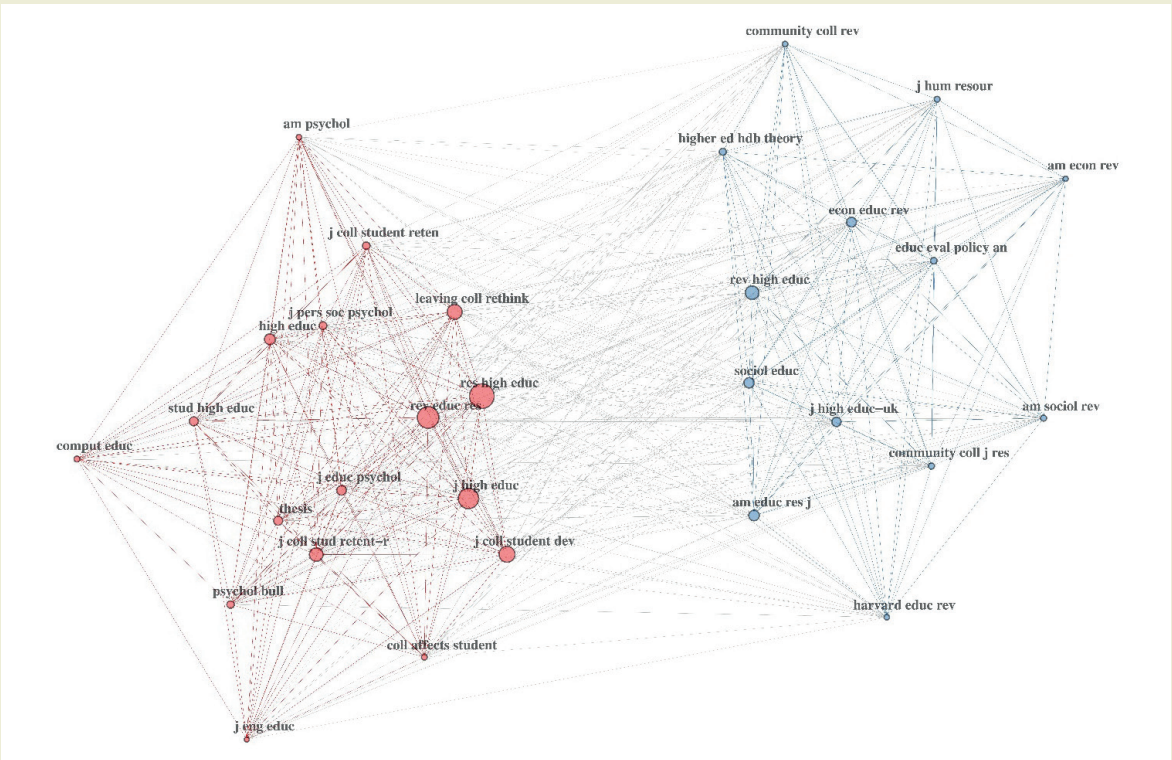

Figure 7. The co-citation network analysis

the economics of education, and community college-specific journals such as *Sociology of Education, Economics of Education Review, and Community College Review*. In both clusters, journals are mainly U.S.-based.

5. Discussions and Conclusions

Paralleling the expansion and development of higher education around the world in the last century, one major issue that arises for higher education administrators and policymakers to address is related to student success. Even though almost one-third of students drop out of higher education around the world (OECD, 2022), we observe that most of the research on college student retention is done in English-speaking countries, specifically the U.S., Australia, the UK, and Canada. Among these, the U.S. shouldered most of the work, with 5,304 authors among a total of 8,438 authors. The attention of the journals toward student retention peaked when studies on retention became increasingly more popular around the world in the 2000s, and new publications have been produced by scholars from different countries alongside the U.S.

Despite the rapid increase in the number of higher education students, which is well reflected in the retention research in English-speaking and Western countries, especially after 2000, in non-Western countries, we found that the number of publications on college student retention is limited. This means that the growth potential in the number of higher education students in these countries does not seem to be equally reflected in the number of scholarly works on student retention. This is thought to create a significant research and policy gap in the future, considering the role these countries will play in the world.

Two major non-Western countries (i.e., China and India) produce less than two percent of scientific publications on student retention. This finding is very important considering that these two countries alone are projected to provide more than 60% of the G20 workforce with qualifications in STEM fields by 2030 (OECD, 2015, p. 1). Moreover, China exceeded the number of scientific publications of the U.S. according to Scopus data as of 2016, and India became the third-largest producer of scientific publications in 2017 (National Science Board, 2021). Nonetheless, the U.S. continues to dominate scientific publications in higher education studies, especially in student retention. Additionally, the U.S. is one of the leading countries making efforts through policymakers, universities, and other organizations to ensure the success of its students (Perna & Thomas, 2008), especially considering that ethnic and racial diversity continues to increase in the U.S. (Hably et al., 2012). Despite such a focus on diversity, the characteristics of the student population are not in line with the general population of the U.S. (Kuh et al., 2011). Accordingly, policymakers encourage higher education institutions to implement strategies to improve student retention and persistence. This might be the reason for the dominance of the U.S. in the contemporary literature on retention.

According to recent data, from 1996 to 2018, international collaboration in research has increased from 12% to 23% globally (National Science Board, 2020). This means that international collaboration in research has become central to knowledge production, especially in Europe where growth in science production relies mainly on international collaboration (Kwiek, 2021). The focus of science has shifted from national to global levels, and the collaborations among scientists on a global scale have increased (Wagner, 2009). Nonetheless, our investigations into author networks on college student retention revealed a somewhat contradicting finding. It shows that the U.S. still dominates the bulk of collaboration in these networks. Similar to the pattern seen in the number of authors in terms of countries, much of the institutional collaboration among higher education institutions concentrates within the U.S. where about two-thirds of the authors reside. This finding conforms to the expectations, as the U.S. is the dominant country hosting the most active researchers currently and historically. As Olechnicka et al. suggests (2019, p. 92) "the contemporary global scientific network is woven around the U.S. Its central role is largely derived from the superior mass of the U.S. research and development sector." However, unlike the increasing international research collaborations in the field of higher education (Fu et al., 2022), our findings suggest that international collaboration is not visible among top institutional collaborators. Although there are collaborations between scholars from different parts of the world, these collaborations are limited to U.S. scholars, who are responsible for producing most of the research in the field.

Our keyword analysis indicates that there are a few focus areas that need to be addressed. In the first group, retention is mostly associated with persistence, attrition, engagement, and success. Within this group, the link between the terms of retention, online, and distance education is also noteworthy. This might be related to the fact that students in online and distance education programs are more likely to drop out of their education than their counterparts in traditional programs (Levy, 2007). Thanks to the popularity of online education programs, especially for disadvantaged and working adult learners, online education increases access for those

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who would otherwise never have the opportunity for education (Bettinger et al., 2017). However, dropouts from online programs might continue to be a major research area in the future. In the second group, the term higher education is a hub term associated with dropout, completion, the academic performance along with newly studied methodologic terms of data mining, machine learning, learning analytics, and logistic regression. Administrators and policymakers use dropouts to make predictions on student retention and success. Along with increasing data about students as learners, new technologies are used to predict the possible future scenarios of students. Learning analytics (Clow, 2013; Long & Siemens, 2011), data mining (Behr et al., 2020; Delen, 2011), machine learning (Delen, 2010), and other techniques are currently used in detecting possible causes of dropping out and ways of preventing students from leaving their programs. For example, the use of Course Signals, described as "the most successful application of predictive modelling to student completion in higher education," led to an increase in the number of students retained in higher education (Clow, 2013, p. 687). Additionally, Behr and colleagues (2020) argue that using multifaceted student data through advanced data mining techniques can help managers predict potential college dropouts. In support of this, machine learning applications have been effectively used "to predict and explain the reasons behind freshmen student attrition" (Delen, 2010, p. 498). Our keyword analysis also demonstrates other keyword groups. In these groups, college retention is studied within specific fields such as nursing, engineering, STEM, and technology. Our findings also highlight student retention in community colleges. This is an interesting finding as almost half of the students at community colleges leave their education (Windham et al., 2014).

Among the top sources on student dropout, major higher education outlets are the *Research in Higher Education*, *Community College Journal of Research and Practice*, and *Journal of College Student Development*. Additionally, a new journal first published in 1999, *Journal of College Student Retention: Research, Theory, and Practice*, dedicates its scope to this specific area of college student retention, producing most of the research in the field. Various academic journals delve into the topic of student dropout. Apart from general higher education journals like *Higher Education, Journal of Higher Education, Review of Higher Education*, and *Journal of Further and Higher Education*, some journals specifically concentrate on community colleges such as *Community College Review*, nursing such as *Nurse Education Review, Nursing Education Perspectives,* and *Journal of Nursing Education*, and engineering such as *Journal of Engineering Education* and *International Journal of Engineering Education*. These journals often feature numerous articles on the issue of student retention. Student dropout research has been especially vibrant in community college literature (Windham et al., 2014) as well as in nursing in which there is a high later-year dropout (Bakker et al., 2019) that results in the shortage of healthcare professionals in the market (Department of Health and Human Services, 2017). Similarly, dropout has been a growing concern in engineering education as it has adverse effects on the high demand for professionals in many countries (Tayebi et al., 2021).

By merging all scholarly articles on college student retention indexed either in Scopus or Web of Science, our results show that, while many other nations have now expanded their higher education systems and continue to increase their number of scientific publications, the U.S. still dominates scholarship on college student retention. Considering that retaining and successfully graduating students will continue to be a difficult endeavor especially for recently expanded higher education systems such as China and India, these two major non-Western countries have been noted by their limited number of publications (less than two percent of the global total). The U.S. higher education is noteworthy for its early expansion (Douglass, 2005; Gumport et al., 1997; Gür, 2016; Trow, 1973), as well as its constant and extensive higher education scholarship, including research on college student retention. Based on the findings, we argue that other higher education systems, such as those in China, India, and Türkiye (Gök, 2016; Özoğlu et al., 2016), which have experienced rapid expansion in recent decades, may face challenges such as high student dropout rates and may require more comprehensive research on retention.

In the last century, higher education has expanded significantly around the world, leading to a substantial increase in research focused on understanding and addressing student retention—with more than 5700 articles examined in this research. Amid the growing demand for higher education globally, student retention will remain a critical area of study for scholars in the future. Further research can explore additional scholarly materials such as books, chapters, reports, and conference papers, which were not included in this study. While bibliometric research allows us to understand themes and patterns comprehensively, it does not provide the opportunity to thoroughly examine the different dimensions of the subject. Consequently, we recommend further meta-analysis and meta-synthesis studies.

Research Ethics
Not applicable.

Author Contributions
Contributions: Enes Gök: Conceptualization (lead); writing – original draft (lead); methodology (equal); formal analysis (equal); writing – review and editing (equal). Bekir S. Gür: Conceptualization (equal); writing – original draft (equal); formal analysis (lead); methodology (equal); writing – review and editing (equal). Mehmet Ş. Bellibaş: Writing – review and editing (lead). Murat Öztürk: Software (lead); methodology (equal).

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