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**LEARNING STYLES IN HYBRID EDUCATION PROCESSES**

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**Abstract**

A documentary review was carried out on the production and publication of research papers related to the study of the variables Learning Styles and Hybrid Education. The purpose of the bibliometric analysis proposed in this paper was to know the main characteristics of the volume of publications registered in the Scopus database during the period 2016-2021, achieving the identification of 92 publications. The information provided by the said platform was organized through tables and figures, categorizing the information by Year of Publication, Country of Origin, Area of Knowledge and Type of Publication. Once these characteristics were described, the position of different authors regarding the proposed topic was referenced by applying qualitative analysis. Among the main findings of this research, it is found that the United States, with 26 publications, was the country with the highest scientific production registered in the name of authors affiliated with institutions of that country. The Knowledge Area that made the greatest contribution to the construction of bibliographic material referring to the study of the different learning styles in hybrid education processes was Computer Science with 49 published documents, and the type of publication that was most used during the above-mentioned period was the conference article, which represents 53% of the total scientific production.

**Keywords:** Learning Styles, Hybrid Education.

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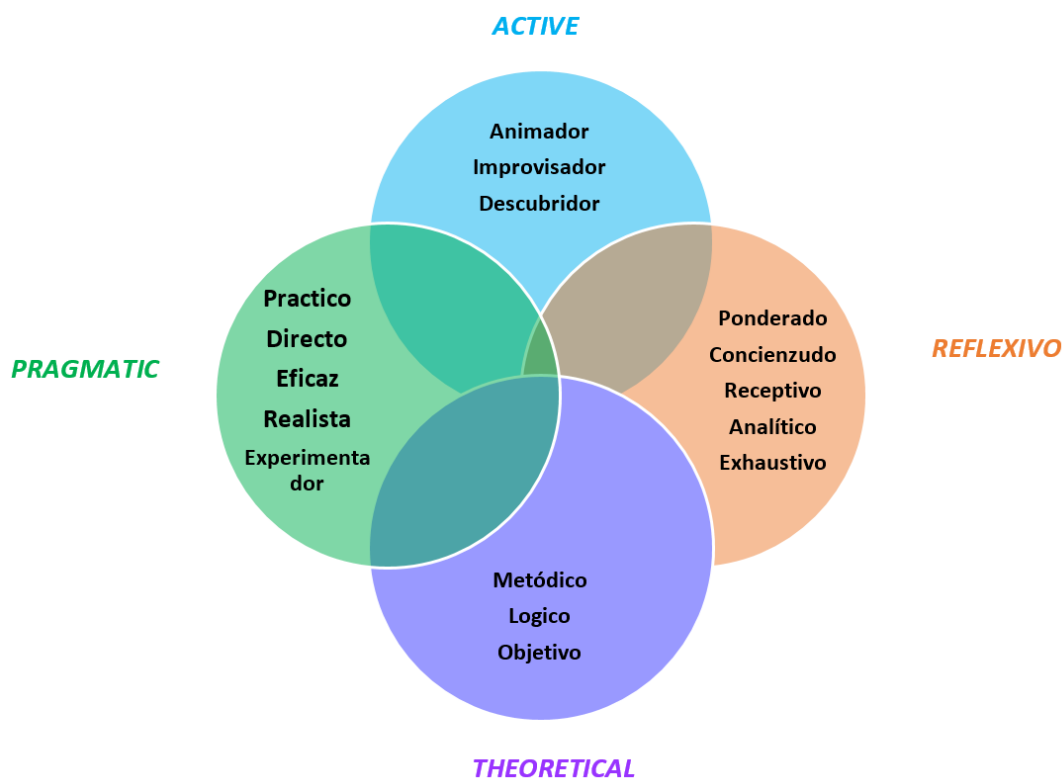
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## 1. Introduction

For Keffe (1988) "learning styles are the cognitive, affective and physiological traits that serve as relatively stable indicators of how students perceive interactions and respond to their learning environments"; cognitive traits refer to the way students transform perceived data, whether visual, auditory, kinesthetic, etc., into useful information for problem-solving, application of new knowledge to exercises recreated in the classroom, or applicable to everyday life. On the other hand, affective traits approach motivation and expectations that are a major influence on students, at the moment of taking advantage of the information provided to them. Similarly, preferences or affinities for certain areas of

knowledge influence, which determines the degree of absorption and attention to the information received. Finally, physiological traits refer to the physical characteristics of the individual, health conditions, dexterity, motor skills, and presence of disabilities, among others, that may affect the teaching-learning process.

There are different learning styles, which can be categorized as Active, Reflective, Theoretical and Pragmatic (Ahmed, 2010) (Figure 1) and which define the predominant characteristics of students, and it is there where the educator must identify the necessary strategies to involve these characteristics with methodologies capable of achieving a successful learning process in students.



**Figure 1.** Personal characteristics in learning styles.

**Source:** (Ahmed, 2010)

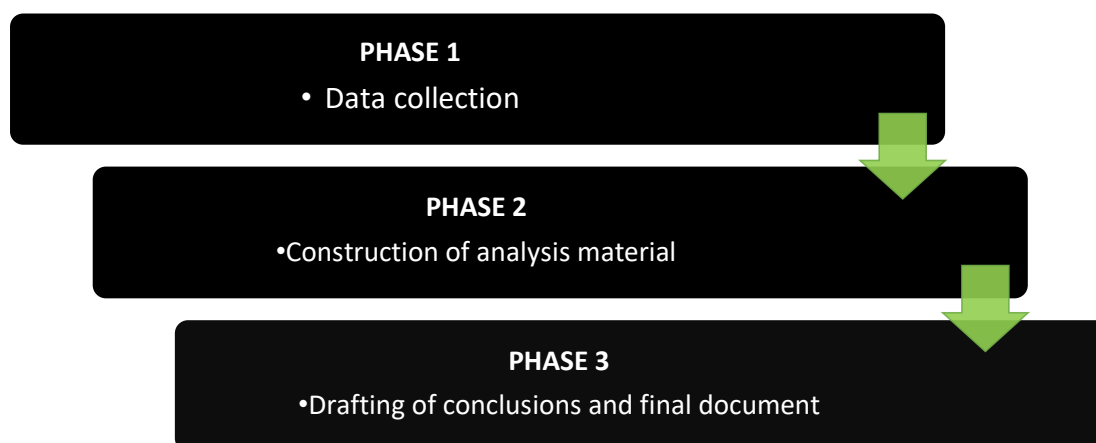
Educational models have evolved as society itself has evolved. Globalization has brought with it hundreds of thousands of new and better tools to carry out tasks in the minimum time with the minimum effort, to which the educational sector has not been oblivious. It has been proposed, through the

use of Information and Communication Technologies (ICT), the implementation of virtual strategies to expand the field of action of educational institutions and at the same time educating students and teachers according to technological advances that are useful and applicable to any aspect of

their lives. Virtual education was born as a response to the high demand from people who, for multiple reasons, have not been able to continue their academic training in person; therefore, at present, the hybrid model is proposed, to continue offering students the possibility of being trained in person in the institutions, but integrating this methodology with the use of technological tools. In the first instance, the hybrid model has to rely on technology, but focus on a pedagogical innovation that facilitates the same learning experience for remote students as those in the classroom (De Obesso & Nuñez, 2020).

Therefore, it is necessary to know which have been the most efficient strategies for the management of different learning styles in an environment marked by the growing proposal of a hybrid education model, which is why the development of this article has been proposed to answer the question: How has been the production and publication of research papers concerning the study of learning styles in hybrid education processes during the period 2016-2021?

### 3.1 Methodological design



**Figure 1.** Methodological design

Source: Own elaboration

#### 3.1.1 Fase 1: Data collection

The data collection was carried out through the Scopus web page search tool, through which a total of 92 publications were identified. For this purpose, search filters were established, consisting of:

## 2. General objective

To analyze from a bibliometric and bibliographic perspective, the production of research papers on the variable Learning Styles in Hybrid Education processes during the period 2016-2021.

## 3. Methodology

Quantitative analysis of the information provided by Scopus under a bibliometric approach on the scientific production related to the study of Learning Styles in the processes of Hybrid Education is carried out. Also, from a qualitative perspective, examples of some research papers published in the area of the study mentioned above are analyzed from a bibliographic approach to describe the position of different authors on the proposed topic.

The search is carried out through the tool provided by Scopus and the parameters referenced in Figure 1 are established.

- ✓ Published papers whose study variables are related to the study of Learning Styles in Hybrid Education processes.
- ✓ Without distinction of the country of origin

- ✓ Without distinction of area of knowledge.
- ✓ Without distinction of type of publication.

### 3.1.2 Phase 2: Construction of analysis material

The information identified in the previous phase is organized. The classification will be made using graphs, figures and tables based on data provided by Scopus.

- ✓ Word Co-occurrence.
- ✓ Year of publication
- ✓ Country of origin of the publication.
- ✓ Area of knowledge.

- ✓ Type of publication

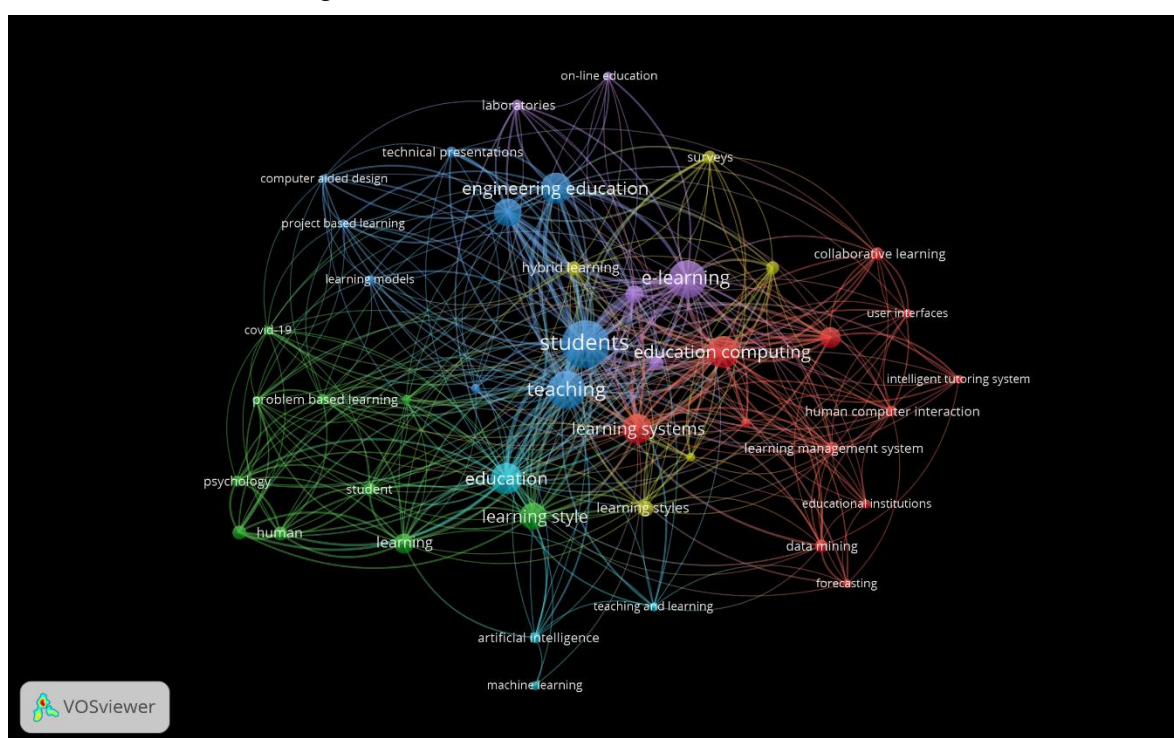
### 3.1.3 Phase 3: Drafting of conclusions and final document

After the analysis is carried out in the previous phase, the conclusions are drawn up and the final document is prepared.

## 4. Results

### 4.1 Co-occurrence of words

Figure 2 shows the co-occurrence of keywords within the publications identified in the Scopus database.



**Figure 2.** Co-occurrence of words

Source: Own elaboration (2022); based on data provided by Scopus.

Students and Teachers were the most frequently used keywords according to the publications identified through the execution of Phase 1 of the Methodological Design proposed for the development of this document, associated with research focused on Virtual Education, Classroom Education, Hybrid Education, Learning Styles, Online Learning, among others, which allows inferring that the set of

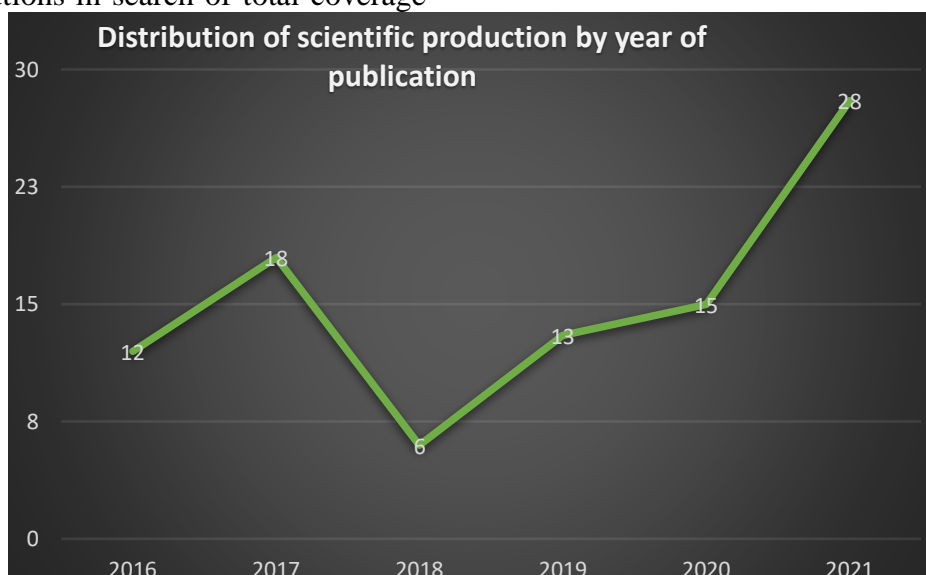
analyzed publications, comply with the minimum parameters to apply the bibliometric analysis methodology in compliance with the stated objective. The authors' interest in highlighting the different teaching methods and their application to the different types of learning, always seeking to meet the pedagogical objectives set by the educational management, is evident.

Collaborative Learning, Intelligent systems for Tutoring, Use of Interfaces, and Learning Management systems, are part of a whole set of strategies designed from the knowledge in ICTs to implement in educational institutions, and training programs under virtual methodologies, which can also be applied in the presentality giving way to the implementation of mixed techniques, or alternation expanding the field of action of the institutions in search of total coverage

to the population in the guarantee of their fundamental right to education.

#### 4.2 Distribution of scientific production by year of publication.

Figure 3 shows how the scientific production is distributed according to the year of publication, taking into account the period from 2016 to 2021.



**Figure 3.** Distribution of scientific production by year of publication.

**Source:** Own elaboration (2022); based on data provided by Scopus.

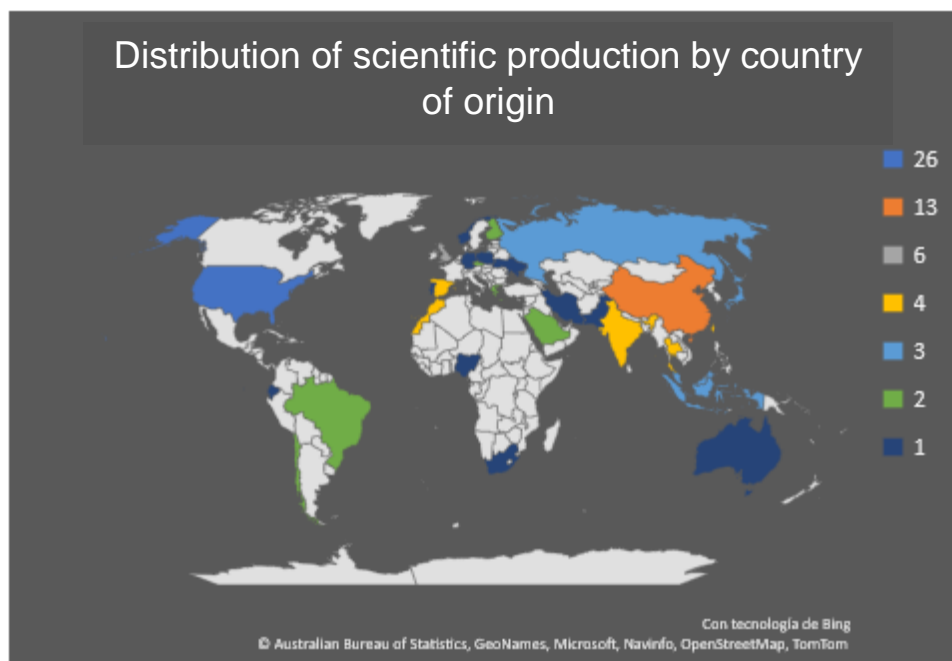
The scientific production related to the study of learning styles in hybrid education processes has fluctuated significantly during the years referenced in the previous figure, which is the main characteristic of its volume. On the other hand, taking into account the time window analyzed, and the absence of restriction in terms of countries of origin, a low volume of publications is determined where the lowest number was registered in 2018, the moment in which only 6 research papers were registered in Scopus, and the peak occurred in 2021 when 28 publications were carried out. The above is assumed as a response to the health crisis caused by the pandemic caused by Covid-19 in China, which forced educational institutions to implement virtual strategies to give continuity to the academic calendar in response to the social

distancing measures imposed by governments to reduce the number of infections and deaths from the disease. An example of the above was found in the article entitled "Useful teaching strategies in STEMM (Science, Technology, Engineering, Mathematics, and Medicine) education during the covid-19 pandemic" (Church et al., 2021) whose objective was to describe teaching strategies that could be adapted to most STEMM courses, regardless of classroom size, which is valuable for those educational environments capable of migrating from a classroom to a hybrid or strictly online teaching environment. The benefits identified by the study were listed as follows: (1) provide security and stability for students and instructors; (2) help improve teacher-student communications

that the pandemic had strained; (3) strengthen student attention; (4) ease the transition from classroom to online teaching; (5) enable the use of new technologies; and (6) offer teaching practices that we envision for post-SARS-CoV-2 educational settings.

### 4.3 Distribution of scientific production by country of origin.

Figure 4 shows how scientific production is distributed according to the country of origin of the institution to which the authors are affiliated.



**Figure 4.** Distribution of scientific production by country of origin.

**Source:** Own elaboration (2022); based on data provided by Scopus.

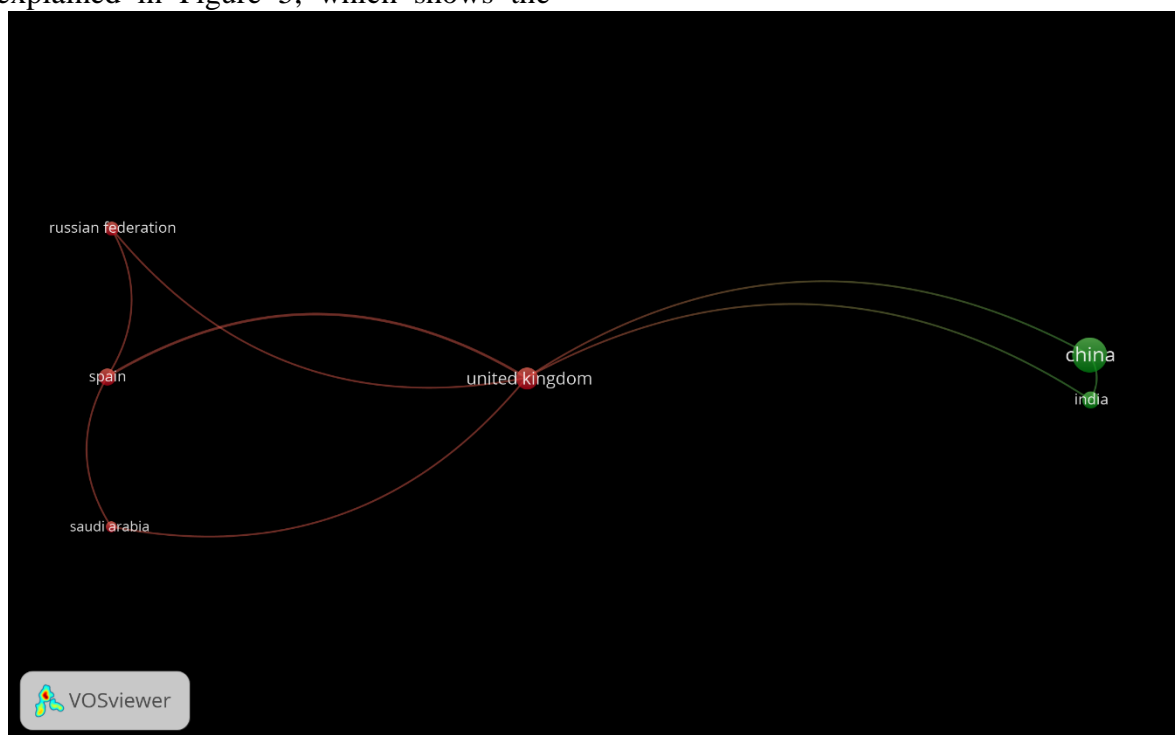
The United States was the country with the highest number of research papers published in high-impact journals indexed in the Scopus database during the period 2016-2021 with a total of 26 documents registered on this platform. In the second place, China with 13 papers, followed by the United Kingdom and India with 6 and 4 publications respectively. Brazil and Chile were the Latin American countries in the highest positions in terms of their volume of scientific production referring to the study of learning styles in hybrid education processes, occupying the 12th position with 2 documents registered in Scopus. Among these, the conference article published by authors affiliated with Brazilian institutions entitled "LSBCTR: a learning style-based recommendation algorithm" (Moraes et al., 2020), whose objective was to present a hybrid algorithm for the recommendation of Learning Objects directed to the learning

profiles of students, stood out. The article achieved the proposal of an algorithm that allows the identification of different teaching strategies according to the needs of each student, profiling their learning styles based on the Collaborative Topic Regression model, a hybrid recommendation algorithm that combines a Collaborative Filtering method and probabilistic modeling of topics.

At this point, it is worth noting that the production of scientific publications, when classified by country of origin, presents a special characteristic and that is the collaboration between authors with different affiliations to both public and private institutions, and these institutions can be from the same country or different nationalities so that the production of an article co-authored by different authors from different countries of origin allows

each of the countries to add up as a unit in the general publications. This is best explained in Figure 5, which shows the

flow of collaborative work from different countries.



**Figure 5.** Co-citations between countries.

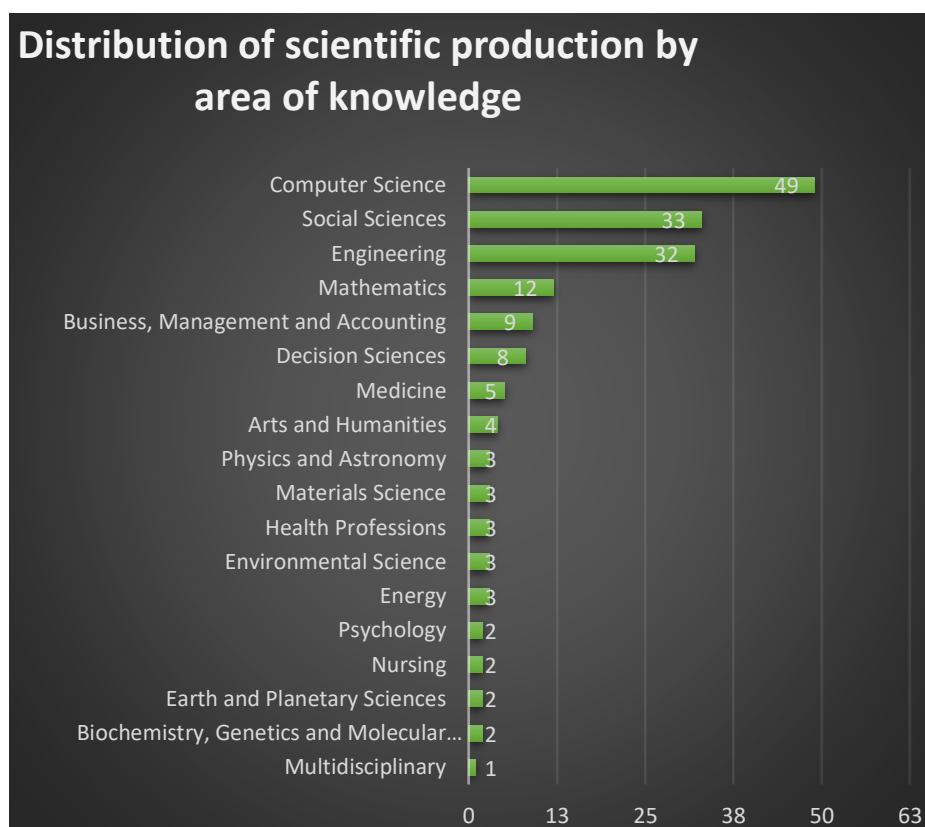
**Source:** Own elaboration (2022); based on data provided by Scopus.

The United Kingdom is the country with the highest number of international co-authored publications with researchers affiliated with institutions in Russia, Spain and Saudi Arabia. On the other hand, China and India also have publications in common. An example of the above in the article entitled "Extensive classification of visual arts paintings to improve the educational system using hybrid SVM-ANN with sparse metric learning based on kernel regression" (Xu, et al., 2021), which had the participation of authors affiliated

with institutions in China, India and the United Kingdom.

#### 4.4 Distribution of scientific production by area of knowledge

Figure 6 shows how the production of scientific publications is distributed according to the area of knowledge through which the different research methodologies are executed.



**Figure 6.** Distribution of scientific production by area of knowledge.

**Source:** Own elaboration (2022); based on data provided by Scopus.

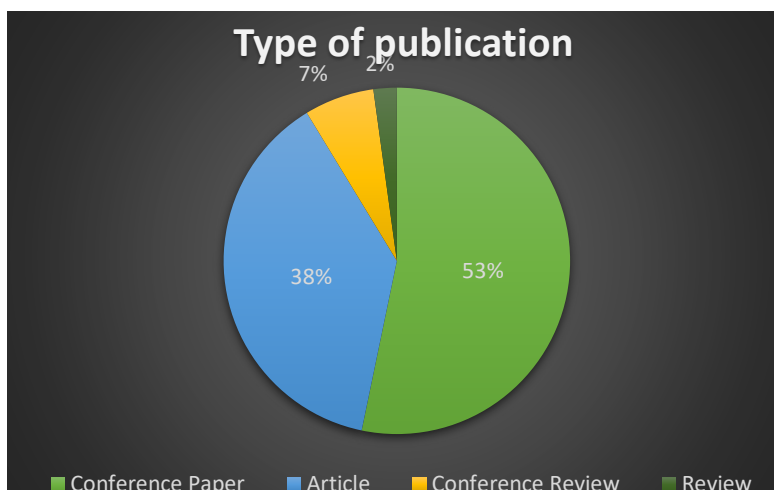
Computer Science was the area of knowledge that made the greatest contribution to research related to the study of different learning styles in hybrid education processes, understanding the importance and influence of any theory created around technological advances such as digital devices, virtual programs, tools designed for synchronous or asynchronous communication, among others. 49 research papers were published developing different methodologies based on this area. In the second place, Social Sciences with 33 publications, which allows inferring that the social impact generated by the implementation of policies for hybrid education as an efficient alternative in the search for the assurance of the Fundamental Right to education as a fundamental task of the states worldwide was also evaluated by the researchers. Engineering was likewise, one of the areas with the greatest contribution to scientific production, with a total of 32 papers, among which was the conference article entitled "Remote and

hybrid learning environments: a case for promoting student participation" (Sunny & Bucks, 2021) and whose objective was to explore student evaluation of the various participation strategies undertaken by faculty at the University of Cincinnati, a large urban Midwestern university, in a fully remote and hybrid first-year engineering design course. The study featured the design of two mechanisms for data collection which were (1) a faculty survey to identify engaging strategies and (2) a student survey to evaluate these strategies. From the above, only the record of certain student evaluations was achieved, but not the total results, since the purpose was to record the effectiveness and validity in the application of this type of instrument to measure the perception of the main stakeholders, against methodologies such as virtual or hybrid.



#### 4.5 Type of publication

Figure 7 shows how the bibliographic production is distributed according to the type of publication chosen by the authors.



**Figure 7.** Type of publication

**Source:** Own elaboration (2022); based on data provided by Scopus.

Conference articles were the type of publication most frequently used by authors and researchers when presenting their findings on the different learning styles in hybrid education processes, 53% of the total production corresponds to this methodology. In the second place, Journal Articles represented 38%, Conference Reviews 7% and lastly, Reviews with 2%. Within this last classification, the work entitled "A blended learning system to improve motivation, mood and satisfaction in university students: randomized controlled trial" (Lozano-Lozano et al., 2020) stands out, whose objective was to examine the short-term effects of a blended learning method using traditional materials plus a mobile application, the iPOT mobile learning application, on knowledge, motivation, mood, and satisfaction among undergraduate students enrolled in a first-degree program in health sciences. The researchers conducted the intervention on a group of students, to evaluate their perception of a methodology that combines the traditional teaching method with strategies based on technological tools, such as mobile devices, concluding that the blended learning method led to significant improvements in motivation, mood and

satisfaction compared to traditional teaching, and elicited statements of subjective improvement in terms of English proficiency.

#### 5. Conclusions

Thanks to the bibliometric analysis carried out in this document, it was possible to determine that the United States is the country with the largest number of scientific publications related to the study of learning styles in hybrid education processes with a total of 26 publications in high impact journals indexed in the Scopus database during the period 2016-2021. The above allows inferring that, on the part of the institutions of the North American country, there is an outstanding interest to know from the different learning styles the most effective tools or strategies when implementing academic plans in the training for the different levels, from preschool to postgraduate.

One of the main findings of this research is the evidence of the little active participation of educational institutions worldwide, in studies directly related to the analysis of learning styles in the processes of hybrid education, it is assumed in this way that

being a topic that is still in the testing stages in many institutions, there is still not enough material or evidence to launch theories about both variables. Thus, it is determined that, within the time window proposed for the development of this article, the year 2021 was the year during which the largest number of publications took place, a total of 28 documents were registered in Scopus, a significantly high figure if compared to that delivered by the year 2018 when only 8 were registered in the same platform.

The above can be explained thanks to the position of different authors cited, who stated in their studies that once the pandemic caused by Covid-19 was identified and the restriction policies to avoid contagion and death due to the same disease, educational institutions were forced to design virtual strategies to give continuity to academic training, however, once all activities have been gradually reestablished, methodologies based on the use of technological platforms and devices are still preserved as one of the main strategies by the educational management, to expand coverage as a guarantor of compliance with the Fundamental Right to Education, as well as the generation of innovative processes that provide competitiveness and quality in the training of all students at each academic level. Therefore, it is hoped that through articles such as the one presented in this document, the scientific community will become aware of the social, cultural, economic and other impacts of the implementation of strategies for mixed or hybrid education through the efficient identification of the different learning styles and that this information will constitute important raw material in the generation of new knowledge.

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