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A Bibliometric Analysis of WiFi Accessibility on University: For Future Research Direction

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ABSTRACT

This paper investigates the availability of free WiFi on college campuses and how availability interacts with students to compose their social and academic engagement. Utilising a bibliometric method First, this study provides an overview of significant authors, themes, and research trends regarding WiFi accessibility in higher education institutions. The research data were obtained using the Scopus database and analyzed by VOSviewer, Microsoft Excel, and SPSS 25.0. The results of the study show that WiFi can promote higher academic accomplishment, collaborative learning, and participation in extracurricular activities. However, issues such as a lack of reliable WiFi and thin coverage need to be resolved to ensure students get the best educational experience they can. It says universities should update new technology and maintenance, so students and faculty have a stable and fast internet connection to the entirety of campus.

INTRODUCTION

Access to the internet is a fundamental necessity for higher education institutions worldwide in this era of digitalisation. According to Faradina & Myori (2022), change in the use of information and communication technology (ICT) changed a lot in how the student get, manage, and share the information, and it greatly affects the students learning experience. One of them is the availability of WiFi at the university campus, which the students have significantly contributed to help increase their participation in both academic and social life (Sánchez-Pinargote et al., 2022). Hence, this work examines the impact of WiFi availability on student participation in campus activities. One of the significant aspects contributing to the potency of the learning is WiFi present in the universities. Students' navigation of information is faster (Das Swain et al. 2023) and more efficient due to the advantage provided by mobile technology coupled with a stable internet connection, which in turn affords (them) great learning efficiency. Moreover, WiFi enables students to connect with online learning platforms and the digital academic resources and

educational software necessary for their assignments and projects (Abayomi Awe, 2020). WiFi also provide an important component to enhance interaction and collaboration among the students in the social context. Students are now able to communicate more effectively through social media and other online communication tools because of the access to the internet (Mohottige et al., 2018) In addition to encouraging team-based learning, this acts to improve students' social bonds with each other. Moreover, on-campus WiFi enables students to engage in other extracurricular activities (e.g., clubs, associations, social events) necessary for shaping their personality and interpersonal skills (Indunil et al., 2023).

Nonetheless, the quality problem and narrow range of WiFi coverage of campus area remain a bottleneck (Yan & Zhou, 2022). According to a (Honma & Kiyohara, 2023) numerous university struggle with variable WiFi connection common quality and a coverage hole in many adapted areas. Such conditions can influence student life and their engagement in college life. Moreover, poor WiFi quality could lead to distraction and discomfort, which in turn lowered student productivity and motivation (Hertzog & Swart, 2018). Thus, the purpose of this study is to determine the extent to which WiFi access promotes students' online academic and social campus participation. The next study will focus on WiFi quality, signal strength, speed, and the area where the WiFi works fine. This study will also analyze the levels of students' dependency on WiFi for academic activities like research and online learning along with groupwork, and on social activities including communication and engagement in events on campus. To further enhance the student experience, universities must take the necessary steps to improve their WiFi infrastructure (Alhari & Lubis, 2023). To provide stable and fast connectivity across the campus, the latest technology and maintenance is key. Furthermore, in order to guarantee that their needs and expectations are met, universities should include students in the WiFi performance assessment and improvement process.

Thus, better WiFi access on college campuses will lead to higher student participation in educational and social opportunities (Yan & Zhou, 2022). Universities can improve the quality of learning, foster greater student interaction, and enhance the experience on campus by providing a robust internet connection (Kurniati et al., 2020). This research will provide a clearer insight into how WiFi access affects student participation and shed light on better ICT infrastructure to affect higher learning institutions.

OBJECTIVES

There are two objectives for this study which are:

1. To identify key trends and topics in WiFi related research.
2. To study how WiFi affects students' academic and social engagement

LITERATURE REVIEW

Introduction

Wireless internet technology (WiFi) has emerged as one of the most prominent technological developments and has greatly affected higher education regarding academic and extracurricular activities involvement by students (Yan & Zhou, 2022). We will conduct a literature review on existing studies on the influence of the availability of WiFi on student engagement, specifically, student academic performance, social interaction, and experience in campus.

WiFi Accessibility and Academic Engagement

Enhanced Learning Opportunities

Access to WiFi allows for continuous access to online resources, educational platforms, and academic content, essential for student learning and engagement (Masimula et al., 2023). Succeeding studies confirm that students with reliable WiFi access are more prone to engage in online discussions as well as access digital libraries and use educational applications, which arguably influences their academic performance (Dirckinck-Holmfeld et al., 2023)

Mobile Learning

The availability of mobile learning with the support of WiFi for the students, makes learning flexible and convenient for students at any time or place (Pietraru et al.,2021). Dahlstrom, Brooks, and Bichsel (2023) found that when students access learning materials and communication tools on campus by using mobile devices connected to campus WiFi, they are more engaged in learning (Frisancho et al., 2023).

Digital Collaboration

WiFi access facilitates collaborative learning, allowing learners to collaborate on projects and assignments in real-time, irrespective of their physical location (Zakaria et al., 2022). According to a study the student participants who use online collaborative tools demonstrate higher levels of engagement and academic performance (Wang et al., 2020). Students can work together in a virtual space due to WiFi accessibility, facilitating real-time communication and collaboration via Google Docs, Microsoft Teams, and any number of learning management systems (LMS). This constant linkage sustains a more vigorous and interactive learning process whereby students engage with peers and lecturers beyond the bounded walls of a formal classroom (Masimula et al., 2023).

WiFi Accessibility and Social Engagement

Social Media and Communication

Through WiFi, students can connect through social media, which encourages socialization and community (Rizqy Az, 2021). These interactions serve to enhance students' social engagement through establishing community and support systems (Magaisa et al., 2023). WiFi access is crucial to keep students socializing with each other. However, social media platforms like Facebook, Twitter, and Instagram have become integral to students' social interactions, and WiFi enables students to stay connected with friends and family, share experiences, and participate in online communities (Ellison et al., 2007). Such online interactions matter in terms of social capital and campus community.

Extracurricular activities

As many student organizations use online platforms for coordination and communication (Deri Hidayat Tullah, 2021), WiFi accessibility very well will impact participation in extracurricular activities. Through internet access, students can attend virtual meetings, webinars, or online events, facilitating their involvement with campus life (Sánchez-Pinargote et al., 2022). WiFi enables the movements of extracurricular activities. Student run groups and orientations need online platforms to schedule events, organize meetings and communicate with members. Platforms like Slack, Zoom, and Google Meet are commonly used for taking part in virtual meetings, events, planning them, and for this reason students have an easy access to take part in extracurricular activities, while not being on the site (Dirckinck-

Holmfeld et al., 2023).

WiFi Accessibility Challenges

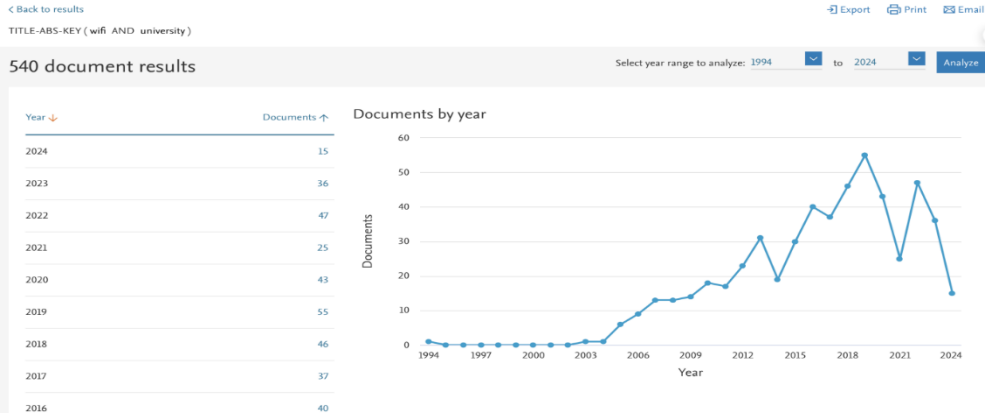
Service quality

Although it has its advantages, the quality of wifi service is still a matter of great importance. The productivity of the students may also be affected by intermittent connectivity and limited coverage (Alhari & Lubis, 2023). Furthermore, the research indicated that poor quality WiFi builds frustrations, as well as, decreased motivation for students (Napitupulu et al., 2018). WiFi service quality is among the factors that may contribute to increasing or reducing students' engagement. Frustrations and less engagement to frequent interruptions, poor connection and slow internet speed. Similar is the case of students who not only require gadgets, but also a reliable WiFi connection, as unavailability of both meets the same due to which students get challenges in completing their assignments or participating in online discussions or attending virtual classes ultimately affecting (Alwi, 2019).

METHODOLOGY

The bibliometric analysis methodology is one of the most widely used techniques to assess the quality, authority and relevance of the work (Ellegaard & Wallin, 2015) and was applied in the current study. For example, Wallin (2005) argues that a bibliometric technique can effectively determine gaps in a discipline that requires more research. Since the journal had the "the largest single abstract and indexing database ever built" (Burnham, 2006) (p. 1) and "the largest searchable citation and abstract source of searching literature" (Ahmi et al., 2019) (p. 1), the data was extracted from July 28th, 2024 from the Scopus database. In addition, Noyon, Moed, and Luwel (1999) used a scientific map analysis to understand the structure, development, and major key players of the field. Moreover, all of the analytical results according to the study of Ahmi et al. (2019), were extracted from collected documents that contained information on "access type, year, author name, subject area, document type, source title, keywords, affiliation, country, source type, and language" (p. 2).Different types of links were created to build bibliometric networks with various chains. More recently, in this study, a co-occurrence relationship, as suggested by Callon, Courtial, Turner, and Bauin (1983), was used. Also, all topics related to waqf's papers were the scope of this study as the title of the paper implies. For the study, we used the following query: (TITLE ("WIFI" AND Üniversity"), resulting in 540 duplicate-free documents after data cleaning. Microsoft Excel, SPSS 25.0, VOSviewer and the Publish or perish program were employed to incorporate and visualize the data throughout the analysis process. In the presentation of data, a traditional bibliometric method for citation analysis, research output and publication evolution was utilized. On 28th July 2024, it will be all the data used in this report were taken.

STUDY FINDINGS



The number of documents fluctuates significantly not maintaining the rank number of documents per year from 1994 to 2024 as shown in Figure 1. It reflects a slightly upward trend between the years 2016 and 2019, with the number of documents increasing from 40 in 2016 to a maximum of 55 in 2019. 2019 had 90 documents, which was followed by a drop to 43 documents for 2020 and a further drop to 25 for 2021. But in 2022, the number of documents jumped to 47. It fell to 36 documents in 2023 and to a low 15 documents in 2024. According to the line graph, 2019 is the year with the maximum number of documents at 55 versus 2024, which displayed the minimum number of documents, only 15.

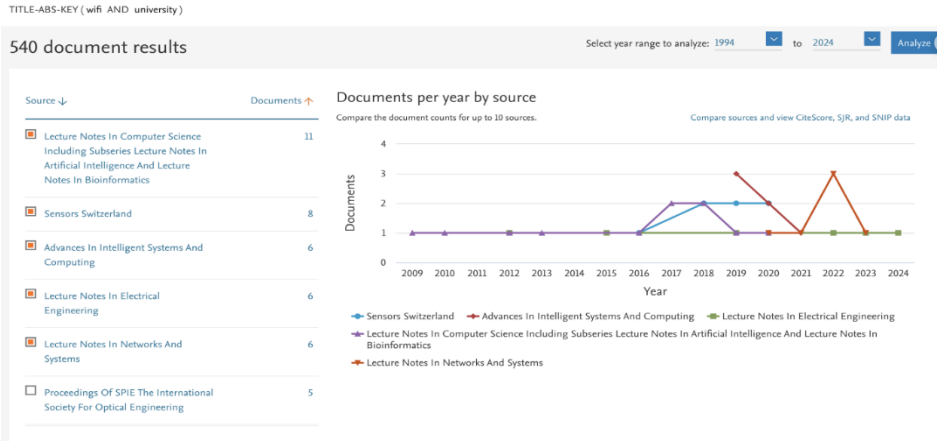
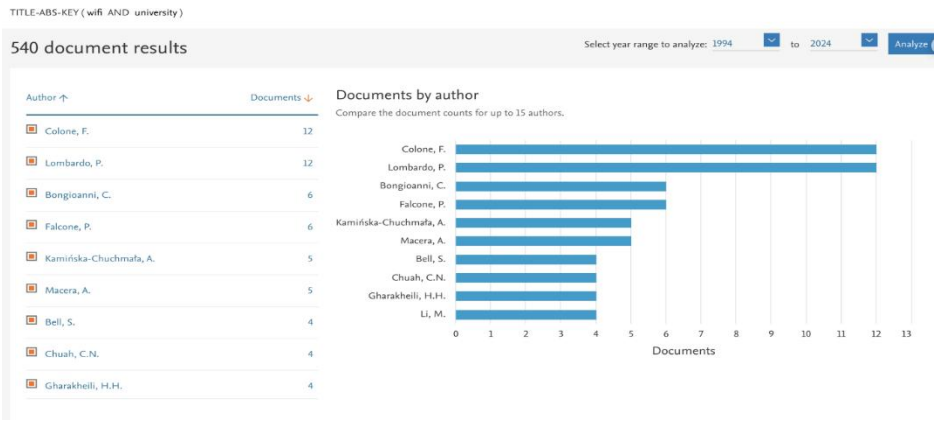
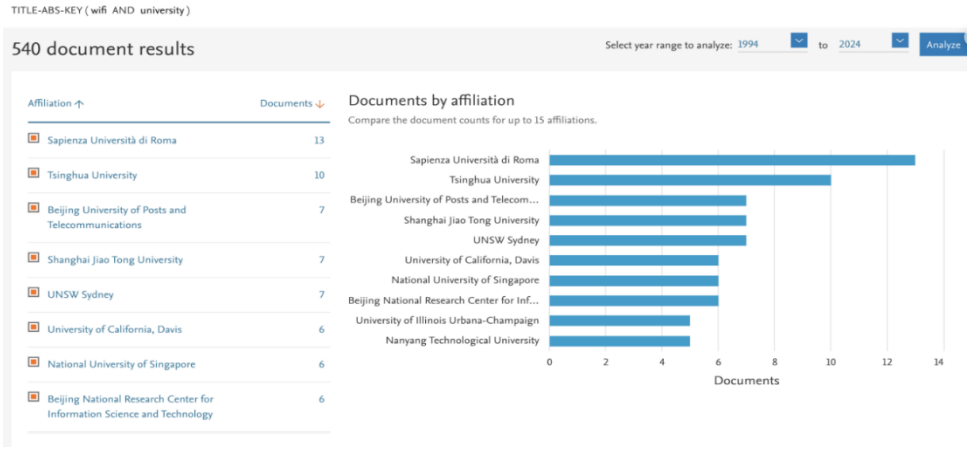


Figure 2 shows the counts of the number of documents by year by source from 2009 to 2024. Based on the data, Lecture Notes in Computer Science Including Subseries Lecture Notes In Artificial Intelligence and Lecture Notes in Bioinformatics had the most documents of 11 documents. Sensors Switzerland of course got second most with 8 documents. For Advances In Intelligent Systems and Computing, Lecture Notes in Electrical Engineering and Lecture Notes In Networks and Systems 6 documents were produced by them. This demonstrates that "Lecture Notes in Computer Science" was substantially ahead in the number of documents produced, closely followed by "Sensors Switzerland," while the other three sources clocked an equal number with six documents each.



A comparison is made with the top 10 out of 15 authors based on the document count (Figure 3). Colone, F. and Lombardo, P. were outperformed the other 15 other authors as the best author with 12 compared with 6 documents and below compared with other authors. The highest frequency of documents was represented by Colone, F. and Lombardo, P. with 12 documents. Second highest with 6 documents each, we have Bongioanni, C. and Falcone, P. This led to A.M. Kaminska-Chuchmala and A. Macera with 5 documents each. The other four authors, each with 4 documents, are Bell, S., Chuah, C.N., Gharakheili, H.H., and Li, M.



The number of documents affiliated with educational institutes is represented in the form of the ranking as depicted in Figure 4. Sapienza Universita di Roma ranks first with the most number 13 documents. The university of second place is Tsinghua with 10 documents. Followed by Beijing University of Posts and Telecommunications, Shanghai Jiao Tong University and UNSW Sydney with 7 documents each. There are 6 documents from University of California, Davis, National University of Singapore, and Beijing National Research Center for Information Science and Technology, respectively. Lastly, University of Illinois Urbana-Champaign and Nanyang Technological University both have 5 documents.

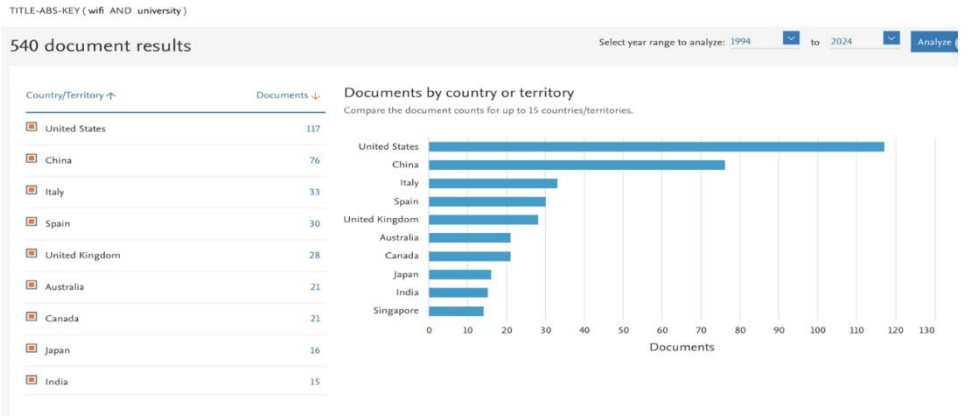
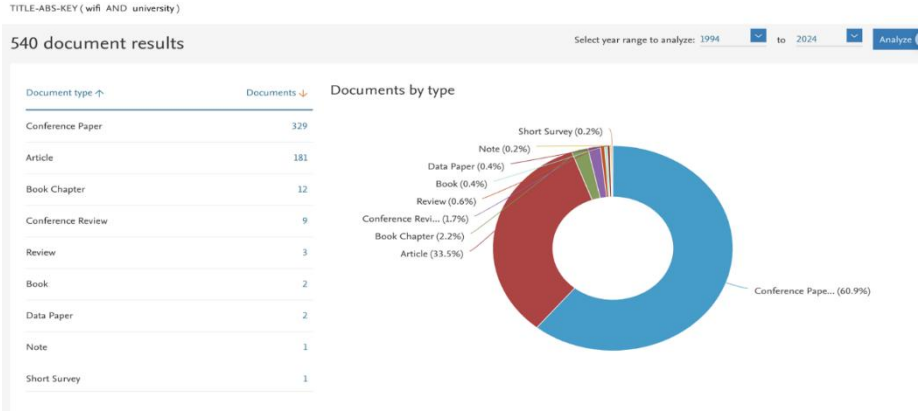
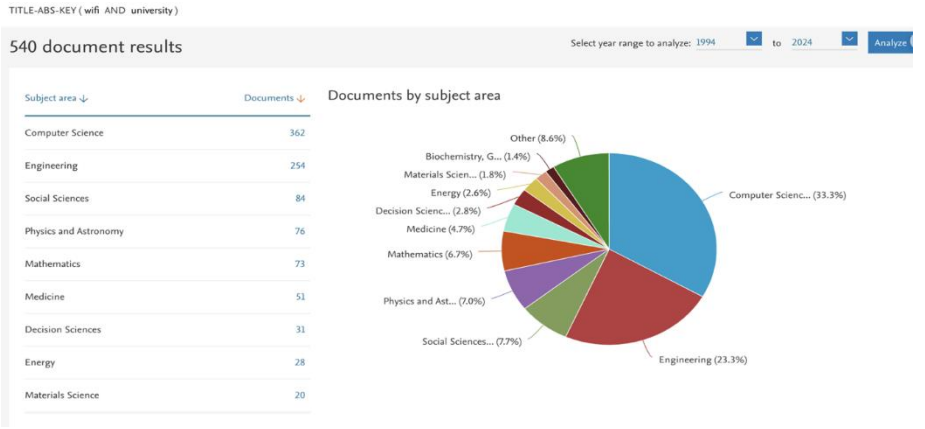


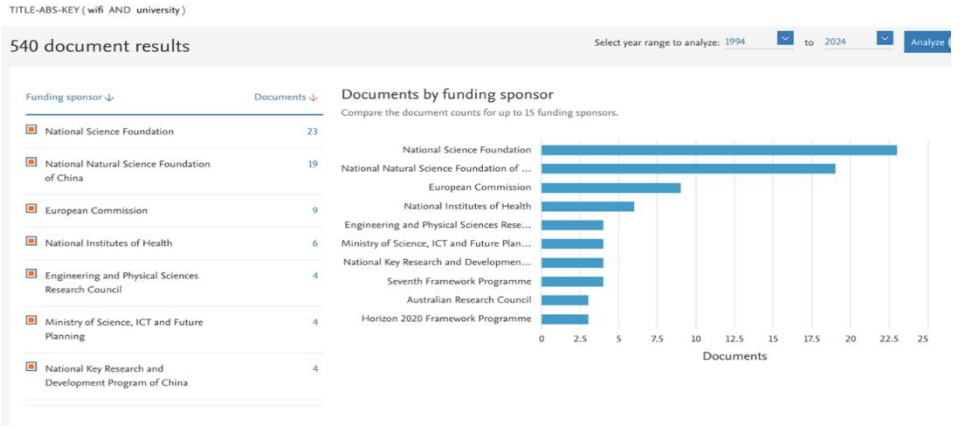
Figure 5 presents documents by country or territory and compares document counts for up to 15 countries or territory. As can be seen from the graph, for the documents USA has higher than any other countries with 117 documents. Second place was taken by China with a total of 76 documents. The other Countries have far less documents, Italy 33 documents, Spain 30 documents and United Kingdom 28 documents. Australia And Canada recorded with 21 documents. The 4th highest country was Japan with 16 documents followed by India which was the least country which recorded 15 documents.



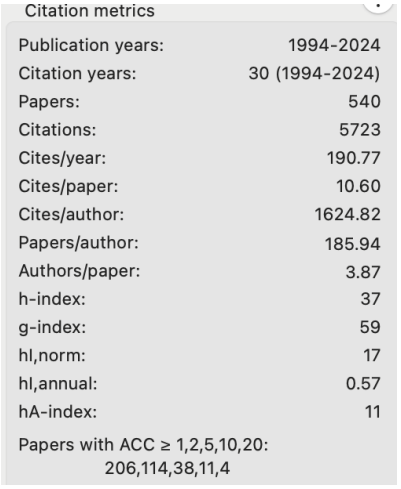
However, for the Figure 6, Conference Paper has the highest percentage which is 60.9% or 329 documents type. The next biggest document on the pie chart is article with 33.5% percentages that is 181 documents; book chapter in third place with 2.2% percentages or 12 documents. Conference review has 1.7% and 9 documents then review 0.6% 3 documents. The most number of similar documents similar to above are book (0.4%, 2) and data paper (0.4%, 2) with the same percentage. The smallest percentage are note and short survey which are 0.2% percentages or 1 document respectively. That is also the most written article and the most topics about technopreneur published in conference paper.



This pie chart illustrates which subjects have the most WIFI documents in a university. Computer Science has the highest percentage (33.3%) with 362 documents, followed by Engineering (23.3) with 254 documents, Social Sciences (7.7%) with 84 documents, Physics and Astronomy (7.0%) with 76 documents, Mathematics (6.7%) with 73 documents, Medicine (4.7%) with 51 documents, Decision Sciences (2.8%) with 31 documents, Energy (2.6%) with 28 documents and Material Science (1.8%) with 20 documents.



On the basis of Figure 8, it presents a comparison of the top 10 funding sponsors of documents, which are classified by funding sponsor. Among the documents, the National Science Foundation is higher than other funding sponsor with 23 documents. The second is the National Natural Science Foundation of China with 19 documents, European Commission with 9 documents, and National Institutes of Health with 6 documents. On the other hand, Ministry of Science, ICT and Future Planning Engineering and Physical Sciences Research Council, National Key Research And Development Program of China with four documents is the same sponsor.

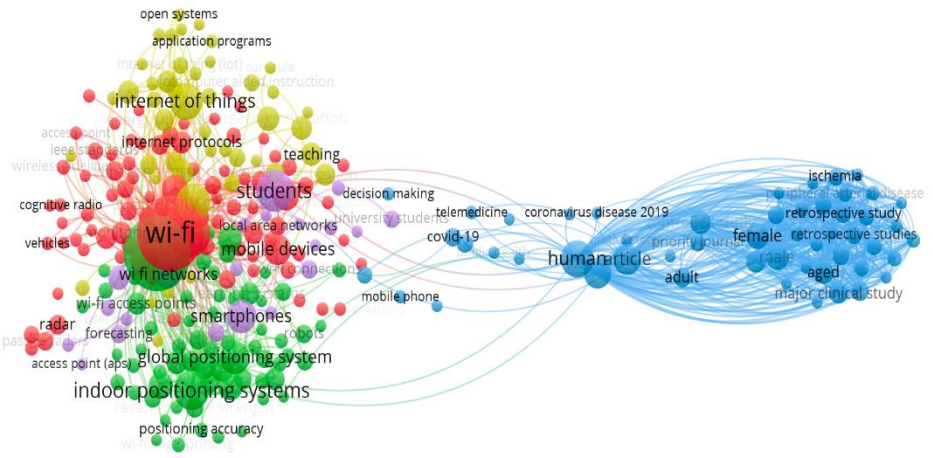


Citation metrics	
Publication years:	1994-2024
Citation years:	30 (1994-2024)
Papers:	540
Citations:	5723
Cites/year:	190.77
Cites/paper:	10.60
Cites/author:	1624.82
Papers/author:	185.94
Authors/paper:	3.87
h-index:	37
g-index:	59
hI,norm:	17
hI,annual:	0.57
hA-index:	11
Papers with ACC ≥ 1,2,5,10,20:	206,114,38,11,4

Figure 9: The citation metric an extensive summary

This citation metric provides a general overview of the research productivity and impact of a given author or research entity between 1994 and 2024. During this 30-year period, 540 publications containing 5,723 citations were published. The quality (number of citations per paper average 10.60 and citations per year 190.77) and outputs are impressive. Also with an h index of 37, 37 papers have 37 or more citations each, indicating a large body of quality research. 59 g-index indicates impact of the most cited papers further confirms its importance. This metric indicates an incredibly collaborative team, or a paper mill based on reporting an average of 3.87 authors per manuscript and 185.94 papers per author. The breakdown of papers by citation count (ACC) shows a typical distribution and reflects common pattern of a few seminal number of influential works among much larger body of work. Out of a total of 206 papers for which at least one citation was available, only 4 papers had 20 + citations Perish Hapzing software is used to calculate citation metrics, providing scholars with an abundance of data on the impact and readership of their works. It gives your insight into the impact and exposure of your academic work via tracking and analysing citations.

Figure 10 shows the keyword map shows how education, medical research, and technology are all intertwined. This map of keywords shows how education, medical research and technology are all connected. As we can see, the Wi-Fi stands in the middle of the box with a strong connection to many other technology sectors like mobile devices, networking technologies and the Internet of Things. This cluster shows how omnipresent wireless communication is in modern-day systems ranging from indoor locating to wide area navigation. Alongside that we see a focus on education, specifically on students and teaching, suggesting the increasing integration of tech within education environments. The map then approaches a particular medical research cluster that prioritises human studies, primarily those related to COVID-19 and other clinical queries.



To conclude, the interplay of these three domains, with tech first, education second, and health third, could give a rather interesting suggestion of the influence and path technological discoveries to the educational teaching ways, which clearly in the same way affect health practices. The visualisation encapsulates the transdisciplinary nature of 21st century R&D, whereby breakthroughs in one field of work can have far reaching implications into other domains that may have seemingly no connection whatsoever

DISCUSSION

Access to WiFi in university campuses has proven to be a challenge in enhancing academic performance, social engagement, and technological innovation and promoting interdisciplinary opportunities. Besides, good WiFi also positively impacts the academic and collaborative efforts of the students. As reported by Dirckinck-Holmfeld et al. (2023) suggest that reliable access to the internet contributes to learning efficacy and is beneficial for group-based projects as it allows users to access educational tools and digital resources continuously. On the other hand, low quality WiFi can impact productivity and motivation as indicated by Hertzog and Swart (2018), which may cause increasing frustration and disengagement from academic and extracurricular activities. The growing need for high-speed and dependable internet highlights the importance of universities implementing cutting-edge technologies such as 5G Sánchez-Pinargote et al. (2022) advocate for the exploration of mesh networks to excitingly rethink internet service delivery, arguing that contemporary innovations can fill existing coverage and service gaps and provide needed community digital capacity for academic use. WiFi technology is no longer simply related to academics, rather it has integrated the academic world with the various other spheres of the industry such as education, health care, and engineering through IoT (Internet of things). As discussed in figure 10 of the study, WiFi acts as a technical foundation, bringing together different configurations and driving creative solutions across multiple disciplines, from telehealth, to collaborative platforms for learning in education.

RECOMMENDATIONS FOR FUTURE RESEARCH

Future research should further refer to the developments come from a MESH network and 5G in university campuses. By doing so, existing problems in connectivity, speed, and reliability can be solved, and it can also improve the learning and social experiences of students (Kurniati et al., 2020). More research must be done to explore the impact of WiFi accessibility on students' mental health and productivity. For example, Honma and Kiyohara (2023) highlight that the WiFi infrastructure, as well as its quality, may have a considerable effect on students' stress levels, motivation and overall well-being The effects of WiFi go well beyond academia — to healthcare, to the economy. Researchers should investigate the role of WiFi in interconnected such as healthcare IoT systems and other specific areas of economic development. WiFi is emerging as a central enabling factor across the three technological, educational, and medical domains — these use cases (Figure 10) signify very large potential implications.

CONCLUSION

This bibliometric analysis of WiFi accessibility in universities has given a deeper view of the evolution of research in this area. According to several studies, it is the area of study and field that most people are pursuing is WiFi, both in Computer Science, Engineering, and Sociology. This statement proves that WiFi technology has a significant impact on many fields. Moreover, the most significant sponsor of this research is the National Science Foundation, revealing a strong organizational support in developing WiFi research. In addition, according to the citation metrics, there are also plenty publications with considerable impact, having demonstrated the profound impact of this study on the academic community. As expected, the keyword map displays a very close link between technology, education, and medical research reflecting the transdisciplinary nature of how the developments in the WiFi technology field impact established fields across the new landscape of and the winners are? In summary, WiFi accessibility in universities is a relevant and dynamic research topic that has the potential to keep on growing and to have a positive impact on the future of education, technology and other related areas. While this is an important factor influencing student participation in higher education, the access to specific programs can be crucial (Dirckinck-Holmfeld et al., 2023). Enhanced Academic and Social Engagement Enhanced student outcome by reliable and high-quality WiFi services for universities. Our findings demonstrate such innovative approaches and as research progresses, we recommend continuing to solve challenges such as WiFi accessibility so that all students can obtain this important resource.

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