

Teaching Tools to Improve Knowledge in Secondary Education: Bibliometric Trends in Scopus

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Abstract. The present study aimed to analyze the bibliometric trends in Scopus on didactic tools to improve knowledge in secondary education, from 2007-2024. The methodology used was bibliometrics to quantify the amount of scientific literature on this topic. Eighty-seven publications in Scopus, which met the inclusion criteria and key words in English (*Teaching tools and Knowledge*), were chosen for inclusion in the research. A considerable increase in scientific production was observed between 2015 and 2024 ($n=76$; 87.4%), with Spain being the country with the highest research contribution (12.1%). In addition, Education and Information Technologies was the most important source, accounting for 4 publications. The most cited author was Yunus, with 60 citations. In addition, most of the publications (84%) were scientific articles, with 40% focused on social sciences and 13% focused on psychology. It is concluded that the literature on didactic tools for improving knowledge in secondary education has been the subject of research, with a wide range of collaborations between different authors, contributing countries, new topics and high-impact sources. Finally, this bibliometric assessment provides a theoretical and documentary basis for future research.

1. INTRODUCTION

Secondary education faces constant challenges in the search for effective methods to improve student learning (Cóndor et al., 2023; Delgado & Zambrano, 2021; Roca-Castro, 2022). In this context, didactic tools play a crucial role, as they allow teachers to enrich their pedagogical practices and facilitate the understanding of content (Da Silva et al., 2022; Pincay et al., 2023). Likewise, with increasing digitization and access to educational resources, it is essential to analyze current trends in the use of these tools, especially through academic platforms, which offer a broad and quantitative view of scientific production in the area (Jiménez et al., 2022; Román et al., 2023).

In that order of ideas, didactic tools encompass a wide range of resources, from printed materials to advanced digital technologies (Romo et al., 2023; Quispe & Nieto, 2024). In the digital realm, online learning platforms, educational applications and virtual environments offer unique opportunities for interaction and collaboration between students and teachers (Peralta et al., 2022; Guzzetti, 2020). These technologies allow educators to diversify their methodologies, facilitating the implementation of strategies such as project-based learning, collaborative learning and the use of multimedia resources, which contributes to maintaining student interest and motivation (Orellana et al., 2022; Ruiz, 2024; López, 2021).

Likewise, the incorporation of didactic tools also fosters the development of key competencies, such as critical thinking, problem solving and creativity (Bracho et al., 2023; Román-Mireles & Mora-Barajas, 2022). By providing students with practical and relevant learning experiences, they are encouraged to actively participate in their education, developing skills that will be essential in the world of work and in their daily lives (Mero-Ponce, 2021; Valeriano, 2021). This proactive approach to learning not only improves understanding of content, but also strengthens young people's autonomy and confidence (Romero-Carazas et al., 2023; Mondalga, 2024).

In this context, there have been significant challenges with student motivation, academic achievement, and the effectiveness of pedagogical approaches in secondary education (Miranda & Choez, 2024; Egas et al., 2023). According to several studies, they highlight those conventional instructional methods that mainly involve passive delivery of knowledge have not been effective in fostering meaningful learning (Berrones et al., 2023; Parra & Mejía, 2022). In this sense, the incorporation of didactic instructional methods that foster critical thinking, active participation, and the application of knowledge in real-world contexts has become increasingly popular (Lema-Paucar & Calle-García, 2021).

Likewise, students' understanding of difficult ideas and their level of motivation to study can improve with the use of tools such as concept maps (Quezada et al., 2025), interactive digital platforms (Ayauca et al., 2024) and project-based learning (Hernández et al., 2023), according to multiple studies. However, despite the progress achieved, there are still gaps in the implementation of these tools and in the evaluation of their effectiveness in secondary education, especially in schools with scarce resources (Valbuena & Alvarado, 2020; Velarde, 2020).

In addition, the critical capacity of secondary school students has been limited by the prevalence of outdated or traditional teaching techniques, along with the lack of teacher training in creative strategies (Guerrero, 2022; Guzmán & Perales, 2023). Also, many educators are unprepared or too busy to make good use of teaching resources, which hinders student learning (López et al., 2023; Nicolae & Laguna, 2022). This leads to a disconnect between the teaching methods used in schools and the skills students need to succeed in the modern world, including the ability to think critically, solve problems independently, and apply

collaborative work effectively (Jorda et al., 2023; Herrera & Espinosa, 2024).

In this sense, in the last decade there has been an increase in the number of research on didactic tools to improve knowledge in secondary education (Monteza, 2022; Benítez et al., 2023; Monteza, 2022). Therefore, based on the review of the existing literature, we seek to examine publications and articles indexed in Scopus, to identify patterns in the research, as well as the most relevant thematic areas and methodologies that have proven to be effective, in addition to the gaps that exist in the literature that could be explored by future researchers (Peralta et al., 2023; Rivera, 2024). To determine which publications have had the greatest impact and to track the growth of human knowledge, the bibliometric study examines various forms of written content, such as books and articles (Caló, 2022; Leyva et al., 2022).

Therefore, it is vital to have a reliable method of collecting information so that the databases can adequately assist in the study of the historical context (Sanz, 2022). To this end, bibliometric indicators should be used, i.e., a set of metrics to quantify the amount of material written on a given topic or set of related topics (García-Villar & García-Santos, 2021; Llerena & Arévalo, 2021).

Similarly, a bibliometric framework is necessary for the collection of information on didactic tools to improve knowledge in secondary education. Throughout the review process, the following indicators will be taken into account: year of publication, country of origin, subject matter, type of file, affiliations, sources and authors. Based on this premise, the aim of the study is to analyze the bibliometric trends in Scopus on didactic tools for improving knowledge in secondary education, from 2007-2024.

In addition to identifying and systematizing effective didactic tools for the improvement of learning in secondary education, this research contributes to the field of education through a bibliometric study that allows the analysis of trends, gaps and evolution of scientific production on the subject. Through the examination of the academic database (Scopus), the most commonly used methods, the most common environment, the tools with the most empirical support, the countries with the most papers in the area and the network of collaboration of authors and institutions are revealed. With the help of this bibliometric method, an up-to-date and critical picture of the current state of the literature can be obtained, which in turn enables effective teaching tactics to be chosen and evidence-based suggestions to be made. Thus, the study provides a scholarly resource that can be used by academics and educators.

2. METHODOLOGY

A bibliometric analysis of the present dataset, which refers to didactic tools to improve knowledge in education, was performed. Thus, bibliometrics played an important role in facilitating the research data collection (Salinas and Garcia, 2022). The search also took into account the distinctiveness of the topic, in addition, an important database that gathers and evaluates academic publications on a global scale, such as Scopus, was analyzed.

Likewise, Boolean search terms such as: teaching AND tools AND knowledge were used, where 121 academic publications were chosen to define the topic of the research. Once all the data were filtered and collected, a total of 87 publications were selected for the study. In addition, the exclusion criteria for publications were as follows: (1) study conducted before 2007 or after 2024; (2) publications that were identical to each other; and (3) research that had nothing to do with the present research.

On the other hand, to understand the global influence of research on didactic tools for improving knowledge in secondary education, 87 publications were reviewed. For this purpose, the following were considered: year of publication, authors, sources or journals, country of origin, type of file, academic area and institutional affiliations (Florez-Fernández & Aguilera-Eguía, 2020). Data processing and analysis was performed in Excel with emphasis on descriptive statistics and count data. In addition, the keyword co-occurrence map was also created using VOSviewer V_1.6.19.

3. RESULTS

In this bibliometric study, articles published in journals or other sources between 2007 and 2024 were considered. In this research, 87 academic papers on didactic tools for improving knowledge in secondary education were chosen. Accordingly, Figure 1 shows the most recent papers from around the world included in the Scopus database. According to the statistics, 76 scientific papers were published between 2015 and 2024, representing 87.4% of the total publication.

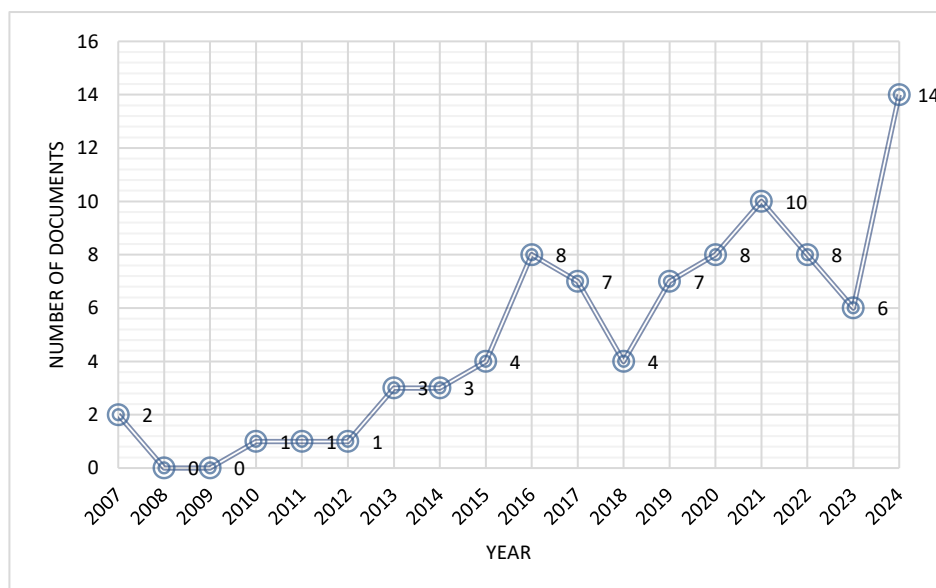


Figure 1: Documents published by year.

Articles from 41 different nations were published in academic journals. Figure 2 shows that, of the top ten countries in terms

of scientific production, Spain is the one with the most research, with thirteen studies (12.1%). With 10 publications (9.3%), the United States is in second position, followed by Australia with 9 publications (8.4%). Likewise, 75.9% of the academic articles were published in English, 19.5% in Spanish and 4.6% in Portuguese.

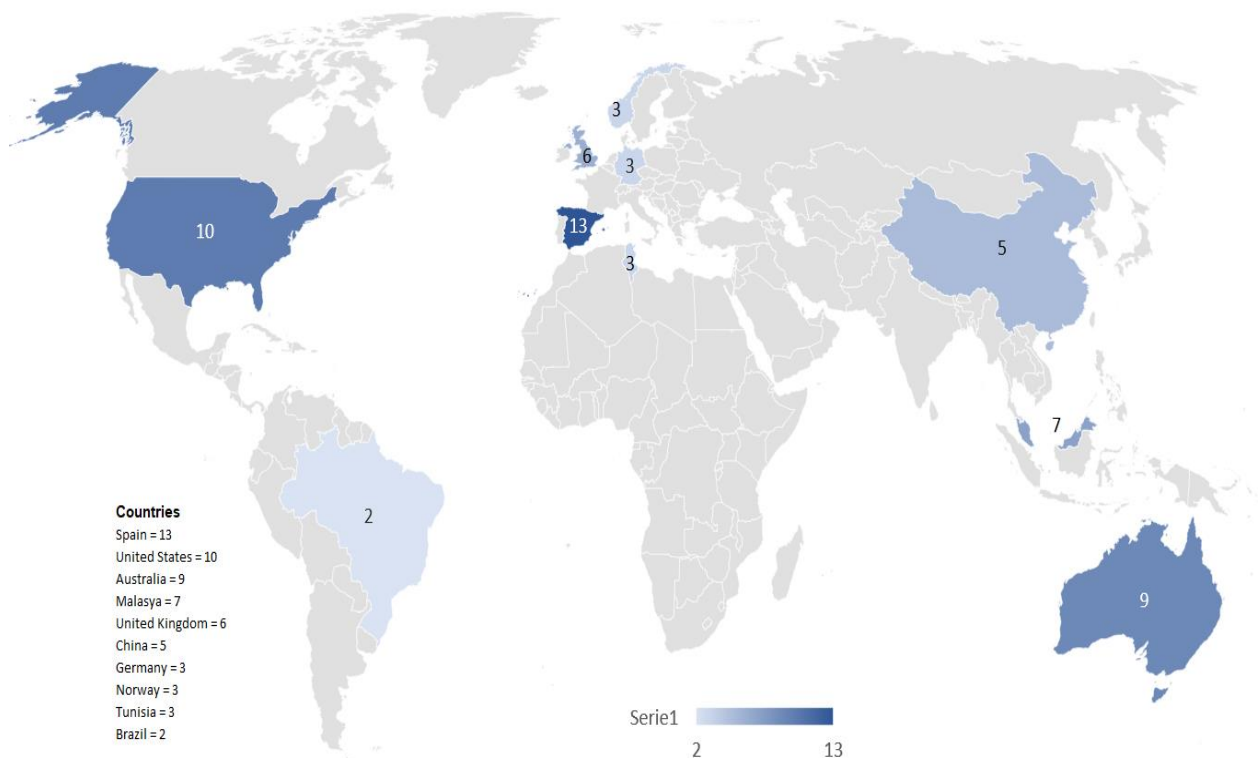


Figure 2: Publication of documents by country.

In addition, seventy academic sources were consulted in this evaluation. In reviewing the most outstanding works in this area, a list of the top ten journals by number of citations was drawn up (Table 1). To begin with, Education and Information Technologies and Lecture Notes in Educational Technology were the two most outstanding journals in terms of scientific production, with four and three publications, respectively. Likewise, the most cited journal during the entire research period was Computers and Education, with an impact factor of 3.651 and 112 citations of published papers. As an additional fact, the vast majority of the journals are in the top quartile. Furthermore, with a weighting of 240, the American Journal of Kidney Diseases obtained the highest H-index.

Table 1: Publication of documents by source or journal.

Source or magazine	Number of documents	Quotations	Impact Factor	Quartile	H-index	Country
Education and information technologies	4	35	1.301	Q1	76	United States
Lecture notes in educational technology	3	3	0.397	Q4	19	Switzerland
BMJ open	2	4	0.971	Q1	160	United Kingdom
Computers and education	2	112	3.651	Q1	232	United Kingdom
Eurasia journal of mathematics science and technology education	2	55	0.451	Q2	56	Turkey
Heliyon	2	62	0.617	Q1	88	Netherlands
Sustainability Switzerland	2	14	0.672	Q1	169	Switzerland
Advanced science letters	1	2	0.126	Q3	32	United States
American journal of kidney diseases	1	108	3.096	Q1	240	United States
American journal of obstetrics and gynecology	1	7	1.531	Q1	33	United States
Mfm						

The 87 academic papers were written by authors from more than 127 different faculties and institutions. Throughout the research period, Figure 3 shows the institutions with the highest number of scholarly publications. Among them are: Universiti Kebangsaan Malaysia (3), Research Laboratory of Technologies of Information and Communication and Electrical Engineering LaTICE (2) and Universitat de València (2), among others.

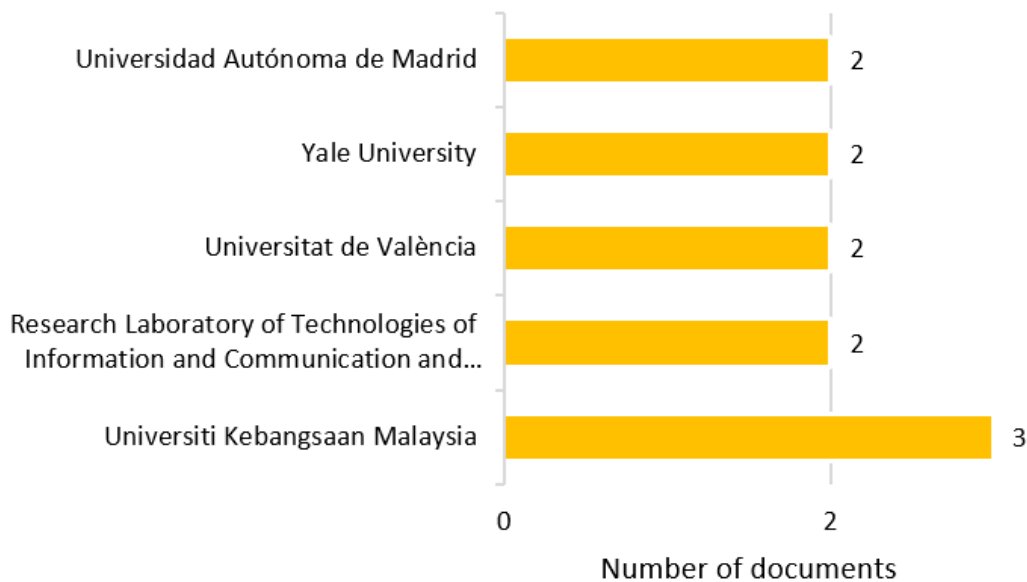


Figure 3: Documents published by institution.

The selected academic publications included papers written by 142 different authors. Among all authors, Yunus, M.M. has the highest number of citations (60) according to Table 2. Ramoo, V. had 38 citations in two publications. While Abu, H. and Ahmed, K. tied in third position with one publication and twenty-eight citations each.

Table 2: Published papers by author.

By author	Quantity	Total citations	By author	Quantity	Total citations
Besbes, R.	3	3	Ahmed, K.	1	28
Ramoo, V.	2	38	Alexander, A.	1	1
Yunus, M.M.	2	60	Almeida, L.P.C.	1	1
Abass, Q.	1	1	Alotaibi, J.S.	1	12
Abdullah, K.L.	1	10	Alsina, P.J.	1	0
Abdullah, W.I.W.	1	2	Altun, A.	1	19
Abella-Garcia, V.	1	1	Arif, F.	1	1
Abu, H.	1	28	Ariza-Cardiel, G.	1	12

Figure 4 shows a review of studies on didactic tools for improving knowledge in secondary education from 2007 to 2024. Recent research on this topic comes mainly from the social sciences (40%) and psychology (13%). Likewise, scientific articles account for 84% of the production, while book chapters account for 13% and books for 3%.

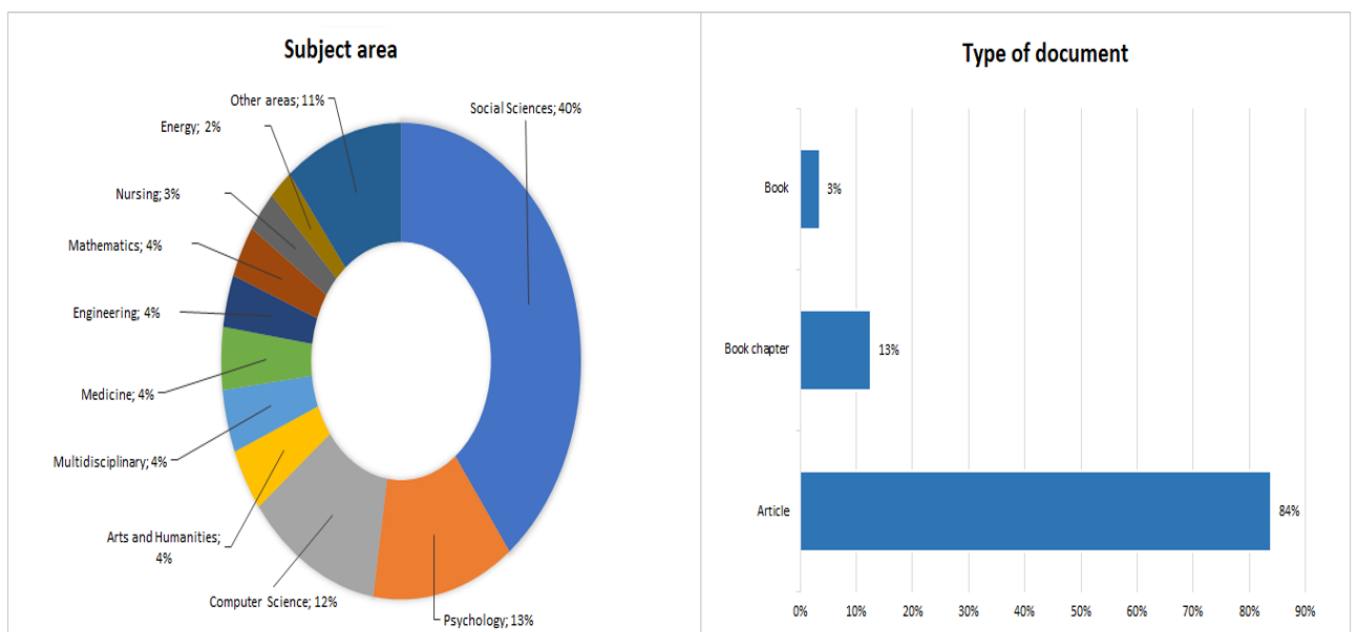


Figure 4: Publication of documents by thematic area and type.

On the other hand, Visual Object Sense (VOSviewer) is an alternative that allows viewing groups of related terms with a color code indicating how closely related they are. In this way, titles, abstracts and keyword lists are included, Figure 5 shows the word count of the articles studied.

- Green cluster. "teaching tools" (n=53 occurrences), groups the following words: motivation, students, knowledge, perception, sustainability, student, secondary education, learning systems.
 - Yellow cluster. "education" (n=47 occurrences), groups the following words: ICT, teacher training, secondary school.
 - red cluster. "controlled study" (n=38 occurrences), clusters the following words: quality of life, follow-up, health attitude, middle age, health literacy, randomized controlled trial.
 - Blue cluster. "learning" (n=26 occurrences), groups the following words: internet, prospective study, satisfaction, medical education, surveys and questionnaires, computer-assisted teaching.
 - Purple cluster. "education program" (n=18 occurrences), groups the following words: schools, children.
- Because of this classification system, most of the keywords in the study are directly applicable to the topic under investigation.

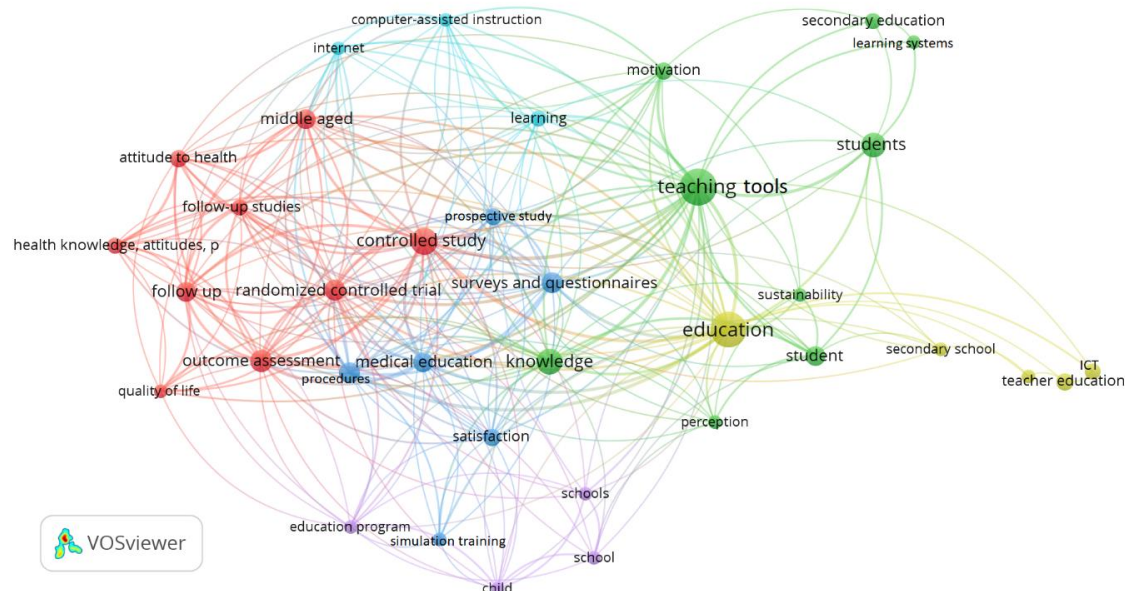


Figure 5: Map of keyword co-occurrence.

Source: Results in VOSviewer (2024).

4. DISCUSSION

The time period covered by this analysis is from 2007 to 2024, making a review of the literature worldwide. The data show that the highest number of publications scientific publications on this topic of didactic tools to improve knowledge in secondary education occurred between 2015 and 2024.

Theoretical advances in a wide range of disciplines, such as social sciences, arts, humanities, computer science and psychology, also add to the current importance of the topic. Studies such as Estrada and Bennasar (2021), who state that incorporating didactic activities through information and communication technologies (ICT) is a remarkable possibility at present, since this tool helps learning, knowledge improvement and real-time interaction between students and teachers. Similarly, Flores et al. (2021) agree that knowledge has the capacity to generate new interpretations and structures. As a result of these interpretations, emerging ideas and approaches emerge, in contexts that may be very different from those in which the knowledge base first emerged.

Likewise, in the research of Montero et al. (2024), they showed that including interactive content within the pedagogical approach can inspire students to learn and can serve as a model for other institutions to follow. This demonstrates that classrooms with interactive materials foster more engaged and relevant learning (Aguilar & Zambrano, 2022). Similarly, Mercado-López (2022), states that educators need professional development to master and effectively use information and communication technologies. In this way, they could improve, evaluate, foresee, inquire and assess pedagogical procedures (López, 2021; Valbuena et al., 2021).

For its part, the study by Tejada et al. (2021), highlights the value of didactics as an engaging resource that can be shaped by the individual efforts and imagination of students, fostering the growth of their creative abilities while facilitating collaboration and dialogue among classmates, and ultimately leading to an expansion of their collective body of knowledge through the application of a feedback mechanism. Likewise, Moronta (2024) suggests that the multidisciplinary approach contrasts with conventional teaching techniques that emphasize the passive transfer of knowledge, as it is based on constructivist ideas that encourage active learning through practice and problem solving.

In general, it is shown that bibliometric analysis on didactic tools to improve knowledge in secondary education has progressively boosted research in various fields, countries and languages (Pejman et al., 2023; Olson et al., 2021). The reason is that schools no longer focus solely on memorization, but encourage students to think critically and creatively, with the aim of helping them acquire skills such as analytical reasoning, emotional regulation, perceptual clarity and knowledge (Caro, 2021; Benítez & Glavinich, 2021).

5. CONCLUSION

In recent years, there has been an increase in the amount of research on didactic tools to improve knowledge in secondary education.

The analysis revealed that the total number of publications indexed by Scopus increased by 55.2% (n=48) between 2016 and 2024, with 2016, 2020, 2021, 2022 and 2024 standing out overall. On the other hand, Spain's production rate (12.1%) is the

highest of all the countries considered. In addition, 75.9% of the publications were written in English. Likewise, of all the authors mentioned, Yunus, M.M. had 60 citations. The most important source was the journal *Computers and Education*, which had two articles, one hundred and twelve citations and an impact factor of 3,651.

On the other hand, the institution that contributed the most publications was Universiti Kebangsaan Malaysia, with three articles. Of the total number of publications selected for the research, 84% were scientific articles; 40% were in the field of social sciences, and 13% in the field of psychology. In addition, the VOSviewer keyword analysis found 53 occurrences of the keyword "teaching tools".

The analysis of 87 academic articles reveals that didactic tools are crucial for improving the knowledge of secondary school students. It is concluded that, currently, a wide range of materials available on the topic of didactic tools to improve knowledge in secondary education have been developed, including collaborations between different authors, contributing countries, new topics, and high impact sources, these trends indicate that, in the near future, students will need to be able to think creatively and adapt quickly to drive academic success in education. Finally, this bibliometric assessment provides a theoretical and documentary basis for future research.

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