

Global Research Trends in Pro-Environmental Behaviour (PEB) Studies in the Field of Computer Science from 1976-2019: A Bibliometric Analysis

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ABSTRACT

This article aims to investigate from a bibliometric perspective, the pattern and trends of the pro-environmental behaviour (PEB) related studies in the field of Computer Science over the past 43 years extracted from the SCOPUS database. This is one of the early attempts to explicate and describe the patterns of published articles of PEB in the field of Computer Science. From the first article traced in 1976 until 2019, the total numbers of published documents related to pro-environmental behaviour across all disciplines are 2276. However, only 97 documents were found in the field of Computer Science. It is noted that the integration of PEB in Computer Science has indicated an exponential increase in annual publication rate and this trend appears to be evident in developed countries. Specifically, the analysis of productivity according to country/region, institution and funding sponsor suggested that the research landscapes in particularly in Malaysia are paying attention to the intersection of PEB and Computer Sciences. The exploration in the type of publication, source of publication, keyword and language analysis provided the orientation, status and trends of the topic and potential hints to future studies in this field. Overall, progressive trends in publications suggest that the integration of the topic would be continuously published and studied in Malaysia as well as among the international community.

Keywords: Bibliometric, Scopus, Trends, Sustainability, Behavioural.

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INTRODUCTION

The assessment report by the Intergovernmental Panel on Climate Change addresses the urgent need to mitigate human activities and behaviour affecting the environment globally.^[1] This is known as 'Pro-Environmental Behaviour' (PEB) which means the positive individual or community behaviour towards maintaining a sustainable environment by reducing the immeasurable impact of humans towards the environment. This positive behaviour 'that consciously seeks to minimise the negative impact of one's actions on the natural and built world'^[2] is inclusive in the central theme of United Nation's 17 Sustainable Development Goal.

Weighing the importance of promoting sustainable development internationally, the study on PEB has demonstrated an expeditious increase across different fields of studies. Typically, the human behaviour related studies are often found from the perspectives of social sciences, biology/psychology and humanities domains. However, in line with

the digital era, the studies that highlight the human behaviour by utilising computer technology are gaining its popularity. The call to integrate computer technology towards understanding and altering human behaviour has started since the 1970s but gained its momentum later in the 2000s.^[3] In recent years, the leverage of Pro-Environmental Behaviour (PEB) study has extended from classical psychology, social sciences and humanities towards more technical oriented area such as Computer Sciences. Despite the volume and variety of publications, this phenomenon still receives less attention. The potential cultivation of certain targeted behaviours includes information technology, programming, networking, database design and/or mobile technology. To illustrate these evolutionary trends, a bibliometric analysis is conducted. This analysis provides a significant insight into the progression and distribution of biblio information of published documents within a particular research field.

The extensive analysis of bibliometric regarding PEB found in other disciplines includes behavioural studies^[4] tourism^[5] and, economy.^[6] Meanwhile, in the discipline of Computer Science, the bibliometric analysis inclined towards identifying prominent scholars^[7] and trends in Computer Science subdisciplines such as data sciences and big data,^[8] text-mining^[9] and, computational linguistics.^[10] However, to date, this is the

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first attempt to analyze the bibliometric characterization in this mutually exhaustive topic; ‘Pro-Environmental Behaviour (PEB)’ within the field of ‘Computer Science’. Thus, the main objectives of this article are: (1) to summarise and quantify the history of PEB from 1976–2019 and emergence of the same topic in Computer Science since 2008; (2) to identify the overall application status of the PEB from the perspective of ten bibliometric indicators which are years, source, author, affiliations, country, type, subject area, keywords and funding sponsors; (3) to identify the gaps, challenges and orientation for future research. It is hoped that this study may aid subsequent researchers to understand, promote and develop the PEB through the use of computer technology.

BACKGROUND

The environment refers to the biotic and abiotic factors that affected the survival and development of an organism, population, or community. The biotic factors include the organisms and their interactions with other organisms. Meanwhile, abiotic includes non-living factors such as sunlight, soil, air, water and climates. The interactions between organism and environment presume as constant and dynamic to form an equilibrium state of nature or ‘balance of nature’.^[11] Consequently, the organisms responded to changes in their environment by evolutionary adaptations in structural form and behaviour.

The initial idea of the metaphor known as ‘balance of nature’ held by ecologist, philosopher and theologian. The Gaia Hypothesis,^[12] Herodotus Postulates,^[13] divinistic human role in the earth^[14,15] and Ying and Yang^[16] are the striking examples of the metaphor in specific communities. The majority believes that the environment is naturally balanced and any fluctuation in it will revert to its original state.^[17] The conceptual scaffolding of this idea was going back to the 19th century. This idea led to a worldview that nature was best left to its own devices and that human intervention into it was unrealistic. Simply said, the environments are resilient to changes. Therefore, it was accepted that anything that human does to the environments; the natural feedback mechanism will revert to the equilibrium state.

Later, the theory was challenged and revoked by ecological scientists and mathematicians. For example, chaos theory in a hydro system,^[18] plant/animal populations dynamics^[20,21] suggested that nature is complex and dynamic. Even the role of the dynamic complexity of the environment is mused, debated and argued among the scientist. Generally, it is accepted that human behaviour is one of the precursors for the sustainability of the environment. Therefore, past studies show that the human behaviour is claimed as the crucial factor in determining the environment to be in a favourable state for earthlings.^[22,23,24] Contradicted to the concept of ‘balance of

nature’, the newly proposed term to show the opposite idea of the metaphor such as ‘anti balance of nature (ABON)’, ‘imbalance of nature’ or ‘flux of nature’.^[25] The new paradigm shift premises that environment is ‘dynamic and highly variable with open-ended trajectories contingent upon proceeding events’.^[26] In other word, environments are delicate, fragile and should be sustained by humans. The new paradigm is widely accepted in other disciplines outside ecology.^[27–29]

In the 2000s, the term ‘sustainability’ started to be the central idea in research agenda related to the environment in pure science, applied science and humanities. The lexical link between ‘sustainability’ and ‘environmentalism’ is quite recent. The concept of environmental sustainability begins the ‘environment-conscious’ movement since Rachel Carson’s seminal work published in 1962.^[30] In the 1980s, the popularity of ‘sustainability’ term skyrocketed when the International Union for the Conservation of Nature published the World Conservation Strategy, including an entire section called “Towards Sustainable Development”.^[15] Since then, to perpetuate the environment, the campaign to modify human behaviour started to upscale to the global level. The focal theme of the call is to develop a favourable environment by altering human attitudes and behaviour. Collectively, the positive acts displayed by the human in response to its environment known as Pro-Environmental Behaviour (PEB) Kollmuss and Agyeman (2002) provided the most cited definition of ‘PEB’. PEB refers to ‘behaviour that consciously seeks to minimise the negative impact of one’s actions on the natural and built world’. Meanwhile, Steg and Vlek (2009) stated that pro-environmental is behaviour that is intended to minimise one’s negative impact on the natural environment. Both definitions highlighted the ‘conscious or intentional act,’ which indicates the contemplative and careful thought, considering the activity or action that benefited the environment. The examples of pro-environmental behaviour^[31] are diverse but not limited to recycling, reuse of products, reduction of waste production, use of non-toxic substances, purchase of energy-efficient appliances, reduced driving and flying, buying seasonal and local foods, reducing room temperature, limiting hot water use, eliminating standby electricity, supporting and environmental organisations. The studies that concern PEB in the specific demographic variables directly or indirectly include gender and ethnic-racial,^[32–35] biological variables,^[36–38] social and workplace,^[39–42] cognition and learning.^[43,44] This positive behaviour did not only regard as individual behaviour but also as pro-social behaviour which in turn the studies related to PEB covers in psycho-social studies as well.^[45–49] Rapidly, studies concerning PEB started to propagate in many areas. As compared to earliest study on environmentalism among ecologist, geographer, theologian and mathematician, the PEB studies resonate in cognitive science,^[50–52] education,^[53] management,^[54] neuroscience^[55]

and engineering and architecture^[56-60] and computer science.^[3] The increasing attention to PEB has shifted from psychology, biological sciences and social sciences toward, the application of the PEB in the future will continue to increase and involve more topics including technology-oriented fields such as Computer Sciences and technology.

PEB in the field of Computer Science

Behavioural sciences systematically analyzes and investigates human behavior through scientifically sound, and descriptive explanations of judgements and decisions making. As discussed previously, the earliest study concerning pro-environmental behaviour has drawn attention from environmental psychologists who attempted to explain and understand the factors that moulded individual pro-environmental behaviour.^[61,62,63] Being focal, pro-environmental related research has widened to other disciplines, indicating this theme has been approached from different angles. Past studies showed that a variety of influencing factors have been identified; including demographic variables (e.g., age, gender), social-psychological constructs (e.g., attitudes, social norms) and situational factors (e.g., infrastructure, incentives).^[31] In parallel with remarkable progress in PEB, computer scientists has embarked on exploring this aspect as well. As computer technologies have penetrated in most aspects of human life, the reliance on technology in this era could either affect ecologically in a damaging or benefiting manner. For instance, improper *technotrash* disposal upsets the ecosystems^[64-68] but the advantages of the paperless communication^[69] are possible to reduce deforestation for paper production. On the other hand, several studies has documented the positive relationship between computer technology integration in promoting PEB.^[70-72] Still, the impact of technology towards the environment is inconclusive; the advancement in technology is rapidly pervasive and has changed the behaviour of people who interact with the world. This scenario attempted the merge of computer technologies in behaviour studies potentially involving ubiquitous computing and IoT,^[73] multimedia,^[74] artificial intelligence,^[75,76] artificial behaviour,^[77] human-computer interaction^[78] computational trust,^[79] and autonomous systems.^[80] Computer technology, along with PEB, could potentially reboot the health of our nature. Pedersen, claimed that, compared to the conventional approach in behaviour science, the nature of Computer Science research involves systematic analysis and investigation of studied behaviour through naturalistic observation and controlled scientific experimentation.^[81] Therefore, computer scientist attempts to provide legitimate and objective conclusions through rigorous formulations and observations. In contrast to traditional behaviour science, which includes psychology, psychobiology, criminology and cognitive science; the rational and normative seek to understand on how one behaves; ideally^[82] or rationally.^[83] However, assimilation

of both; technology from Computer Sciences perspectives and pro-environmental behaviour from behavioural science perspectives, could yield towards a better understanding of the typical tendencies of human cognition, emotion and action with a much holistic point of view. The focus in this article is to understand the publication trends using bibliometric analysis towards exploring the computer-based technological integration in promoting pro-environmental behaviour directly or indirectly.

Bibliometric analysis

The classical definition of bibliometrics is statistical and mathematical methods to books and other media of communication".^[84] Bibliometrics (or scientometrics) is the quantitative analysis and statistics of publications and bibliography output in various reputable mediums to understand emerging trends and the knowledge structure of a research field.^[85] The quantitative measurement of publication of PEB in SCOPUS allows the past years trend overview, latest developments and future trends. Although the result is not exhaustive as an in-depth review of related literature, bibliometric analysis demonstrates the opportunity for exploring the gaps and new frontiers in research.

Based on comparative research^[86] on several databases have concluded that, in recent years, SCOPUS database has gained attention for bibliometric studies, especially from developing countries. As this database is published by Elsevier, it has been used for a variety of purposes such as determining the scientific indicators, selection of journals, scientific output evaluation, forecasting the research potential and standard tool for policy and management in research for the past decades.^[87] Therefore, considering this database advantage and importance, the pieces of literature in this study were retrieved from SCOPUS. Bibliometric analysis is considered as one of the reliable methods for quantitative analysis of documents published in the specific discipline of study.^[22,87-95,96] This analysis employs statistical techniques, which include learning the patterns in literature characteristics of a particular topic of interest; weighing the authors, institutions, countries/region, and journal of interest and discover the research trends. The technique involves the extraction of vital information from a large number of documents and provides a piece of necessary descriptive information and objective reference for retrospective analysis.

METHODOLOGY

By searching for "pro-environmental behaviour", all the publications record were extracted based on the online database of the SCOPUS citation index. Specifically, the search began by setting the query string to TITLE-ABS-KEY ("pro-environmental behaviour" OR "pro-environmental

behavior”) and the search conducted on 26th April 2020 and assigned ‘without any limitation’. The first document published regarding PEB was in the year of 1976.^[61] Therefore, the time frame limit for this analysis was set from 1976–2019. The electronic search outputs are conducted and downloaded on the same day (26th April 2020) to avoid any updates on the database. Accordingly, 2276 hits were returned. Then, from the same output, the documents published in Computer Science identified. From the output, the total number of published document in Computer Science concerning PEB is only 97, with the earliest publication were in 2008.^[97] The selected result of the “full record and cited references” for each document in batches was exported in XLS format for subsequent analysis. The analysis by the database system was also recorded. For further analysis, both records were performed with a manual examination to eliminate irrelevant literature and later analysed using Microsoft Excel.

The data was extracted and analysed according to the guidelines by Reuthers (2008) without any modification.^[98] While proposing new technique would facilitate comparison with the results of other studies, the standard-technique chosen in this article was tailored with the research objectives.

RESULTS AND DISCUSSION

Based on the data retrieved from the SCOPUS database, the ten bibliometric indicators used are years, source, author, affiliations, language, country, type, subject area, keywords and funding sponsors. According to the guide of bibliometric data evaluation by Reuters (2008), paper count provides the raw data for all citation analyses. The examinations of the analysis are in two-fold: first, the overall PEB related document across discipline and second, focuses explicitly on document constituents in computer science per se.

Annual publication rate and first publication

Figure 1 displays the annual trends in the published document of PEB across all disciplines. Altogether, 2276 documents were published from 1976–2019. The number of annually published documents has steadily increased with minor fluctuation since 2000, reaching the highest number of 431 documents, in 2019. From 2000 to 2019, the average annual rate of publications reached was 98.63%

Figure 2 shows that from the extracted data of PEB in Computer Science, the first publication was in 2008. Since then, the publication rate increased but still less than a total of 17 documents per year. The highest publication was in 2018, which comprised 17 documents. From both growth rates, it indicated the increase in research activity PEB in general and in Computer Science specifically.

The increasing trends from both data (Figure 1 and Figure 2) are relatable with the overarching paradigm on the sustainable development of the United Nations. The United Nations Conference on the Human Environment in 1972 and followed by Bruntland Commission Report in the years of 1987^[99] has initiated the themes of “development that meets the needs of the present without compromising the ability of future generations to meet their own needs” in global. As research associated with PEB was always addressed as one of the crucial aspects of sustainable development, this theme serves as the backbone of studies related to PEB across all disciplines. From the released framework and initiatives for a future plan by United Nation, it is expected that these similar thematic trends would continue to flourish until 2030.^[100]

Distribution of subject Area

The 2276 documents that are published which highlighted the PEB are found across 27 subject areas which are Social Science, Environmental Science, Business, Management and Accounting, Psychology, Energy, Economics, Econometrics and Finance, Engineering, Agricultural and Biological Sciences, Computer Science, Arts and Humanities, Medicine, Earth and Planetary Sciences, Mathematics, Decision Sciences, Biochemistry, Genetics and Molecular Biology, Multidisciplinary, Nursing, Neuroscience, Chemical Engineering, Physics and Astronomy, Health Professions, Materials Science, Chemistry, Pharmacology, Toxicology and Pharmaceuticals, Veterinary, Immunology and Microbiology. Table 1 shows the top ten paper counted in the respective subject area. Apparently, these subject areas portrayed the three pillars of sustainable development by the UN (i.e. economic, social, and environmental). As such, this trend suggested that the research concerning PEB promotes area of research among the social science, environmental science, business, management and accounting, psychology and energy area of study compared to the other subject areas.

According to the SCOPUS classification system of a subject, a document may include more than one subject area. Indeed, from the entire 97 documents published in the area of Computer Science, 86 of the documents concerning PEB in the field of Computer Science were also belonged to 13 other subjects; including engineering, mathematics, social sciences, environmental science, business, management and accounting, decision sciences, energy, arts and humanities, neuroscience, psychology, biochemistry, genetics and molecular biology and chemical engineering. The distribution is shown in Figure 3. Among the 97 documents, 63.0% of them are cross-discipline with engineering, mathematics, social sciences, environmental science and business.

Type of publication and primary source journals

The 2276 documents are ranged from different types and sources of publications. From the analysis, the top 5 published documents from 12 are article, conference paper, book chapter, review and book. The lists of the top 10-source journals concerning the number of publications; which accounted for approximately 35.18% of the 155 sources of publications

- 1) Journal of Environmental Psychology
- 2) Sustainability Switzerland
- 3) Journal Of Cleaner Production
- 4) Environmental Education Research
- 5) Environment And Behaviour
- 6) Journal Of Sustainable Tourism
- 7) Frontiers In Psychology
- 8) Ecological Economics
- 9) PsyEcology
- 10) Resources Conservation And Recycling

The listed journals suggested as the most influential journals in applying the PEB across all areas over the past decades. From the rank of publication sources, the top three journal official websites of the sources identified to understand this publication pattern. The highest source is from The Journal of Environmental Psychology, which was established since 1980 and that accepted multidisciplinary publications regarding human-environment interaction. Thus, the accumulated publication over the long years has reached 135 documents. Compared to the Journal of Environmental Psychology, The Sustainability Switzerland (or Sustainability) journal is initiated in 2009 but releases numerous publications (bimonthly publication) and rapid review. Journal of Cleaner Production has more focused disciplines even started in 1997, but similar to Sustainability, this journal releases annual issues frequently (about 36 issues per year). Focusing on Computer Science, another analysis is conducted to precisely identify the prominent publication source of PEB in Computer Science of 97 identified documents.

From the findings, the 97 documents searched in this database were published in 34 different publication sources. The highest contributor is 'Lecture Notes in Computer Science, including subseries lecture notes in artificial intelligence and lecture notes in bioinformatics.' It published a broad spectrum of document types that comprise the book, eBook, conference proceedings, book series, textbooks and primary reference works from distinguished authors, specifically in the areas of Computer Science. Then, the second-highest documents contributed by the 'ACM International Conference Proceeding Series'. This proceeding series published the document in all areas of computing and IT at a relatively

low cost. This marketing strategy might attract scholars and authors in the mentioned area. The third highest source of publication is 'Conference on Human Factors in Computing Systems Proceedings,' which published documents in the field of human-computer interaction since 1982. Besides staying relevant and stable publication rate over long years, other characters such as publication frequency, the disciplinary-focused, wide spectrum of authentic documents, quick review and/or relatively low-cost publication are the unique vital characters that draw authors' attention to publish their work at the identified source.

Countries and regions

According to the statistical method, the countries and regions cover the information of all the authors in each document. In-regards with PEB publication regardless the subject area, top 15 countries/regions contributed to the most significant publications are United States (511), United Kingdom (367), Australia (214), Germany (156), Canada (139), China (118), Spain (116), Netherlands (86), Italy (84), Sweden (79), France (70), Japan (62), South Korea (61), Malaysia (56) and New Zealand (44). From the listed countries, it seems the large and populous countries have made significant contributions to the PEB related documents. The top five countries are paying attention to environmental policy practice and investing in scientific research and scholarly attention.^[22] As one of the representatives from Southeast Asia, Malaysia is one of the highest contributors in publication. The data reflected the Malaysia Government policy towards sustainable consumption. Malaysian researchers have attached the great interest in publishing academic journals on environmental behaviour and sustainability.^[101]

Scrutinising the publication record on the area of science computer, the analysis of the 97 identified documents showed a fascinating spectrum regarding geographical distribution. Figure 4 shows the top 10 contributing countries and regions in descending order are as follow: United Kingdom (20), United States (14), Canada (9), Australia (6), Spain (6), Germany (5), Malaysia (5), Netherlands (5), Portugal (5) and Denmark (4). Most of the countries, as mentioned earlier, are the frontiers in computer and technological advancement, indicating that these countries/regions have a relatively healthy influence on the application of the PEB to Computer Science research. Again, amongst the developed western countries, Malaysia is the only developing country in Southeast Asia, showing interest in publishing studies about PEB in Computer Science. Apparently, the evidence in the ranking indicates the positive feedback from the academic community towards the plan by Ministry of Higher Education Malaysia to promote the Industrial Revolution 4.0 across all the disciplines of study.^[102]

The outstanding institution, researcher and funding

sponsor

Focusing on published document in PEB, the leading institutions are the University of Queensland, University of Groningen, Universidad de Sonora, University of Leeds and Sejong University. Meanwhile, the top 5 most depicted authors are Steg, L., Corral-Verdugo, V., Han, H., Milfont, T.L. and Fielding, K.S. From the extracted database, the most frequent sponsors for the fund are from the National Science Foundation, National Natural Science Foundation of China, Economic and Social Research Council, Social Sciences and Humanities Research Council of Canada and Australian Research Council.

Meanwhile, the top 5 affiliations of the documents with the integration of PEB in Computer Sciences are The James Hutton Institute, Universidade da Coruña, University of Salford,

University of Toronto and Aalborg Universitet. Alonso-Betanzos, A., Craig, T., Fontenla-Romero, O., Sánchez-Marroño, N. and Becerik-Gerber, B. actively published the document in the Computer Science field. Nonetheless, the National Science Foundation, Ministry of Higher Education of Malaysia, Deutsche Forschungsgemeinschaft, European Commission and Foundation for Fundamental Research on Matter are the top funding sponsors in studies of PEB in Computer Sciences.

Keywords and language analysis

Keywords are descriptive words that concisely reflect the content, theme and methodology of a document. The 2276 documents retrieved in this study contain 193 keywords. The most frequent keyword includes the variations of the spelling of PEB, such as ‘Pro-environmental Behavior,’

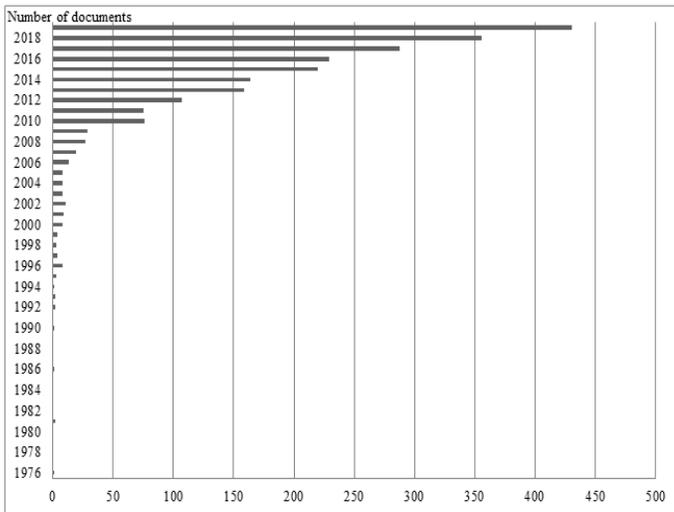


Figure 1: Total publications (accumulated) of PEB across discipline between 1976 and 2019.

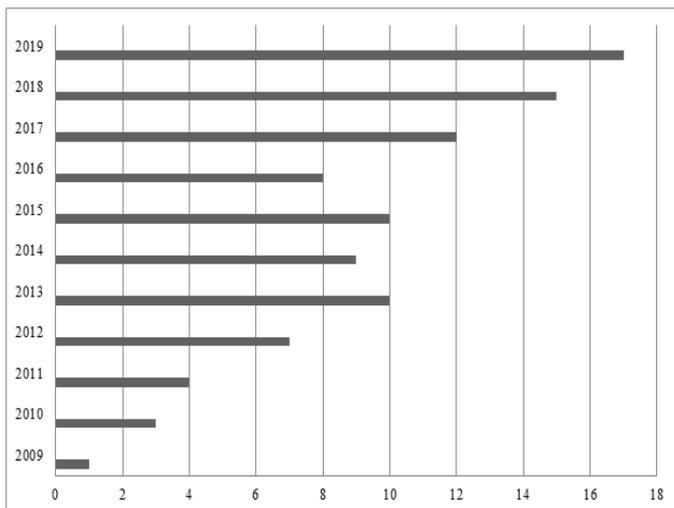


Figure 2: Total publications (accumulated) of PEB in Computer Science between 2008 and 2019.

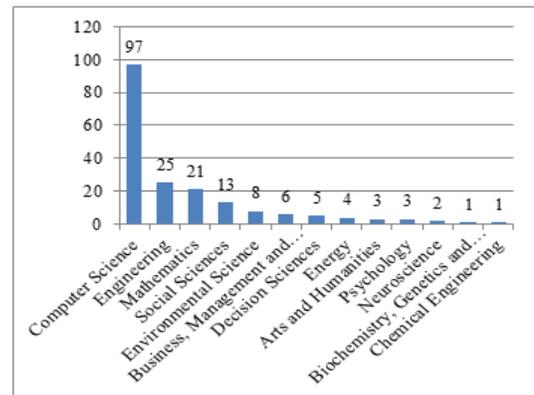


Figure 3: The distribution of documents in Computer Science according to the subject.

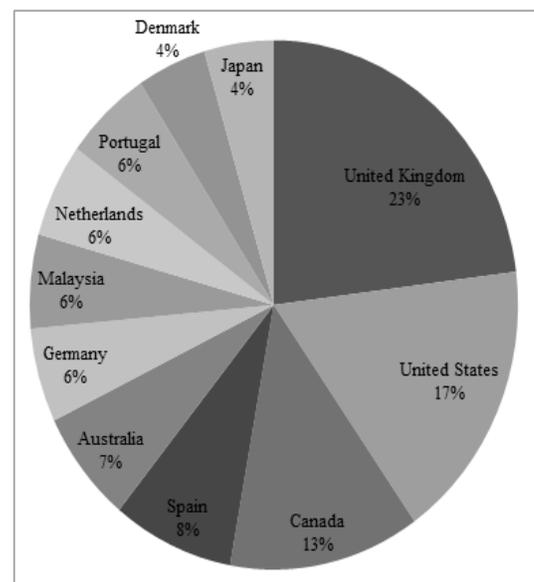


Figure 4: Distribution of document in Computer Science among the top ten contributing country.

Table 1: The number of documents published across 27 subject areas.

Subject Area	Documents
Social Science	965
Environmental Science	927
Business, Management and Accounting	508
Psychology	444
Energy	295
Economics, Econometrics and Finance	239
Engineering	221
Agricultural and Biological Sciences	109
Computer Science	97
Arts and Humanities	95

'Pro-environmental Behaviour' and 'Pro-environmental Behaviors'. Besides, the related keywords frequently occur with PEB are 'Sustainability,' 'Climate Change', 'Sustainable Development', 'Human', 'Environmental Protection', 'Environmental Attitudes' and 'Environmental Education'. The related keyword indicates the field, subfield, topic, research issue, predictor, variables and themes in PEB. From the acquired data, the keywords are human and environment and the interaction of both. The majority of documents are in English (2210) and followed by Spanish (45), French (9), Portuguese (8), Croatian (3), Japanese (3) and others.

Meanwhile, the top 10 frequently used keywords in all 97 English-written documents are 'Pro-environmental Behaviors', 'Sustainable Development', 'Behavioral Research', 'Pro-environmental Behavior', 'Sustainability', 'Environmental Technology', 'Human Computer Interaction', 'Information Systems', 'Decision Making', 'Energy Utilization', 'Social Networking' and 'Persuasive Technology'. As compared to the comprehensive research of PEB, not surprisingly in Computer Science, most of the combined keywords with PEB are the application of content knowledge of the Computer Science area in behavioural studies.

Limitations

This study presents a bibliometric analysis of the literature published in the SCOPUS database on PEB between 1976 and 2019 in general. Subsequently, a more focused analysis of the retrieved documents in regards to the Computer Science subject area is also reported. The analysis shed some light on the evolution of publications in PEB according to the ten bibliometric indicators, as previously discussed.

The publication rate in PEB was increasing exponentially and expected to remain the same trends in the future. The distributions of PEB according to the subject area are more inclined towards fields related to economic, social and environmental. The analysis also remarked the lack of empirical studies that integrate PEB in Computer Science

compared to other disciplines. Even though the emergence of first published documents of PEB-Computer Science relatively present compared to other disciplines, the trend of publication rate is steadily progressing. Thus, there is still much to discover in studies that combining both PEB and Computer Science.

From the overview of past published documents, the types of publications, in general, are 12, but there are only three types in Computer Science. The sources of publication are varied according to the different unique key characteristics of identified journals. The majority of the leading countries in terms of document productivity, in general, or specific in Computer Science, are inclined towards a more populous and developed country. The outstanding institution, researcher, funding sponsor, keyword and language are also identified. It can be summarised that the studies linked PEB in Computer Science are gaining a positive pace in publication and expected to increase with many diverse types of publications and cover more sources and various keywords. Nevertheless, most of the publications would be in English and expected to have a similar pattern in the future.

However, the interpretation of the result and discussion in this study are subjected to several limitations. This research refers to documentation in the SCOPUS database only. The publication of documents in other databases that do not overlap with SCOPUS and non-indexed journals that are not accessible through the mentioned database are not accounted for the analysis.

CONCLUSION AND FUTURE WORK

In conclusion, PEB-related documents in Computer Sciences make up a subject matter that has been recently developed and currently leads to remarkable important for academics, scholars and practitioners. The revolution of PEB could be explained by the diverse of scholars approaching this issue from different perspectives, which in turn indicate the intense interest that this research topic has presented in general and in the field of Computer Science particularly. The analysis of productivity according to country/region, institution and funding sponsor suggested that the research landscapes in Malaysia are paying attention to the intersection of PEB in Computer Sciences. This area of research (PEB in Computer Science) is predicted to flourish with remarkable progress as it supports the National Policy on Environment^[103,104] which later empowered with Big Data NRE Implementation Initiatives and ICT Strategic Plan in 2016^[105,106] by Ministry of Water, Land And Natural Resources, Malaysia. To conclude, the emergences of technological integration in understanding and promoting specific PEB are interdisciplinary and require the cooperative network among the expert in a different field to work together. In short, behavioural studies integrated

with Computer Science technology can be more fruitful and venues of exploration.

Although it is exhaustive, the existing technique used in this study is a simple descriptive analysis. Likewise, the bibliometric indicators selected in this study are frequently used to measure the quality and quantity of the publication.^[98] However,^[107] argued that the measure does not manifest the actual quality of the document. For future studies, researcher might consider conducting a bibliometric analysis incorporating more than one database, which reaches a better perception of the topic. Additionally, researcher could also use a citation-related and structural indicator to facilitate the comparison of previous work from the similar domain. Furthermore, the citation-related measures the impact of documents and structural indicator that gives attention in the relationships between indicators via sociograms. A much complex analysis using qualitative approach complements with the quantitative bibliometric analysis will allow a comprehensive understanding of the topic.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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