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REVIEW

Increased Popularity of AI and Digital Technologies in ESP: A Bibliometric Review

Albina Elmuratova [1*] **, *Gulnoza Sabirova*** [1] **, *Kamola Alautdinova*** [1] **, *Mukhtasar Abdullaeva*** [2] **, *Zerne Uteshova*** [3] **, *Sayora Elmuratova*** [4] **, *Bibisanem Arzieva*** [5] **, *Zulfiya Kannazarova*** [6]

[1] *Teaching Theory and Methodology Department, Tashkent Institute of Irrigation and Agricultural Mechanization Engineers National Research University, Tashkent 100000, Uzbekistan*

[2] *English Linguistics Department, National University of Uzbekistan, Tashkent 100000, Uzbekistan*

[3] *Foreign Languages Department, Karakalpak State University, Nukus 230101, Uzbekistan*

[4] *Russian Language and Literature Department, Nukus State Pedagogical Institute, Nukus 230101, Uzbekistan*

[5] *English Language and Literature Department, Nukus State Pedagogical Institute, Nukus 230101, Uzbekistan*

[6] *Agricultural Techniques and Technologies Department, Tashkent Institute of Irrigation and Agricultural Mechanization Engineers National Research University, Tashkent 100000, Uzbekistan*

ABSTRACT

English serves as a global lingua franca, essential for communication across various industries. Despite focused instruction in English for specific purposes (ESP) in education, a gap remain between what is taught and the demands of specific fields. Therefore, understanding past and current research on ESP is crucial. This study aims to identify the frequent topics on ESP, with a particular focus on the integration of learning technologies. Eight hundred forty-three (843) papers spanning from 1991 to 2023, selected from the Scopus database, were examined and analyzed. The first-ranked journal with 999 is the first specialist peer-cited international journal, English for Specific Purposes, followed by the Journal of English for Academic Purposes with 316 citations, the International Journal of Bilingual Education and Bilingualism

*CORRESPONDING AUTHOR:

Albina Elmuratova, Teaching Theory and methodology Department, Tashkent Institute of Irrigation and Agricultural Mechanization Engineers National Research University, 100000, Tashkent, Uzbekistan; Email: a.elmuratova@tiiame.uz

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with 211 citations, and System with 146 citations. Results showed that China, the USA, and Russia are three of the top countries to which authors who publish about ESP in education. The study also highlights a notable rise in the frequency of topics such as the utilization of digital technologies, collaborative and assessment platforms, and artificial intelligent (AI) and Immersive technologies. The three key topics in ESP are expected to contribute to the effective development of ESP in education. The authors suggest that the rise of these topics is viewed as one of the positive outcomes of the pandemic. These trends are seen as crucial in shaping future of ESP in educational settings.

Keywords: English for Specific Purposes; Scopus; Bibliometric Analysis; Learning Technologies; Education

1. Introduction

English for Specific Purposes (ESP) is an eclectic approach in language teaching that addresses the current and/or prospective academic and occupational needs of learners. It assimilates the most effective, successful, and valid concepts from various theories and practices, integrating them into a cohesive framework[1]. Research on ESP as a discipline evoked from the 1960s. For instance, ESP originated as a result of global economic advancements, marked by technological progress, the economic influence of oil-rich nations, and a rising influx of international students in English-speaking nations[2]. The evolution of ESP reflects a deeper understanding of how language functions within specialized contexts, emphasizing practical communication skills tailored to the needs of learners in specific professional fields.

ESP integrates components from Task-Based Language Teaching (TBLT), Communicative Language Teaching (CLT), Project-Based Learning (PBL)[3] and a plethora of other teaching approaches. Simultaneously, ESP possesses distinctive characteristics such as discipline-centeredness that set it apart from other language teaching approaches. The overall aim of the ESP curriculum is to match the needs of students in specific fields to be professional communicators in a foreign language. Thus, the primary distinction between ESP and English for General Purposes (EGP) lies in its focused orientation. According to Basturkmen[4], ESP is mainly important in tertiary education, almost everywhere in the world. For example, in Iran, students in higher education institutions have ESP courses to comprehend their field terminology[5], develop students' writing in ESP classes using portfolios in Turkey[6], and improve professional communicative competence in Uzbekistan[7]. This means that the course content and teaching methodology should be based on the learner's reasons and needs for learning. The specific emphases on authentic language use and context-relevant skills make the ESP field particularly sensitive to technological and pedagogical trends.

Over the last few years, artificial intelligence and digital technologies have significantly influenced ESP education and research. Tools such as AI-powered Assistants, automated writing assessment systems, AI-integrated learning platforms, Generative AI applications, and social media platforms for educational purposes have reshaped how ESP courses are designed, conducted, and evaluated. Studies demonstrate the positive influence on students' learning outcomes[8], for providing personalized instruction and feedback, and for creating a supportive and productive learning environment[9]. The COVID-19 pandemic, in particular, can be considered a catalyst for this transformation because of its influence on the increased use of online learning and AI-supported tools. For instance, Crick's[10] research highlights an upward surge in the use of technological developments after the pandemic in educational settings and how these technologies have improved educational accessibility and motivation. Moreover, integrating cloud and AR technologies into education can transform traditional settings into more interactive learning methods[11]. Papadakis et al.[12] suggest that the next step in the development of educational technology will be to improve AI-driven learning analytics, virtual reality integration, and Internet-of-Things (IoT)-based educational monitoring systems. In addition, it is also necessary to mention that the shift to online learning or the use of digital and AI learning platforms after COVID-19 was inevitable, but unprepared[13].

1.1. Bibliometric Analysis

In the late 1960s, Pritchard introduced the term 'bibliometrics', defining it as the application of mathematical and statistical techniques in the analysis of books and various forms of communication media[14]. Bibliometric reviews

aim to provide an in-depth understanding of the literature [15]. Our study covers examples of several bibliometric analyses in ESP [16–18]. Aravantinos et al. [19] conducted a systematic review on the use of artificial intelligence in primary education. They collected and analyzed 35 empirical studies from the Scopus database, categorizing findings on objectives, learning content, activities, outcomes, and pedagogy. Researchers revealed that AI is used in teaching Science, Technology, Engineering, and Mathematics (STEM), languages, arts, and mathematics. The AI integration positively impacted learners' thinking skills, emotions, and physical abilities. The challenges and opportunities of the intersection of artificial intelligence and digital transformation were discussed by Bijou and Elmoutaouakkil [20] by analyzing 119 articles indexed in the Clarivate Web of Science (WOS) and Elsevier Scopus databases. Liu and Hu [21] conducted a co-citation analysis of two flagship journals of ESP from 1980 to 2018, 'Mapping the field of English for specific purposes (1980–2018): A co-citation analysis'. Mardieva et al. [15] in their article 'A Bibliometric Review: Interventions for Enhancing Speaking Skills in non-English-Speaking Contexts' investigated trends in research on teaching speaking skills in non-English-speaking contexts and identified top journals, keywords, and top-cited publications. The study by Lampropoulus and Papadakis [22] provides implications of social robots and AI. Lavidas [23] took a different perspective by exploring students' willingness to engage with AI technologies. While these studies provide valuable insights into the ESP education and research, our study aims to conduct a bibliometric review on the trends in ESP with a particular focus on learning technologies used in ESP. The analysis of key trends and debates in ESP research helped us highlight the evolving nature of the field and the gaps that remain. This synthesis underscores the need for further research on how technological advancements are reshaping ESP theory and practice.

Moreover, the limitations outlined in the article "A Bibliometric Analysis of English for Specific Purposes from 2011 to 2023 Using Citespace: Visualizing Status, Themes, Evolution, and Emerging Trends" by Sining Tan, Madhubala Bava Harji, Xiaogang Hu [17], highlighted the need for examining the most productive authors, institutions, and journals. To address this gap, our study employs the Scopus database and expands the scope of analysis to analyze key contributors to the field, thereby offering a more comprehensive understanding of ESP in education.

2. Materials and Methods

In this paper, we employed bibliometric analysis to identify the past and current state of research, including the contributions of various authors and journals, as well as prevailing trends in the field. This approach helps to illustrate their relationship to the specific research topic or area of interest. The research was carried out on the most widely used online database, Scopus, which is widely recognized for its comprehensive coverage of scientific journals and high-quality data [24]. The analysis was carried out in January 2024. The search span is defined as 1991-2023 using the keywords "ESP" and "education". The language was limited to English alone. As our study includes the global scope of publications, we decided to begin with 'The Modern Age in ESP' when international journals gained widespread popularity [25]. A total of 843 publications sorted out for further analysis on ESP and education issues were downloaded in the form of "full records and cited references" and saved as plain text files for data analysis [26]. The research design is presented in **Figure 1**.

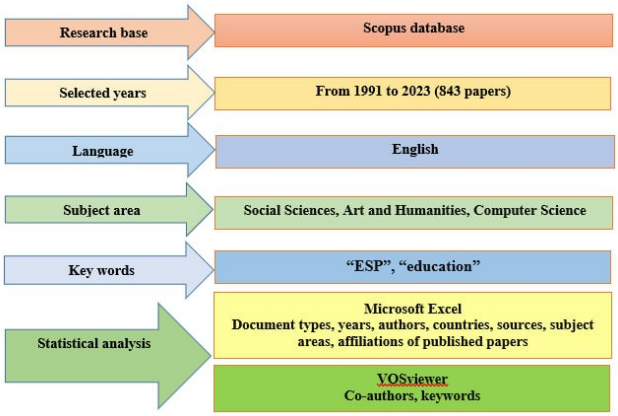

Figure 1. Research design.

The analysis was performed using a CSV file, Microsoft Excel 2021, RIS and Map chart. Data obtained in CSV format was uploaded to Excel for data analysis. Before starting the analyses, the data was manually checked for errors, but no changes were made to maintain the maximum integrity of the data. The retrieved bibliographic records were analyzed, and the most relevant ones were identified. The ar-

ticles from the search were assessed and classified according to different aspects, including annual publication numbers, top lists of authors, institutions, countries, and cited journals. Finally, as a visualization tool, the VOSviewer program was used[27] to analyze the co-authors and co-occurrence of keywords to investigate the knowledge elements and framework of the research field by pinpointing clusters of the most frequently occurring keywords in the literature.

3. Results

3.1. Publication Trend on ESP

In order to understand the development of ESP in English language teaching, annual publication and citation trends were analyzed, as shown in **Figure 2**. A total of 843 papers were published between 1991 and 2023 on teaching ESP around the world. From 1991 to around 2005, the number of publications remained relatively modest; however, a noticeable increase began after 2015.

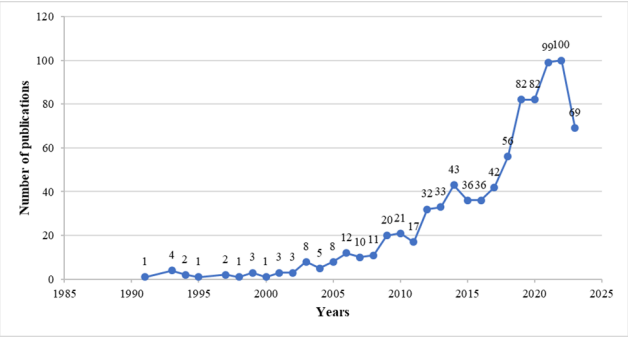

Figure 2. Publication trend on ESP in the world during the period 1991-2023.

In this review, to identify research trends and have a roughly equal number of publications in the examined time span, we categorized the scientific articles into three research phases of development: introduction (1991–2005), slightly growth (2006–2015) and stable growth (2016–2023). Introduction period. The first period consists of 42 publications, representing 4.98% of the total. The results show that interest in teaching ESP started with the development of ESP as a language instruction, the description of ESP, and common methods of teaching. We deduced that researchers are concentrating on curriculum development, material selection, and teaching approaches.

A slightly growth period. This period shows 235 documents, representing 27.87% of the total, with a growth that marks the scientific interest in this field of research. The datahighlights the importance of tools and software for learning and teaching ESP, particularly mobile phones.

Stable growth period. The last period represents the key to exponential growth, grouping more than half of the total number of publications (566 documents) in 7 years (67.14% of the total). In 2022, the highest number of publications was 100, followed by the year 2020 (with 99), making it a sustainable growth field (**Figure 2**). This period shows the strengthening of interest in teachers' perceptions and beliefs, teachers' identity, perceived challenges and needs in ESP, exploitation of Web3 technologies in teaching ESP, online and blended learning were also of high interest during this period.

3.2. Authors and their affiliations

Our findings show that a total of 159 authors from 88 countries have been involved in ESP research from 1991 to 2023. **Figure 3** illustrates 10 significant authors who have each published more than three papers in this field. Among them, Simonova, I. reigned with 20 publications, followed by Basturkmen, H. with 6, Kostolanyova, K. and García-Sánchez, S. with 5, Tsai, S.C., Poulova, P., Jackson, J., Hyland, K., Chaikovska, O. each with 4 papers, and Arnó-Macià, E. with 3 research papers. The list of top authors comes from 4 different continents, including East and Southeast Asian countries (Taiwan, Japan, China, and Indonesia), European countries (the Czech Republic, Russian Federation, Spain, and the United Kingdom), the United States, North America, and Australia.

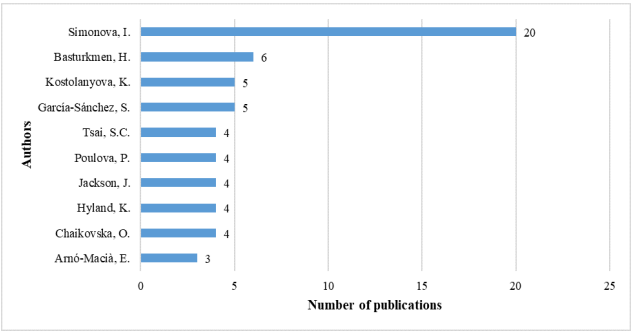

Figure 3. List of top authors published on ESP.

Over a 31-year period, 160 different institutions coop-

erated to publish 843 papers related to ESP worldwide. Our analysis of the top 10 institutes' publications on ESP allowed us to determine the influential and productive institutions in this field. As indicated in **Figure 4**, of the top 10 institutions, 3 were from the Czech Republic and 2 from Spain and China. The most interesting part of it is that between these institutions, "University of Hradec Králové, Czech Republic" occupies the first position in record rank (11 records) where English is taught as a foreign language, followed by Ostravská Univerzita v Ostrave (10 records) and the University of Auckland, New Zealand (9 records).

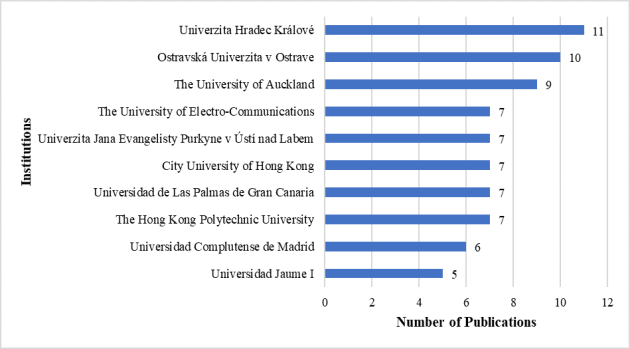

Figure 4. List of top institutions on ESP.

3.3. Top Countries on ESP

The ten most productive countries in the field of ESP between 1991 and 2023 are China, dominated with 89 publications, demonstrating its strong research infrastructure and ongoing dedication to the field of ESP. This is followed by the United States 72, the Russian Federation 38, Spain 54, the United Kingdom 40, Japan 37, the Czech Republic 29, Indonesia and Taiwan 28, and Australia with 24 publications, which also show substantial contributions to the field (**Figure 5**).

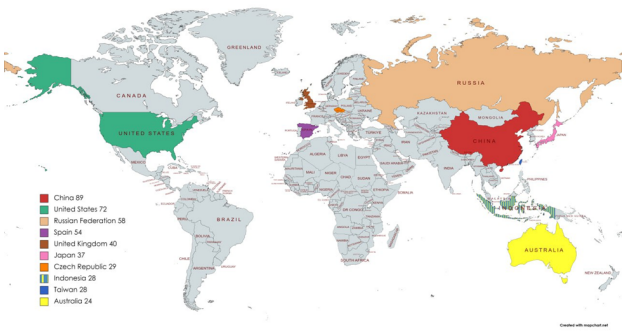

Figure 5. List of top countries on ESP.

3.4. Top Cited Journals on ESP

We collected top journals in **Figure 6**, which published the highest number of papers on ESP. First, we sorted the source names alphabetically in the Excel file extension, compiling 843 documents. After that, step by step total paper citations are summarized by each journal. Finally, as a result, an updated list with potential journal names was generated. The initial 10 journals selected are shown in **Figure 6**. According to the result of the number of citations, the first ranked journal with 999 is the first specialist peer cited international journal, English for Specific Purposes, followed by the Journal of English for Academic Purposes with 316 citations, the International Journal of Bilingual Education and Bilingualism with 211 citations, and System with 146 citations. The figure helps in identifying the most significant publications for research on ESP, the span of these journals is applied linguistics, English language and education, and all of these journals are from the Scopus database.

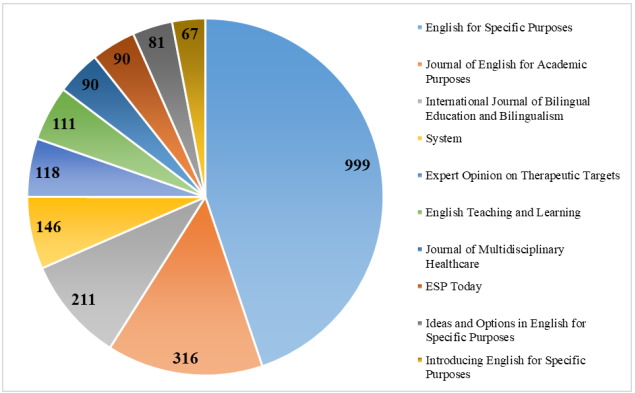

Figure 6. Top cited journals on ESP.

3.5. Top Co-Authorships and Keywords on ESP

VOSviewer can generate co-authorship, keyword co-occurrence, citation, bibliographic coupling, and co-citation maps based on bibliographic data. File formats supported include .txt, .ris, and .csv, which are compatible with databases such as Scopus[28]. The raw file was imported into VOSviewer, and a map of co-authorship and keyword co-occurrence was created using the software (**Figures 7** and **8**). The co-authorship analysis resulted in a network of 1733 authors. Only authors with a minimum of four publications

on the topic of ESP were included. There are 12 items distributed over 11 clusters: cluster 1 (2 items), cluster 2 (1 item), cluster 3 (1 item), cluster 4 (1 item), cluster 5 (1 item), cluster 6 (1 item), cluster 7 (1 item), cluster 8 (1 item), cluster 9 (1 item), cluster 10 (1 item), cluster 11 (1 item). Total link strength (9) and links (2).

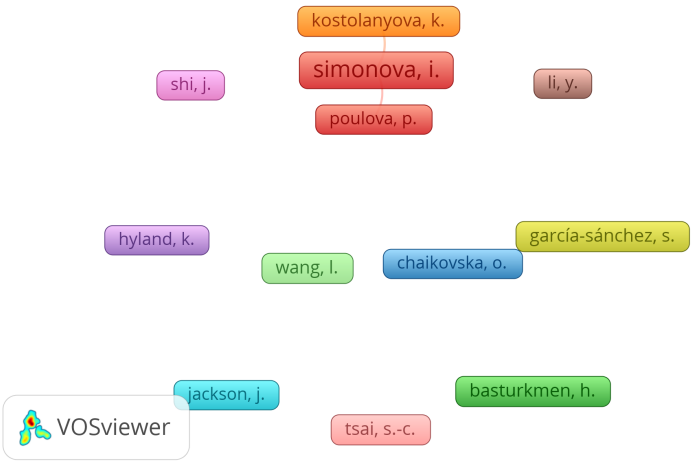

Figure 7. Network map of top co-authorships based on the total link strength.

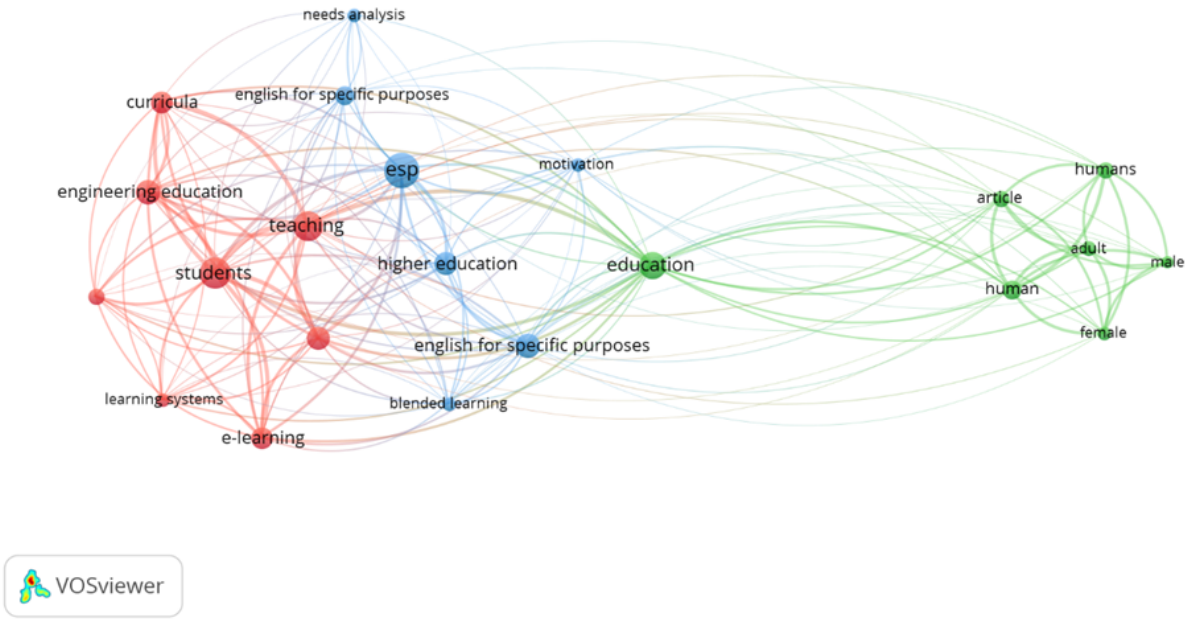

Figure 8. Network map of top keywords based on the total link strength.

The analysis yielded 4323 keywords. Each keyword is represented as a node based on its total link strength, creating a network map of keywords. **Figure 8** displays the network map for the top 10 authors' keyword co-occurrence. Cluster 1 (curricula, e-learning, education computing, engineering education, English for specific purposes, learning systems, students, and teaching), Cluster 2 (adult, article, education, female, human, humans, and male), and Cluster 3 (blended learning, ESP, higher education, motivation, and needs analysis).

4. Discussion

The objectives of this study were to analyze the existing knowledge on ESP in education and identify, through a bibliometric review, the scientific articles and research areas that have had the greatest impact on the topic. The annual production of articles on ESP in education during the period 1991–2023, the scientific articles consist of three periods of development: introduction (1991–2005), slightly growth (2006–2015), and stable growth (2016–2023). This scientometric analysis showed that articles published over 31 years have the highest results on ESP in education studies over the last 7 years. The introduction period shows that the research foci of many articles was on ESP as an effective approach [29]. This period focused on material selection [30] and the ways of further development of ESP to make it more discipline-specific [31], focusing on curriculum development [32, 33]. As the significance of English for global communication in professional settings continued to increase in the slightly growth period (2016–2023), scholars have recognized a demand for skillful ESP instructors [34] and effective training programs for prospective ESP educators [35]. In addition, the integration of ICT into ESP programs to improve IT skills [36] and information literacy [37] was also popular during this period. The concepts of learner autonomy and responsibility control over the learning process gained prominence during the stable growth period (2016–2023) of our study. These ideas are fundamental to technology applications that enable interaction at a distance, such as mobile learning [38] and the incorporation of video [39] into classes. Furthermore, blended learning advantages [40] were mostly discussed compared to face-to-face traditional approaches. Throughout the research periods of our study, much attention has been given to the critical role of ESP instructors, including ESP teachers' beliefs and skills, which remains a significant concern to date [41, 42]. The rising prevalence of ESP in Asian nations is evidenced by the special issue in 2014 of the English for Specific Purposes journal titled 'ESP in Asia' [43], which serves as a testament to the growing adoption and significance of ESP in the region. Similarly, in our study, four Southeast and East countries were among the top 10 authors, and the top funding also belongs to three Chinese organizations. Three institutions from the Czech Republic occupy the first position in the list of influential institutions. The Journal of English for Specific Purposes ranks the highest in the list of top-cited journals.

The COVID-19 pandemic has profoundly impacted every sector, including education, revolutionizing traditional practices. Educational institutions worldwide have adopted remote teaching, leveraging technology to bridge the gap between teachers and students. The implementation of the lockdown after the outbreak of this infectious disease embarked on a transition from conventional classroom settings to online platforms at all levels of education. Consequently, there was a substantial rise in the use of tech-enabled applications such as language apps, virtual tutoring, mobile communication apps [44], and video conferencing tools like Microsoft Teams, Zoom, Google Meet, and various online learning software. In this study, the total number of articles analyzed was 843, spanning a 31-year period. Notably, the stable growth period encompassed 432 works, which constitutes more than half of the entire dataset. Our particular emphasis was on the post-COVID-19 period, during which we observed significant trends in the field of ESP. We have examined works available in the Scopus database, organizing them into three distinct categories: digital resources, collaborative and assessment platforms, and AI and immersive technologies, as shown in the tables below. This structured approach has allowed us to analyze and highlight the diverse ways in which these tools are utilized in modern ESP instruction. The use of social networking services and digital tools, such as Instagram [45], Facebook [46], and YouTube [47], makes learning more engaging and effective. Immersive technologies: virtual [48] and augmented reality [49] can incorporate real-world scenarios, providing access to authentic materials relevant to the learner's specific field. Despite its challenges, the COVID-19 pandemic had several positive impacts on ESP education as a wide introduction of learning technologies into the ESP education process.

4.1. Digital Resources

Pedagogy continuously evolves with the adoption of new instruments, techniques, and approaches. The integration of digital resources in ESP gained our attention. **Table 1** demonstrates that in the last decade of our study, there has been a notable surge in the integration of Information and Communication Technology (ICT) and multimedia technologies within the classroom. The research focused on the experimental applications of digital technologies in the classroom began in 2013.

Table 1. Digital resources in ESP context.

Instrument	Study	Design	Main Findings
Mobile devices	Mobile devices in technical and engineering education with focus on ESP [50]	Questionnaire method was used for data collection	- students mostly possess notebooks, smartphones, PCs, and mobile phones; - mobile devices improve technical and engineering education; - positive feedback on mobile-assisted ESP learning;
Engineering podcasts and videos	Impact of technology on speaking and writing skills of masters in engineering ESP learning [51]	Mixed research design (A two-phase questionnaire was conducted to find out engineering students' opinion about need for learning four basic skills and subskills)	- speaking and writing are highlighted as the most challenging but important; - technical writing skills were enhanced; - no difference in developing speaking skills;
Digital storytelling	Digital storytelling as practice-based participatory pedagogy for English for specific purposes [52]	Experimental study (piloted framework for ESP classes)	- develop language communication skills; - encourages teamwork, digital literacy; - cultivates critical thinking;
Game-Based Mobile Application	Using a Game-Based Mobile Application to Learn Medical Academic Vocabulary: Learning Effects and Learners' Perceptions [53]	Qualitative method (two questionnaires and follow-up interviews were conducted)	- improved medical academic vocabulary; - positive attitude toward the use of mobile devices;
Mentimeter	Using Mentimeter to Elicit Student Responses in the EAP/ESP Classroom [54]	Review of the student response system	- promotes student engagement and interaction in EAP/ESP classrooms; - Enables anonymous responses; can be used for assignments, quizzes, and formative evaluations; - May limit verbal discussions;
Smart devices and technologies	Smart Approach to ESP Instruction [55]	Quasi-experimental ex-post-facto method	- Based on Plaminek's Inventory Coordinators' knowledge significantly increase compared to Explorers, Accurators, or Directors; - enhances overall learning effectiveness;
G Suite for Education	Using the G Suite for Education in Language Teacher Education: Benefits and Challenges [56]	Technical Action Research G Suite for Education was utilized for the delivery of an online Teacher Education course in English for Specific Purposes (ESP)	- Useful for professional development; - creates learning environment; - supports collaborative learning and resource sharing; - facilitates access to digital teaching tools;

However, in the scope of our study, there are also articles addressing the impact of technologies on the teaching process [57]. Among these technologies, mobile devices are particularly prevalent and favored by students. This preference makes it easier to engage them in learning through mobile games. According to the benefits highlighted in the table, mobile games are especially effective in expanding specific vocabulary. On the whole, students generally respond positively [50] to lessons that incorporate digital resources, as these tools significantly enhance their collaboration and communication skills [52]. Furthermore, there are specialized platforms designed to support teacher education [56], ensuring that educators are equipped to meet the needs of the 21st-century Generation.

4.2. Collaborative and Assessment Platforms

According to **Table 2**, in ESP classrooms, Instagram stands out as one of the most popular social networking systems. Given that technology is an integral part of young people's lives, they struggle to imagine life without it. Integrating such technologies into the learning process is a strategic choice.

Table 2. Digital resources in ESP context.

Instrument	Study	Design	Main Findings
Moodle Elgg, Moodle's social learning platform, Google Drive, Docs and Hangouts	Evaluating the use of groupware technologies in support of collaborative learning in an ESP tertiary education course [58]	Statistical analysis of Google drive and Moodle Elgg platforms to determine efficiency.	- Google Drive preferred over Moodle and Elgg due to better usability and efficiency; - Google Drive is more effective for developing linguistic competencies; - Google Hangouts improve direct communication and facilitate flexible collaboration;
Facebook	Effect of using Facebook to assist English for business communication course instruction [46]	Mixed method with qualitative and quantitative approaches	- Improved Business Communication in English;. - peer assessment on Facebook enhanced professional knowledge and learning outcomes; - blended learning using Facebook boosted motivation and improved English proficiency; - students are highly satisfied;
Blogs, YouTube, LinkedIn, SlideShare	English for business: Student responses to language learning through social networking tools [59]	Case study (students collaborated in creating Web 2.0 tools and social networks)	- encouraged cooperation within the groups; - motivating for students; - learner-centered; - important for future business career;
Instagram and LinkedIn	Instagram and LinkedIn at the university: Two language learning scenarios in ESP courses [45]	The analysis of the students' language production with social networks	- useful for learning language in higher education;
Instagram	Teaching EMI and ESP in Instagram [60]	Conducted language training among ESP students and content instructors	- effective for language training; - proved to be agile teaching tool;
Quizlet learning platform	M-learning in teaching ESP: Case study of ecology students [61]	Case study (survey on mobile devices, observation, in-class discussion)	- supported personalized learning environment; - improved reading comprehension; - boosted satisfaction and motivated students in m-learning; - helped making up professional statements;
Google forms	The use of google forms as supplementary learning material for the ESP class [62]	The platform was used for various activities such as student self-assessment, peer assessment, quizzes, tests, surveys, lesson planning, data collection, and documenting personal development.	- improved student performance in specialized vocabulary and grammar; - save time, and improve student participation; - teacher can give immediate feedback; - may encourage cheating;

Research indicates that social networking sites (SNS) are particularly effective for higher education students, enhancing their motivation to learn a target language. Additionally, digital assessment tools simplify instructors' tasks by saving time and providing immediate feedback [62]. However, these technologies also present challenges, such as the potential for cheating [62], which can undermine the validity and reliability of assessments.

4.3. AI and Immersive Technologies

Artificial intelligence covers almost every sphere, including education [63]. The applications of AI in teaching and learning are extensive. According to Crompton and Burke [64], there has been a surge in interest regarding AI's role in education over the last five years; however, the articles in the scope of our study indicate that the last two years have seen a significant increase in studies focusing on AI in ESP education. **Table 3** shows that AI technologies are beneficial in education, particularly for data interpretation, and tools like ChatGPT and VR have proven to be time-saving for written assignments.

Table 3. AI and immersive technologies in ESP context.

Instrument	Study	Design	Main Findings
ChatGPT	Use of ChatGPT in ESP Teaching Process [65]	Use of ChatGPT as a tool for teaching ESP	- saves time in preparing assignments; - effective in evaluating written tasks;
Internet of Things (IoT), Robotics and AI (approached through ML)	Integration of artificial intelligence in stem education through IOT projects based on machine learning [66]	Method of approaching and implementing	- revolutionizes data interpretation; - IoT systems advance towards intelligent, autonomous entities with adaptive learning; - Revolutionize decision-making and predictive capabilities;
VR application Dreams of Dali	Introducing Dreams of Dali in a Tertiary Education ESP Course: Technological and Pedagogical Implementations [67]	Propose meaningful ways the VR application Dreams of Dali can be embedded	- increase familiarization with course-related content in English for Fine Arts; - help simulate an authentic surrealistic environment; - help simulate passive surrealist representations of the art movement;
VR device	An Experiential Learning-Based Virtual Reality Approach to Foster Students' Vocabulary Acquisition and Learning Engagement in English for Geography [68]	Experiential learning-based VR approach	- supported students learning in an iterative cycle of "experience-reflect-discuss"; - facilitated learners' vocabulary acquisition; - strongly activated their long-term memory and facilitated a deeper learning experience;

Virtual reality technologies offer a deeply immersive interaction with a virtual environment [69]. Although VR's popularity in education is growing, our review only included two articles on this topic. These studies demonstrate that immersive technologies enhance vocabulary learning by creating authentic, surrealistic environments within the classroom.

The findings of our bibliometric analysis provide a current overview of the state of ESP in education. The resulting framework demonstrates the dynamic interplay between AI and technology integration in educational contexts, offering beneficial insights for both scholars and practitioners. The increased popularity of AI and digital technologies as a transformative tool that can modify teaching and learning methods to the changing needs of the 21st-century learners is highlighted by this study.

A thorough examination of research directions in the framework of the ESP field demonstrates that learning technologies are transforming pedagogical approaches. There is an abundance of potential for study and innovation at the intersection of ESP and emerging learning technologies. In order to improve ESP pedagogy, researchers should concen-

trate on longitudinal studies, look into cutting-edge technologies like artificial intelligence, and address social, moral, and multimodal issues as the field evolves. Future research can support a more sophisticated and successful integration of innovation in specialized language teaching by embracing these directions.

5. Limitations

A limitation of this study is the selection of only one database, Scopus, for collecting literature. This method was chosen to prevent potential formatting issues that could occur with data from multiple sources. However, this approach limits the study to English-language papers from Scopus, excluding relevant literature from other databases and in other languages. Future research might overcome this limitation by integrating data from various databases and considering literature in multiple languages. Furthermore, other indicators, such as content analysis, research methods, and data analysis, can also be used to enrich the data analysis results.

6. Conclusion

This work focused on ESP in education worldwide, research hotspots, and possible research directions from 1991 to 2023 using bibliometric approaches based on the online Scopus database. In this bibliometric analysis, we have collected, reviewed, and analyzed 843 publications. Results showed that China, the USA, and Russia are among the top countries to which authors who publish about ESP are affiliated. During the stable growth phase of the period, there was a steady rise in publications related to ESP. Throughout both the slight growth and stable growth phases, there was a prominent emphasis on ICT skills and learner autonomy. Our research pays particular attention to the post-COVID-19 period, where we observed a notable rise in the frequency of topics such as the utilization of digital technologies, collaborative and assessment platforms, and AI and Immersive technologies. This period is viewed as a silver lining of the pandemic, despite the numerous challenges it presented across various sectors. The increased frequency of research on the three key topics in ESP is expected to contribute to the effective development of ESP in education. By exploring digital learning methods and technological innovations, this research aims to enhance ESP practices for future educational challenges. The findings from this study offer new insights into the ongoing topic of ESP in education. They provide a critical and up-to-date overview and offer further future research perspectives for ESP teachers and researchers involved in the area of English language teaching and learning.

Further Research studies could examine the distinct learning characteristics of several generational groups, including Generation Z, Millennials, and Generation Alpha. Specifically, investigating the needs and preferences of learners in different generations for ESP acquisition, long-term effects of technologies and AI-driven [74] tools will help in creating more personalized and efficient ESP curricula.

Author Contributions

Conceptualization, A.E.; methodology, G.S. and K.A..; validation, M.A.; resources Z.U., B.A., and S.E.; supervision, Z.K. All authors contributed significantly to the development of the research concept. All authors have read and agreed to the published version of the manuscript.

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Confict of Interest

The authors declare that they have no conflict of interest.

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