

# Environmental knowledge, attitudes and intentions - A bibliometric review

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## Abstract

This study presents a bibliometric review of environmental education, knowledge, attitudes, and behaviors. The analyzed documents are extracted from Scopus and Web of Science databases according to PRISMA methodology for classification, analysis and review. The final documents are analyzed in the VOSviewer software, focusing on identifying the main research areas, authors, institutions, countries, documents, and journals publishing on this topic. The results indicate that the countries that do the most research on this topic are the United States and China, that the main funding agency interested in these topics is the National Natural Science Foundation of China and the main journals that have published the most papers on the topic are Sustainability Switzerland followed by Journal of Cleaner Production, while the most productive authors are Bogner, F.X.; Collado, S. Han and H. Otto, S. The most cited countries are United States of America, China, United Kingdom, Australia, Spain and Germany, while the most cited institutions are Sejong University, University of Bayreuth, University Putra Malaysia and Hong Kong Polytechnic University.

## Keywords

Environmental knowledge, environmental attitudes, environmental behavior, pro-environmental behavior.

## 1. Introduction

Over time, human beings have become aware of the impact of their daily activities on the environment, so much so that the concept of environmental protection has become a goal and a standard of action for the private sector and governments (Bernal, 2013). However, awareness of environmental care is still insufficient, and the level of concern in the social organization is increasing. Therefore, short-, medium- and long-term actions are required, duly articulated, in which the acquired knowledge is applied, and new actions and protocols are investigated based on the advances in environmental knowledge. Wills, policies and needs have to be united to get there, and everything depends on the culture and education of the people involved (Díaz-Horna et al., 2022). Currently, a global effort has been made to advance environmental education (EE) as the axis of sustainable development in the world since sustainable behaviors must be established among populations in order to have a rapid and sustained impact on the actions taken by countries from their political frameworks of law and economics (Sandoval Escobar, 2012).

One of the main reasons for preparing a scientific article is the need to find information that is relevant and provides a good performance for the research being carried out (Calle, 2016). With the passage of time and exponential growth of information, it has led the scientific community to propose new research methods, thus giving rise to bibliometrics, which is made up of mathematical methods and statistical analysis to obtain dependable and quality indicators (Góngora Orjuela, 2010).

In this project, a bibliographical analysis of environmental knowledge, attitudes and intentions is conducted, through a systematic search for information in databases and analysis of success cases, it is worth mentioning that it is relevant, since in bibliographical research it is possible to obtain information. on the number of documents published by an institution, country, funding agency, authors or degrees from quality research groups, and a certain impact on society. Furthermore, systematic reviews are useful, as they can provide a synthesis of knowledge in an area, and future research priorities can be identified (Page et al., 2021).

This article is made up of three parts, the first being a brief introduction to environmental education, followed by a brief explanation of attitudes and intentions, in which projects published by various researchers and their intervention in society are mentioned. and environmental care. The second part constitutes the methodology used to search for information in the databases, as well as its analysis using the VOSviewer software. Finally, the results obtained during the bibliographic search and analysis are found, which are made up of the main research areas, the main funding agencies, the main authors, countries and institutions involved in the research, the main keywords used, the most cited and finally the most cited authors on the subject.

Currently, EE is a fundamental tool for all people to realize the importance of protecting the environment and, change their values, behaviors, lifestyles and expand their knowledge to encourage action through prevention and mitigation (Sierra et al., 2016). An EE must first be educational in nature to develop values, attitudes, actions, and behaviors, all aimed at caring for the environment. Therefore, educational systems should encourage it in their students, especially at higher levels, so that they develop a broader concept of what EE means since they are the ones who will work as professionals in the industry (Vargas Ramos et al., 2011).

The basis of the EE is environmental knowledge, which is defined by Frick et al. (2004) as a combination of knowledge related to the environment, ecosystem functions and problems, and behavioral options that together seek greater environmental benefits (López, 2006). However, this environmental knowledge does not come alone; it requires an attitude to acquire it.

Attitudes are ways an individual actively adapts to his environment and is the consequence of a cognitive, affective and behavioral process. Attitudes are the result of learning done when responding to stimuli and manifest in the form of a positive or negative tendency towards people, objects and situations (Casa et al., 2019). Thus, human beings have different attitudes towards the vast accumulation of symbols and objects that are treated daily or randomly, for example, attitudes towards abortion, politics, work, ethnicity, environment, etc. (Escalona & Boada, 2001).

Thus, environmental attitudes are people's response to the deterioration of the environment. Based on environmental knowledge, these environmental attitudes lead the individual to have an environmental behavior that protects the integrity of the earth's material and social resources (Corral-Verdugo et al., 2010).

The current trend is to generate environmental education in the classrooms of higher education institutions, whether universities or research centers, to raise awareness about the future leaders of the industrial sector. For this reason, it is important to know the perception that students and professionals have on environmental attitudes, the environmental knowledge acquired during their academic preparation, and their environmental behavior during their academic preparation and in their application in the field.

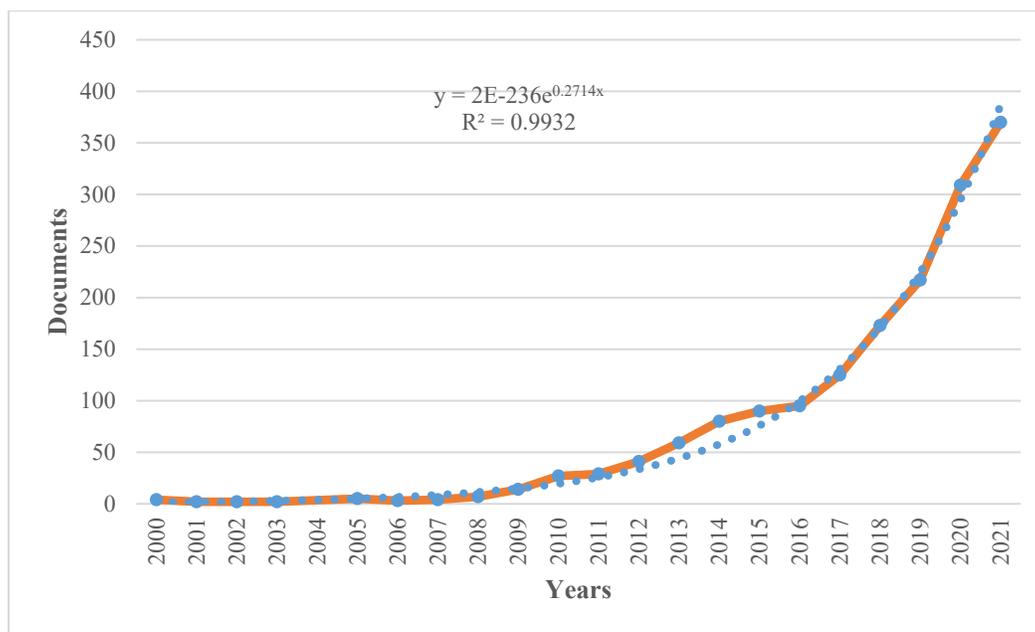
A review of the number of papers published on the variables involved in environmental education, such as environmental attitudes, environmental, behavioral intent, environmental knowledge and pro-environmental behavior, has shown an exponential growth in recent years, which is considered a topic of scientific and academic interest and deserves further study, as illustrated in Figure 1.

Given the importance of the subject, several questions arise, such as:

1. Where are the main research groups on this topic?
2. Where are these research groups located, and which institutions are the pioneers?
3. Which are the most productive and cited authors?
4. Which countries are supporting this type of research?

A bibliometric analysis on this topic is required to answer the above questions. Bibliometrics is essentially focused on calculating and analyzing quantifiable values on a specific topic and searching for statistically regular behaviors over time in the different elements of scientific information consumption (Ardanuy, 2012). In the words of Corrales-Reyes et al. (2018), a bibliometric analysis of scientific production is necessary to evaluate the topic's current state and the contributions of researchers and countries to the areas of knowledge allow orienting future lines of research toward specific fields.

There are bibliometric reviews about environmental education applied to elementary school students, the general population, students and professionals in administration, philosophy, or psychology, among others. For example, Ángel Baquero (2013) states that the first phase analyzes the articles published on environmental education, the second part analyzes the articles on environmental philosophy, and the third part analyzes the currents that derive from this line of information such as ecology, conservation biology, ecofeminism, among others.



**Figure 1.** Timeline for documents published in environmental education

Prosser Bravo and Romo-Medina (2019) also report a bibliometric review of 179 articles from the last 20 years in which the field of study of environmental education with minor students from Ibero-America is shown, identifying the main country of these studies as Spain.

The objective of this article is to report a bibliometric review on environmental education, which allows us to answer the questions that have been proposed above. The article is divided into four sections; the first section introduces the concepts of environmental education and the variables involved, such as environmental behavior, environmental knowledge, environmental attitudes and environmental behavior intentions. The second section shows the PRISMA methodology for identifying the bibliographic references and the VOSviewer software to illustrate their analysis. The third section reports the bibliometric results found, and finally, conclusions are presented in which the trends of this research topic are discussed.

## 2. Methods

### 2.1 Identification of references

The PRISMA 2020 (Preferred Reporting Items for Systematic reviews and Meta-Analyses) methodology is designed to evaluate systematic reviews of studies that evaluate interventions and items applicable to reviews with different objectives, which is why it is used in this article. Previously, the PRISMA 2009 statement was designed to improve the reporting of systematic reviews, and its recommendations have been endorsed by various journals and organizations (Ciapponi, 2021). Please see Figure 2.

The search of the documents is performed in the Scopus and Web of Science databases on March 18, 2022, and using the following search equation: (ALL ("environmental knowledge") AND ALL ("environmental attitude") AND ALL ("environmental behavior") AND ALL ("pro-environmental behavior")) AND (LIMIT-TO (LANGUAGE, "English") OR LIMIT-TO (LANGUAGE, "Spanish")) AND (EXCLUDE (PUBYEAR, 2022)). The above indicates that documents have been identified that have the following words in their content together: "environmental knowledge", "environmental attitude", "environmental behavior," and "pro-environmental behavior", which are documents written in English or Spanish language and the year 2022 has been excluded.

Each platform (Scopus and Web of Science) downloads a database for further analysis in RIS and CSV extensions. RIS files allow the integration of the two databases into one in Endnote software to identify repeated documents, while CSV files allow their bibliometric analysis.

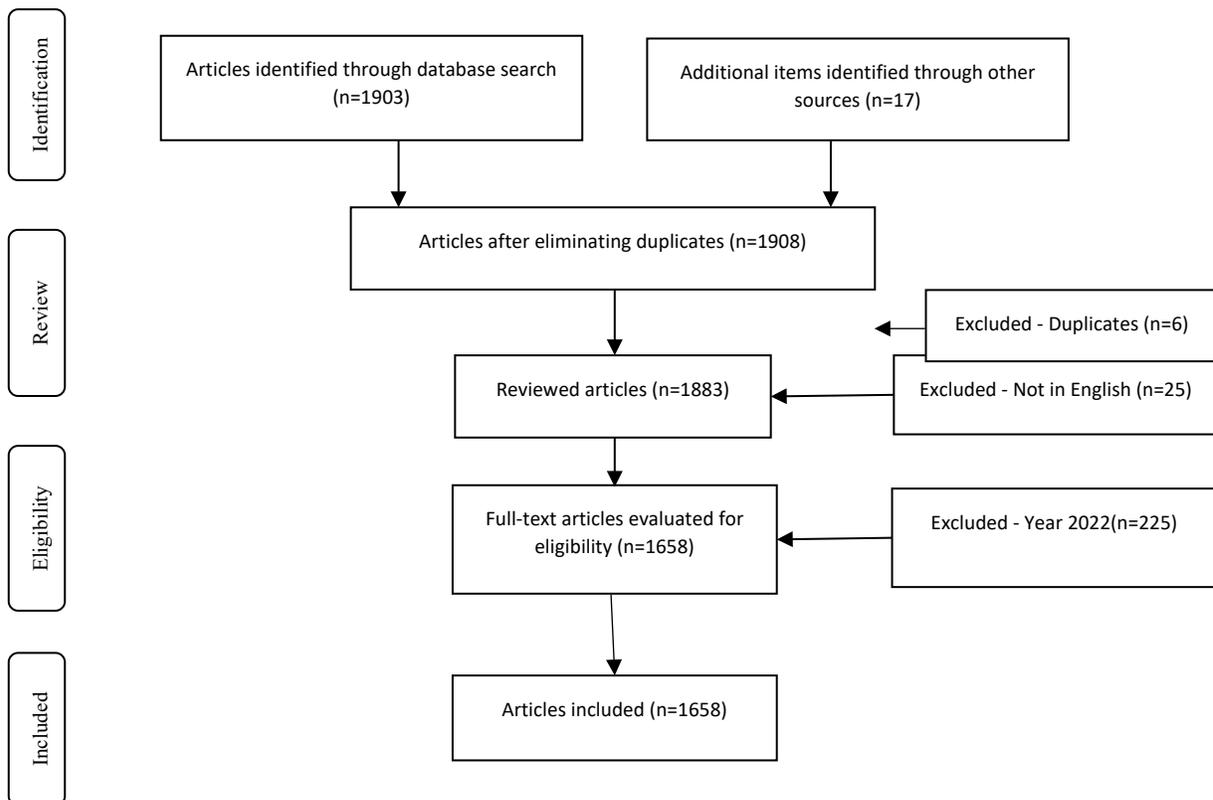


Figure 2. PRISMA Method

### 2.2 Reference analysis

The list of references downloaded from Scopus and Web of Science is analyzed in the software VOSviewer 1.6.18, which allows the analysis by creating visual maps with quantitative data. In addition, the program allows for examining through a viewer the bibliometric maps in detail (Van Eck & Waltman, 2010).

The main objective of the analysis focuses on identifying, analyzing and quantifying the scientific publications that mention topics related to environmental education, such as attitudes, intentions, knowledge and behavioral intention, identifying the publications based on this search. The above allows us to answer the questions initially posed.

### 3. Results

#### 3.1 Main types of documents

The type of papers that have been published about environmental attitudes, environmental knowledge, and pro-environmental behavior are 1490 (89.9%) articles, 55 (3.3%) reviews, 48 (2.9%) conference papers, 43 (2.6%) book chapters, 17 (1%) books and 5 others, being scientific articles the ones with the highest number of presences in the scientific world, showing that it is a topic of interest and that it is fully consolidated.

#### 3.2 Financing Agencies

A total of 159 financial institutions that provide financial support for this type of research were identified, with the National Natural Science Foundation of China being the institution with the largest number of contributions and a total of 72 until 2021, followed by the National Office for Philosophy and Social Science with 29 contributions, the Ministry of Education of the People's Republic of China with 28 contributions and the Fundamental Research Funds for the Central Universities with 26, to mention just a few. Figure 3 illustrates the distribution of these funding entities.

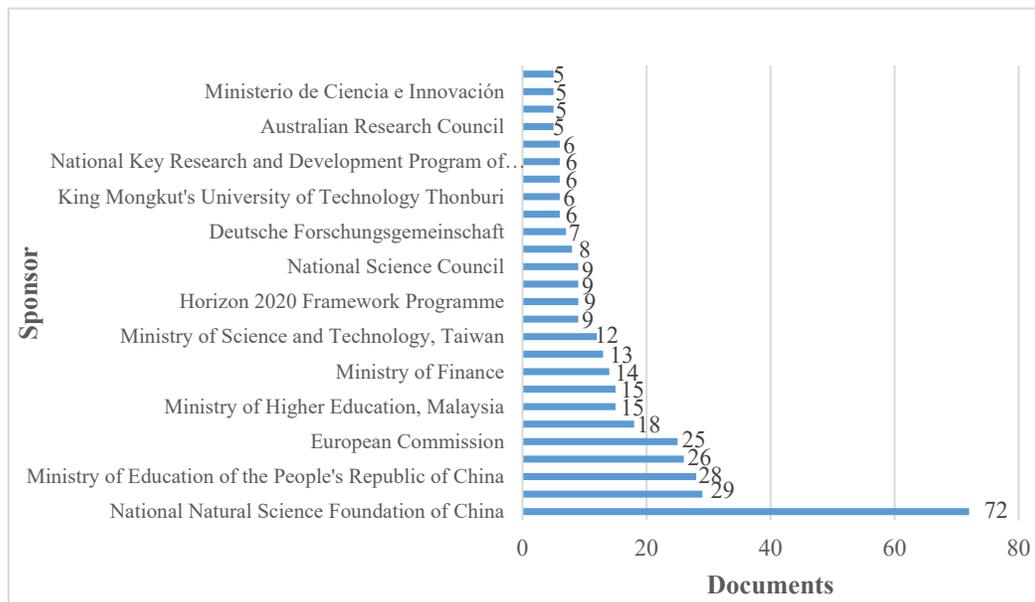


Figure 3. Documents by a funding agency

#### 3.3 Main authors, countries and institutions involved in the research

The analysis indicates that 160 authors have published on environmental knowledge, environmental attitudes, environmental behavior and environmental and behavioral intentions, as shown in Figure 4, where the relationship between authors and groups sharing publications can be seen. The authors with the highest number of papers are Bogner, F.X. with 13, Collado S. Han H. and Otto S with 12 papers, Boeve-de Pauw and Boyes with 10 papers. Table 1 shows the authors with more than five papers, and it is worth mentioning that 46 authors have 4 papers and 79 have three papers, which are not illustrated in the table.

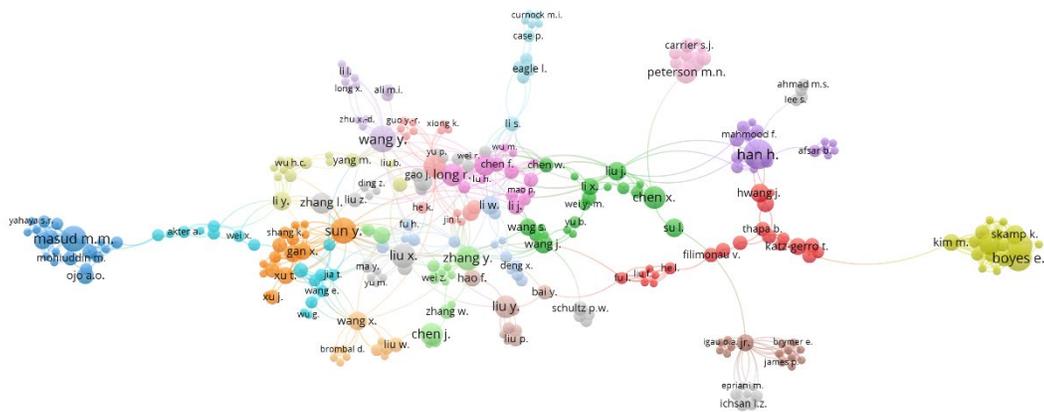


Figure 4. Authors

Table 1. Authors with more documents

Authors	Documents
Bogner, F.X.	13
Collado, S. Han, H. Otto, S.	12
Boeve-de Pauw, J. Boyes, E.	10
Cheung, L.T.O. Masud, M.M. Stanisstreet, M.	9
Fok, L. Lee, T.H. Liobikienė, G. Long, R.	7
Ardoin, N.M. Chen, H. Corral-Verdugo, V. Gericke, N. Jan, F.H. Janmaimool, P. Kaiser, F.G. Malandrakis, G. Quoquab, F. Rosa, C.D. Stevenson, K.T.	6
Hwang, J. Karpudewan, M. Neaman, A. Olsson, D. Sahin, E. Skamp, K. Su, L. Testa, F. Yu, T.K. Yu, T.Y Yusliza, M.Y. Yu.	5

A total of 99 countries are researching this topic; however, those with the highest number of publications are the following: the United States of America with 291 papers, China with 194 papers, Australia and the United Kingdom with 115 papers, Malaysia with 112 papers, Spain with 89 papers and India with 84 papers. Figure 5 shows the list of countries with documents published on these topics.

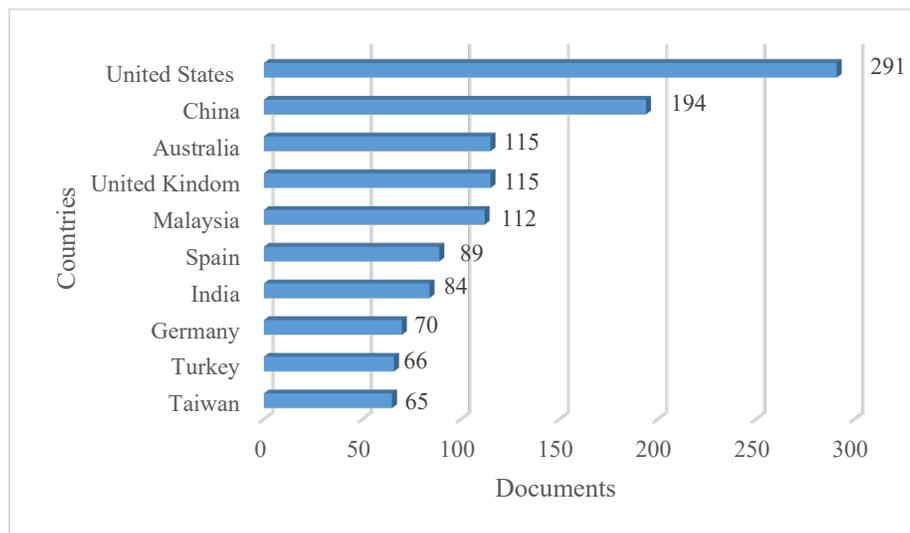
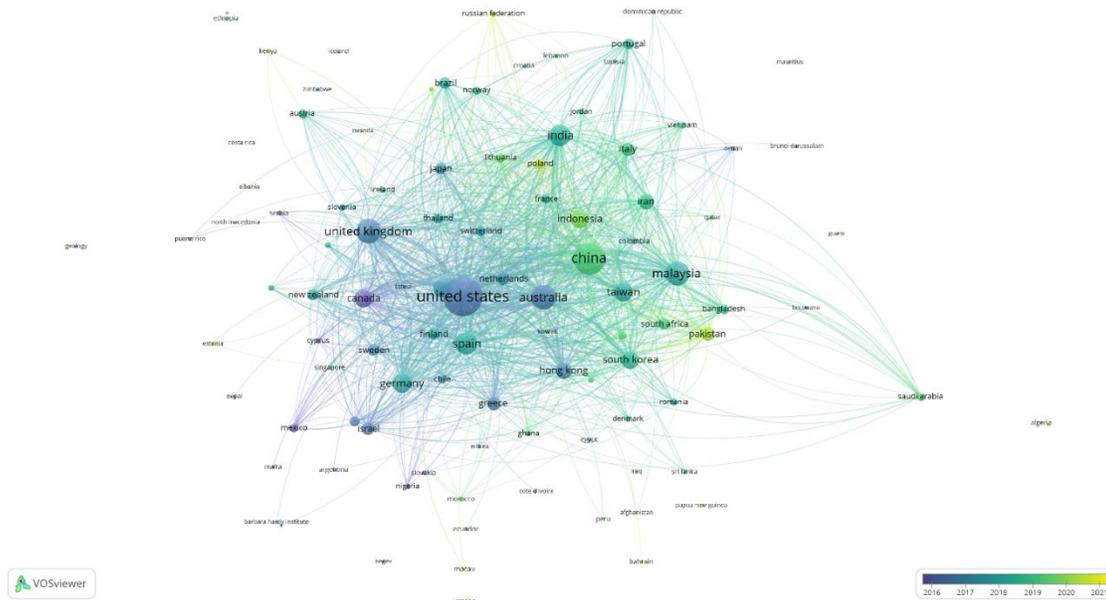


Figure 5. Documents by country

In addition, Figure 6 illustrates the relationships between countries and a color scale is used at the bottom to denote the level of maturity in this regard. It can be seen that the countries with more time researching these topics (blue color) are the United States of America, Canada and Australia, and those that have recently joined (yellow color) are Pakistan, Indonesia and Poland.



**Figure 6.** Relationship of Countries with a timeline

It is interesting to mention that China is a country that has recently begun to study this scientific phenomenon of environmental knowledge; however, it has been observed that its institutions are the ones that offer more financial support to this type of research and also occupy the second place in document production, so it is to be expected that soon this value will increase.

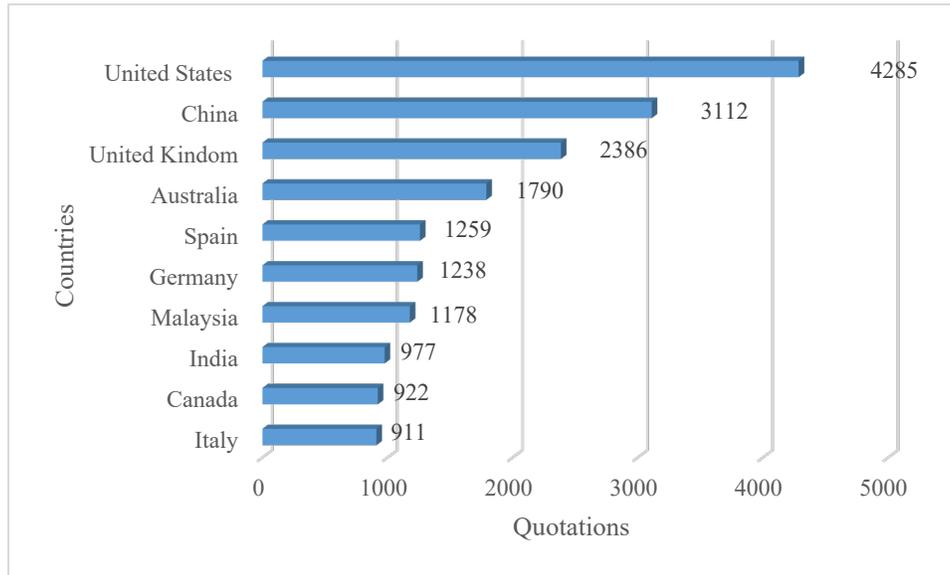
A total of 160 institutions have been detected, with at least 4 publications; the ones with the highest number of publications are University Sains Malaysia (USM) with 19 documents, followed by the University of Sejong in Seoul and the University of Malaya with 18 documents, the third place goes to the Otto von Guericke University of Magdeburg and the University of Zaragoza with 15 documents. Table 2 shows a list of the universities with the highest number of publications on these topics.

**Table 2.** Main institutions with publications

University	Documents
University Sains Malaysia	19
Sejong University, Malaysian University	18
University of Zaragoza, Otto von Guericke University of Magdeburg	15
The Education University of Hong Kong, Universität Bayreuth, China University of Mining and Technology	14
Hong Kong Polytechnic University, Universiteit Antwerpen	13
Chinese University of Hong Kong, Cornell University	12
Kyung Hee University, Middle East Technical University METU, NC State University, Chinese Academy of Sciences	11
The University of Hong Kong, Southern Cross University, University of Liverpool, Tarbiat Modares University, Vytautas Magnus university	10

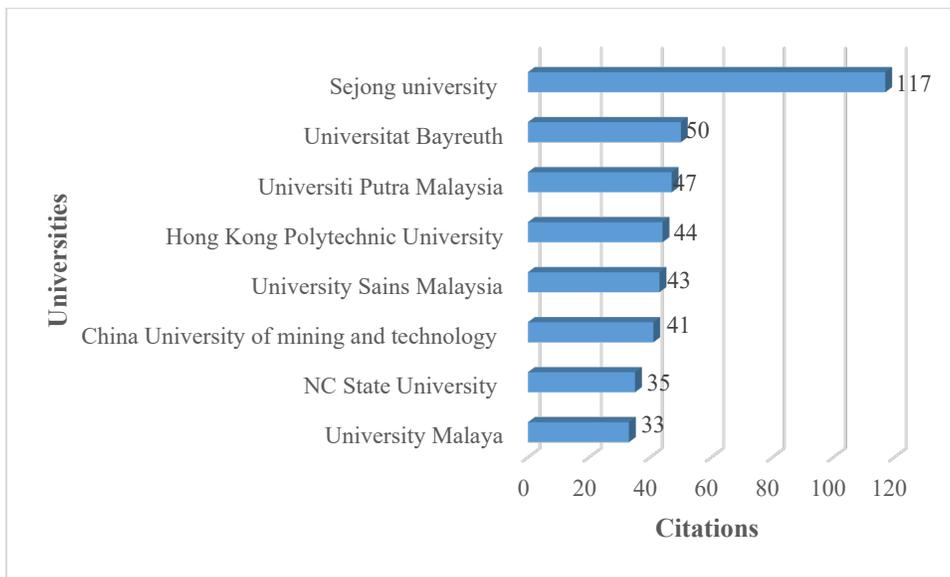


there is a slight contrast, since Turkey and Taiwan, for example, despite having 66 and 65 publications, respectively, do not appear in the main lists of the most cited.



**Figure 8.** Most cited countries

Figure 9 shows the most cited institutions, with Sejong University having the most citations with 117, followed by the University of Bayreuth with 50; in third place is University Putra Malaysia with 47 citations, Hong Kong Polytechnic University with 44, among others, demonstrating that Asian universities have had a greater impact on the publication of new articles on environmental issues.



**Figure 9.** Most cited institutions

### 3.7 Most cited documents

Table 4 illustrates the papers with the most citations on this topic. The article "Mind the Gap: why do people act environmentally and what are the barriers to pro-environmental behavior? The author Kollmuss is the most cited article since 2002, the authors Gifford and Nilsson with the article published in 2014 had 772 citations,

Chen and Tung likewise in 2014 have 628 citations, likewise the most recent document with more citations is the being documents with great impact for research and dissemination of information about environmental education.

**Table 4.** Most cited documents

Document	Author	Year	Quotations
Mind the Gap: Why do people act environmentally, and what are the barriers to pro-environmental behavior?	Kollmuss A., Agyeman J.	2002	3875
Personal and social factors that influence pro-environmental concern and behavior: A review.	Gifford R., Nilsson A.	2014	772
Developing an extended Theory of Planned Behavior model to predict consumers' intention to visit green hotels	Chen M.-F., Tung P.-J.	2014	628
Young consumers' intention towards buying green products in a developing nation: Extending the theory of planned behavior.	Yadav R., Pathak G.S.	2016	495
Education for strategic environmental behavior	Chawla L., Cushing D.F.	2007	457
Green consumption: Behavior and norms	Peattie K.	2010	
Greening due to environmental education? Environmental knowledge, attitudes, consumer behavior and everyday pro-environmental activities of Hungarian high school and university students.	Zsoka A., Szerenyi Z.M., Szechy A., Kocsis T.	2013	373
Environmental knowledge and other variables affecting pro-environmental behavior: Comparison of university students from emerging and advanced countries.	Vicente-Molina M.A., Fernandez-Sainz A., Izagirre-Olaizola J.	2013	345
Correlates environmental behaviors. Bringing back social context	Olli E., Grendstad G., Wollebaek D.	2001	332
Environmental psychology matters	Gifford R.	2014	322

#### 4. Discussion

This document presents the bibliometric analysis of several studies about environmental knowledge, environmental attitudes, and intentions, published in databases until the year 2021, the PRISMA methodology was used, which helps the easy development of bibliographic review articles.

Based on the documents that have been analyzed, it has been observed that the topic of environmental knowledge and education is constantly growing. For example, in 1993, the first and only document of the year appeared; in 1999, it increased to 3 documents, and there was the first upturn in 2010 with 27 documents; at the end of 2021, there were 361 documents on this topic.

When analyzing the countries that are interested in financing this type of research, the United States of America is the main country that publishes on these topics; however, it is not the most cited country; Asian countries being the second most interested in publishing, occupy the first place in terms of citations.

It is also identified that several authors are interested in publishing on these topics, with Bogner and Collado being the authors with the most published documents with 13 and 12, respectively. Meanwhile, among the institutions, University Sains Malaysia, Sejong University, Universiti Malaya, Universidad de Zaragoza, and Otto von Guericke University of Magdeburg are the ones with the highest productivity and some of them are also the most cited.

Bibliometric analysis articles help researchers make decisions about a topic to develop. It can be seen if it is of public interest or organizations for its financing and publication, in addition to finding journals and other research already conducted and presented the results in which they are interested. Year after year, the

publications increase and are updated, opening new paths for those interested in publishing the topics mentioned here.

## 5. Conclusion

The purpose of this writing is to identify the principal authors interested in the subject, the documents with the most citations, and the countries interested in the topic. In addition, this document provides the necessary information to evaluate the growth trend in environmental knowledge, attitudes, and intentions in recent years.

This topic is of vital importance today, as it tries to mark the key points to develop sustainability in people. It also manifests the connection that various authors have discovered between knowledge, attitudes, and environmental intentions. In this way, it can be increased the research bibliography for a more up-to-date document. On the other hand, we cannot fail to emphasize that even the most stubborn of interests or intentions to care for the environment are vital and signify a change in favor of nature.

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**Roberto Aguilar Gómez** is in the final semester of the Automotive Systems student degree at the Universidad Autónoma de Ciudad Juárez, where he has participated in the mini-BAJA SAE project. He is currently a Process Engineer in the medical industry in Ciudad Juárez, Chihuahua, Mexico. He has been assigned to the expansion project in Breslau, Poland. His research areas apply selected lean manufacturing tools associated with process improvements, such as quality, ergonomics, and material flow.