

A bibliometric analysis of GJEE documents

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ABSTRACT: The purpose of this study is to expose the major characteristics of the Global Journal of Engineering Education (GJEE) and to evaluate the position of the journal in the field of engineering education. Bibliometric analysis was used as a main method accompanied by several other statistical techniques including network and content analysis, correspondence analysis and data visualisation. Results revealed that the journal is already established in the field of engineering education with stable publication of documents and supporting the academic environment of educators from all parts of the world. The most cited documents, prominent authors, the most productive affiliations and the most active countries in terms of publishing documents are presented in this article. With the keyword analysis, the evolution of the content of the journal revealed that general topics on engineering education are in decline to make place for more specific topics. The findings demonstrate that the GJEE is a significant source of scientific information in the field of engineering, and more specifically, engineering education.

Keywords: Engineering education, bibliometric analysis, network analysis, thematic map, content analysis

INTRODUCTION

As a part of the World Institute for Engineering and Technology Education (WIETE) community, which has created a conducive international environment for scholarly outputs, the Global Journal of Engineering Education (GJEE) holds a prominent position among world leading journals on the topic of engineering education. The scope of the journal is to publish theoretical and empirical studies related to a wide spectrum of engineering education at the tertiary level.

The progress and evolvement of engineering education as a scientific field has been monitored very closely by several authors; for example, by Breznik and Skrbinjek who addressed it as a separate field [1] or others who treated it more generally as a part of science, technology, engineering and mathematics (STEM) education [2]. The evolution of engineering education was studied by Borrego [3][4], Malmi et al [5] and Wankat [6]. The expanding number of articles and citations on the topic of engineering education was detected in the last decade [1].

Bibliometric analysis, which is sometimes also called bibliometric mapping, is a part of scientometrics and offers various methods to study a scientific field or even, as in this article, a very specific scientific journal. With a thorough literature review on a given topic, bibliometric analysis can serve as an initial step to an umbrella of methods, such as network analysis, content analysis, clustering, correspondence analysis, data visualisation, and others. It was argued by several authors in the past that a bibliometric approach allows to provide very objective and reliable analyses which are based on statistical techniques [7-9]. Furthermore, the most commonly implemented procedures are performance analysis and science mapping [10][11]. The first one aims to analyse production and popularity of several entities (documents, authors, countries to name a few of them) and the second tries to expose the structural patterns of the scientific field [11]. There are some studies that used bibliometric analysis to explore a specific journal [11-13]. As stated by Nebelong-Bonnevie and Frandsen a bibliometric analysis of a single journal can provide a detailed and multi-faceted overview of the journal [14].

The objective of this study was to analyse the research impact of documents published in the GJEE. In this regard, the author seeks to answer the following research questions:

1. What are the distribution patterns of the published documents?
2. Which are the most influential documents, affiliations/institutions and countries?
3. Which are the main topics and evolving trends?

METHODOLOGY

A bibliometric analysis was conducted to get an overview of documents published in the GJEE. This type of analysis produces a structural image of publications in a specific domain and/or a journal [15]. The generated database included all documents of the GJEE published in Scopus and was downloaded as a BibTex file in June 2022. It consists of 375 documents, the majority of them, 308 exactly or 82.13%, are research articles, followed by editorials (28, 7.47%), conference papers (25, 6.67%) and reviews (14, 3.73%).

A descriptive analysis was applied to describe the scientific production, citation and global distribution of authors of the published documents. For keywords, a network analysis was conducted accompanied by visualisation and scientific mapping. In addition, a cluster analysis was used and a thematic evolution analysis were produced.

For preparing the dataset and data analysis R package bibliometrix [16] and its extension biblioshiny were used.

RESULTS AND DISCUSSION

The distribution of documents between 2010 and 2022 is presented in Figure 1. One can observe that the number of articles vary between eight documents in 2010 and 48 documents in 2017. The number of documents in the first year observed is smaller due to the transition period between the UNESCO International Centre for Engineering Education (UICEE) and the WIETE (one issue published). Similarly, the number of documents in the last year observed is not completed as only two out of three issues were published in 2022 at the time of accessing the Scopus database. Generally speaking, the distribution seems to be stable over time.

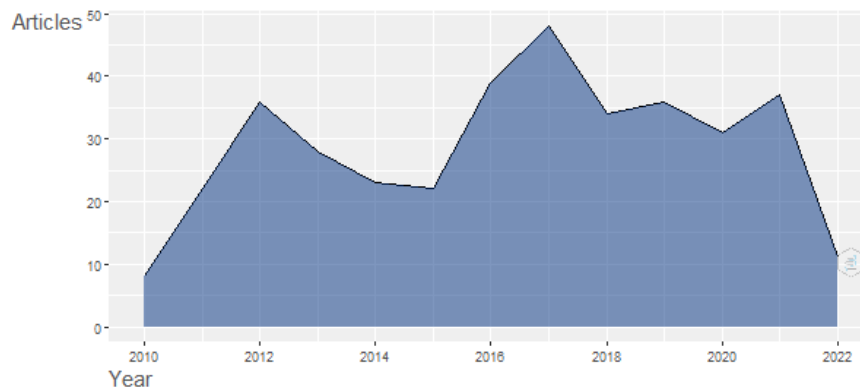


Figure 1: Total annual scientific production.

The distribution of citations is a very important segment of every journal. The highest number, exactly 48 citations, for the GJEE was received in the year 2017 followed by 39 and 37 citations in 2016 and 2021, respectively. However, the mean number of citations per document per year seems to be a more relevant information. In this respect, the year 2019 is on top of the range with just over 1.5 citations per document. The most cited document in the GJEE by far, with 137 citations, is a research article by Meyers et al on the topic of factors relating to engineering identity [17]. Only five other documents (all of them in the category of articles) received 30 or more citations. The article on teaching materials using Android by Ahmar and Rahman [18], and the article on a learning approach in an engineering curriculum by Uziak [19] received 59 and 47 citations, respectively. They are followed by three articles, all sharing 30 citations: on design thinking and its application to problem solving by Arsyad et al [20], on developing a self-learning model based on open-ended questions by Pusca and Northwood [21] and on Scrum in software engineering courses by Mahnič [22].

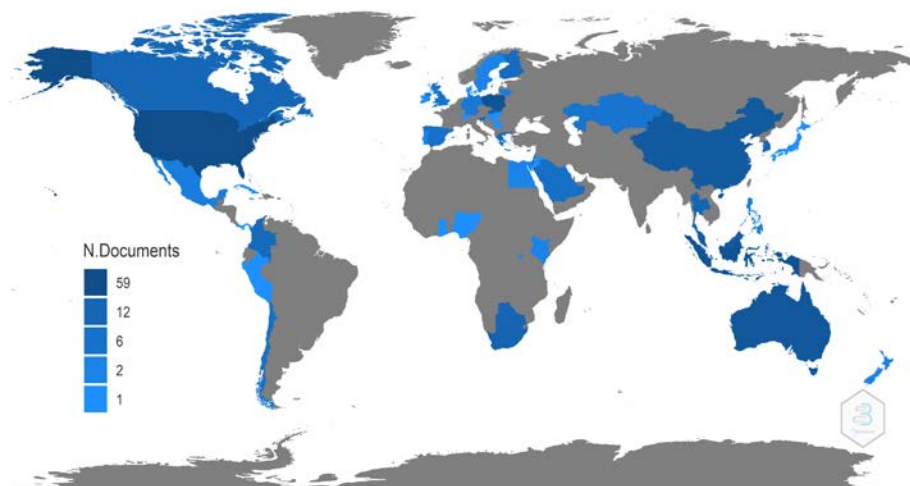


Figure 2: Scientific production by country.

The growth of authors' keywords over the years is displayed in Figure 4. Cumulative occurrences of seven mostly used themes (keywords) are presented on the y-axis, while on the x-axis the time dimension is displayed. *Engineering education* is the mostly used keyword by authors by far, the difference to other keywords has been growing rapidly with time. In the last four years, two groups have been following *engineering education*, the first consisted of *architectural education*, *project-based learning* and *education*. The second group consists of keywords *higher education*, *engineering* and *engineering students*.

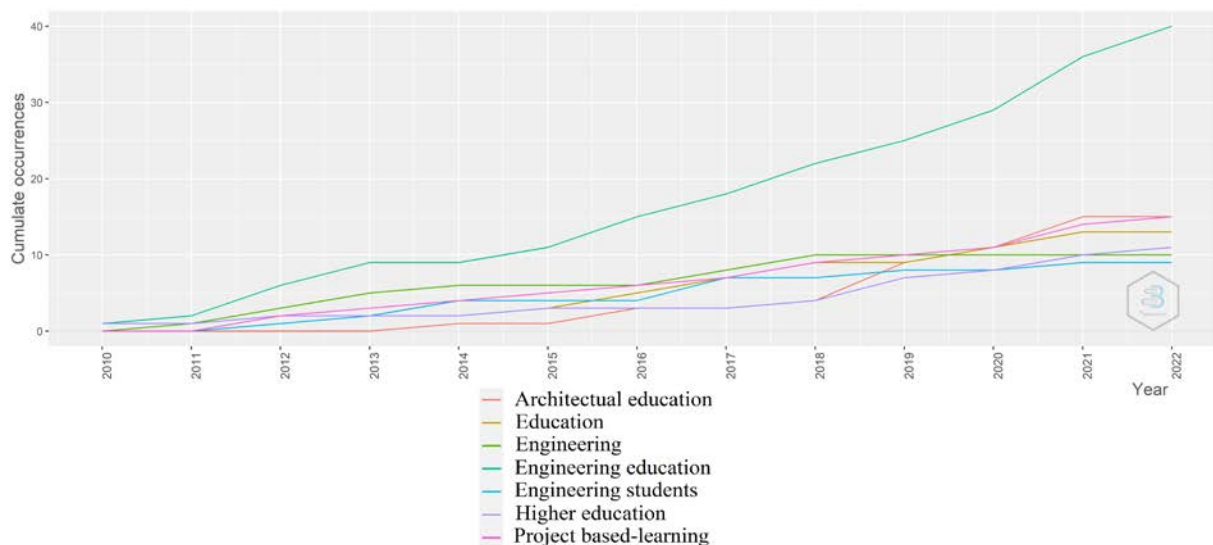


Figure 4: Authors' keywords dynamics.

Similarly, a trend of the use of keywords with their frequencies is presented in Figure 5. The time period when these keywords were most frequently used by authors is shown. It can be argued that the focus of the journal is slowly turning from general terms, e.g. engineering, design, active learning, to more specific ones, such as architectural education, higher education, accreditation, etc.

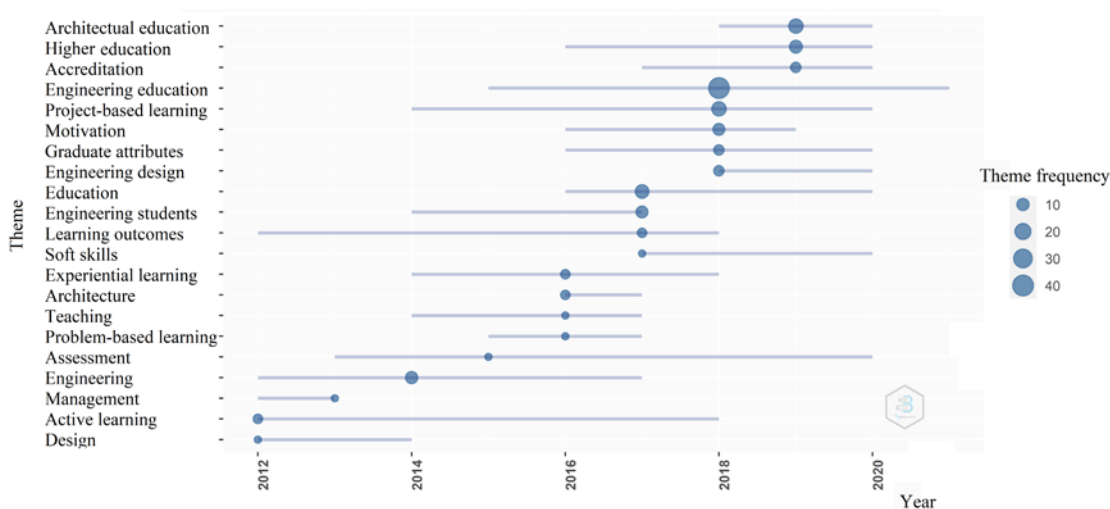


Figure 5: Trend of the use of authors' keywords.

In order to classify themes discussed in the GJEE, the analysis of a thematic map was performed. The general idea of this approach was that the terms that occur together in an article are represented in a term co-occurrence network. Subgroups of strongly connected terms, called also themes, are revealed, where each subgroup corresponds to a centre of interest.

Based on Callon's centrality and Callon's density, a diagram of four typologies can be obtained (Figure 6). In an article by Aria et al, it was argued that the importance of a specific topic regarding the whole dataset is indicated by Callon's centrality, while Callon's density deals with the development of specific topic [11].

In Figure 6, seven main topics are shown. *Project-based learning* was recognised as the motor theme in the GJEE, *engineering* appears as a basic theme. In the lower-left quadrant, *education* and *engineering education* appear as a declining theme indicating that these two themes are being slowly replaced by more specific topics. Supporting this, *curriculum development* is recognised as a niche theme, with high density but lower centrality. High density is detected with regard to the theme *accreditation*, however, the centrality of this theme is indifferent. On the contrary, high centrality and neutral density is recognised in the theme *engineering design*.

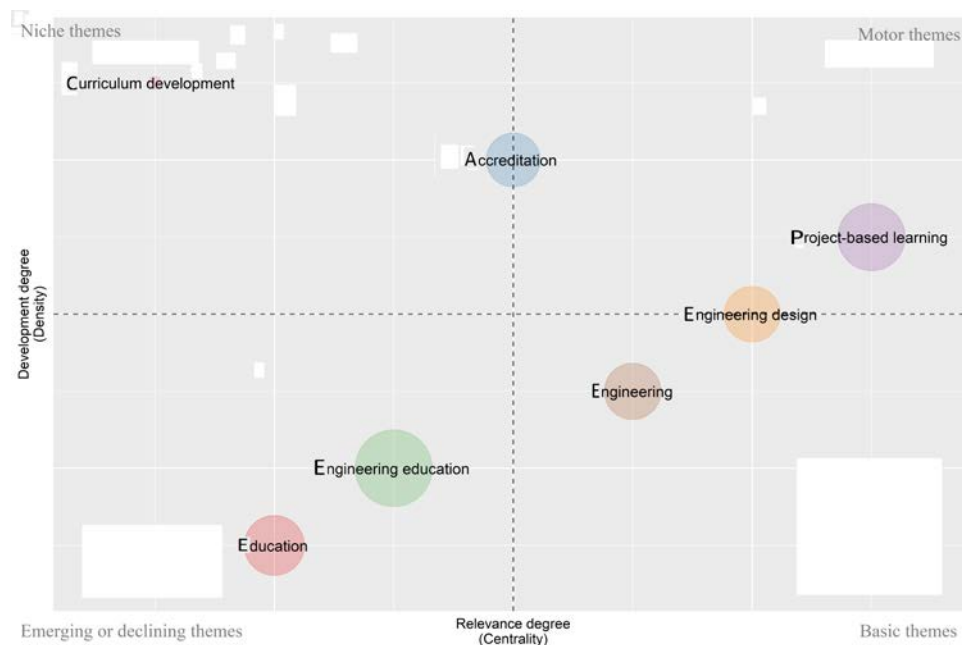


Figure 6: Thematic map.

CONCLUSIONS

Bibliometric analysis includes a variety of quantitative and visual procedures to evaluate the quality of scientific production. This study focused on exposing major characteristics of entities related to the GJEE and moreover to assess the impact of the GJEE in the field of engineering education. It demonstrates evidence that research productivity of the GJEE is stable and follows general themes in the field. It was observed that journal contributions are well distributed over all world regions.

The findings demonstrate that the GJEE is a significant source of scientific information in the field of engineering, and more specifically, engineering education. This study has some limitations, some of them related to the bibliometric approach in general.

It should be pointed out that this study is limited to the last 12 years of the GJEE, when the publication of the journal was covered by Scopus. The whole history of the GJEE from its inception in 1997 can also be considered to cover the pre-Scopus period. The main part of the analysis was purely quantitative; however, there is plenty of room left for a more qualitative approach, which can, for instance, cover the qualitative content analysis of the most important articles included in the GJEE. With regard to content analysis, exclusively authors' keywords were analysed, which can be continued by the analysis of titles and/or abstracts. Nevertheless, considering these limitations, it is believed that the study presented here provides significant insights into the evolution of the GJEE.

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BIOGRAPHY



Kristijan Breznik works as an Associate Professor at the International School for Social and Business Studies and at the College of Industrial Engineering both in Celje, Slovenia. He obtained his PhD in statistics, field of social network analysis and a Master of Science degree in mathematics, field of number theory, both at the University of Ljubljana, Slovenia. His main research interests are social network analysis, data analysis, graph theory, database development, entrepreneurial networks and sport statistics. He is a member of the editorial boards of several prominent journals, such as the *IJIL*, *IJMED*, *IJME*, *WTE&TE* and the *IJVC*M. He has recently authored scientific papers in many international journals and various conference proceedings.