Analysis of 2010-2019 Trends of environmental awareness publication using VOSviewer application

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Abstract. This study aims at identifying and analyzing research on environmental awareness that have been published in international journals in the period of 2010-2019 through bibliometric analysis. The publication trends mapping was conducted in four stages: (1) searching for articles in the Scopus database using the Publish or Perish application; (2) filtering articles to be analyzed, (3) completing article metadata using the EndNote application; (4) conducting bibliometric analysis using the VOSviewer application. The results of the analysis found that (1) the yearly trends of publication on environmental awareness increased by the end of 2019; (2) the most cited articles on environmental awareness were in the business scope with 329 citations; (3) the journal with the most contributions is the Journal of Cleaner Production and the publisher with the most contributions was Elsevier Ltd; and (4) the most used keyword by authors in articles on environmental awareness was “environmental awareness”. This study concludes that the publication trends in environmental awareness is increasing, but the yearly citation pattern is still decreasing. Therefore, writing articles with the top citation on the theme of environmental awareness is a good opportunity for further research.

1. Introduction
Scientific publication through international journals is a means of communication between researchers and practitioners to distribute developments in various scientific information. The study of scientific information on environmental awareness has been developed in various countries [1,2]. This study is important to create a better quality of life in the future through changes in the behavior of people who care about the environment [3,4]. This change in community behavior is one of the goals of the environmental education curriculum to encourage each individual to gain awareness and sensitivity to their environment and environment [5].

In research conducted by okada, Tamaki, Managi, regarding the attention and satisfaction of using electric vehicles in Japan to overcome the problem of global warming, the value of environmental
awareness is what drives interest in buying these vehicles. The results of this study indicate the relationship between the value of environmental awareness and a person's interest in using various environmentally friendly products [6].

Over the last ten years, a great deal of literature has become accessible on environmental awareness. However, no bibliometric studies in journal publications indexed by Scopus were reported. In the various existing literature, bibliometric map depiction of various environmental awareness studies seems to be neglected. This bibliometric study is important to analyze the results of scientific publications quantitatively and qualitatively [7]. Bibliometric analysis can be done through the author's keywords, words in the title [8]. Bibliometric map depiction helps researchers to carry out further research. The Vosviewer application is an application that can be used to process bibliometric data. This VOSviewer application can present co-citation map of 5,000 major scientific journals [9].

For this reason, this research will discuss the following matters:
Q1: How is the trend of environmental awareness research publication years 2010-2019?
Q2: How citation patterns in environmental awareness research years 2010-2019?
Q3: Which journals and publishers published the most environmental awareness articles in the year 2010-2019
Q4: Keyword what author used the most in environmental awareness research years 2010-2019?

2. Methods
This study aims to analyze trends in environmental awareness publications from 2010 to 2019, which are based on publication trends, citation patterns, journals and publishers that publish the most environmental awareness articles, as well as the author's keywords that are used the most. Therefore, the method in this research is carried out in four stages: 1). searching for articles in the Scopus database using the Publish or Perish application, 2). filtering articles to be analyzed, 3). completing article metadata using the EndNote application, and 4). conducting bibliometric analysis using the VOSviewer application. For more details, will be described in sections 2.1 to 2.4.

2.1. Searching for articles in the Scopus database using the Publish or Perish application
To find the source of the Scopus article database, use the Publish or Perish (PoP) application which can be obtained via the link harzing.com/resources/publish-or-perish.

To find the source of the Scopus article database, use the Publish or Perish (PoP) application which can be obtained via the following link: harzing.com/resources/publish-or-perish. As an illustration of how to search for the Scopus database source for environmental awareness articles through the PoP application in this study, it can be seen in (Figure 1).

![Figure 1. Using the PoP application to find a database of environmental awareness bibliography.](image)

This PoP application limits its search to 200 articles, for this reason, database searches were conducted twice in 2010-2014 and 2015-2019. In addition, database searches are limited to title words and keywords in environmental awareness and publication names are limited to journals. The search results for this bibliographic database are stored on EndNote X9 and file CSV to be opened in the Excel application. The saved file will then be checked and provided with metadata.

2.2. Filtering articles to be analyzed
The database of the articles to be bibliometric analysis is filtered. Some of the criteria used are as follows: 1) having the context of environmental awareness, 2) using English, and 3) published by leading
publications and publishers. Every bibliography that will be included or deleted from the bibliometric analysis process is checked first by tracing it into the Scopus data base.

2.3. Completing article metadata using the EndNote application
Checking the completeness of bibliography metadata using the EndNote application is based on the completeness of the data: 1) author names, 2) article titles, 3) author keywords, 4) abstracts, 5) years, 6) volumes, 7) issue numbers, 8) pages, 9) number of citations, 10) article links, and 11) publishers. After the metadata was complete, the bibliometric analysis begun. The total metadata bibliography of environmental awareness to be analyzed can be seen in (Table 1).

| No | Year | Inclusion | Exclusion | Total |
|----|------|-----------|-----------|-------|
| 1  | 2010 | 11        | 0         | 11    |
| 2  | 2011 | 8         | 0         | 8     |
| 3  | 2012 | 15        | 0         | 15    |
| 4  | 2013 | 17        | 0         | 17    |
| 5  | 2014 | 12        | 0         | 12    |
| 6  | 2015 | 12        | 0         | 12    |
| 7  | 2016 | 22        | 0         | 22    |
| 8  | 2017 | 14        | 2         | 16    |
| 9  | 2018 | 23        | 1         | 24    |
| 10 | 2019 | 40        | 4         | 44    |
|    | Total| 174       | 7         | 181   |

2.4. Conducting bibliometric analysis using the VOSviewer application
Bibliometric analysis using the VOSviewer application can be downloaded via https://www.vosviewer.com/. As an illustration of the steps in using the VOSviewer application to analyze bibliometrics on environmental awareness in this study, it can be seen in (Table 2).

Table 2. Use steps of the VOSviewer application to analyze bibliometric environmental awareness.

| No | Steps to use the VOSviewer application | Application view |
|----|---------------------------------------|------------------|
| 1  | Click the Create button               |                  |
Table 2. Cont.

2. Select create a map based on bibliographic data, then click next

3. Select read data from reference manager files, then click next

4. Select endnote and input data base file from endnote that will be used, then click next

5. Select it in the type of analysis on co-occurrences, select it under unit of analysis keywords then click next
3. Results and discussion

3.1. Theme 1: Analysis based on publication trend

Figure 2. Shows that the number of published environmental awareness articles from 2010-2019 is 174. The trend of publication shows an increasing pattern of three times, a decreasing pattern of three times, and a fixed pattern of one time. An upward pattern occurred in 2011-2013, 2015-2016, and 2017-2019; a declining pattern occurred in the years 2010-201, 2013-2014, and 2016-2017; and the pattern remains in 2014-2015. When viewed from a full year, the least publication occurred in 2011 and the most publication in 2019. In terms of the last few years, environmental awareness publications have increased quite significantly. This illustrates the increasing interest of researchers in various countries to conduct studies on environmental awareness. Publication trends affect the interest of researchers to focus more on their field of work [10].

Figure 2. Yearly publication trend.

3.2. Theme 2: Analysis based on the most cited articles

Figure 3 shows that the number of citations per year from 2010-2019 is 1878 citations. The quote pattern shows a three-time descending pattern, a three-fold ascending pattern. The declining citation pattern
occurred in 2010-2011, 2013-2014, and 2015-2017; increasing citation patterns occurred in 2011-2013, 2014-2015, and 2018-2019. When viewed from a full year, the most citations occurred in 2013 and the fewest citations occurred in 2011. So quotes about environmental awareness as a whole have decreased from 2010-2019. This is also shown in the average number of citations per year.

In table 3, we get information about the top five most cited articles, articles written by Liu, Z., Anderson, T.D., Cruz, J.M. (entitled Consumer environmental awareness and competition in two-stage supply chains) as the most quoted article with 329 citations. This shows that the trend of quotations about environmental awareness is most prevalent in the economic field. In this case, the success in marketing various products produced by the company is influenced by the level of consumer awareness of various ecological problems [11].

Table 3. Top five of the most cited articles.

| No | Cites | Authors                  | Title                                                                 | Year | Source                                      | Publisher       |
|----|-------|--------------------------|----------------------------------------------------------------------|------|---------------------------------------------|-----------------|
| 1  | 329   | Liu, Z., Anderson, T.D., Cruz, J.M. | Consumer environmental awareness and competition in two-stage supply chains | 2012 | European Journal of Operational Research | Elsevier        |
| 2  | 304   | Flammer, C.              | Corporate social responsibility and shareholder reaction: The environmental awareness of investors | 2013 | Academy of Management Journal              | Academy of Management |
| 3  | 166   | Zhang, L., Wang, J., You, J. | Consumer environmental awareness and channel coordination with two substitutable products | 2015 | European Journal of Operational Research | Elsevier        |
| 4  | 71    | Liobikiene, G., Juknys, R. | The role of values, environmental risk perception, awareness of consequences, and willingness to assume responsibility for environmentally-friendly behaviour: The Lithuanian case | 2016 | Journal of Cleaner Production              | Elsevier Ltd.   |
| 5  | 62    | Zhang, Y., Zhang, H.-L., Zhang, J., Cheng, S. | Predicting residents' pro-environmental behaviors at tourist sites: Therole of awareness of disaster's consequences, values, and place attachment | 2014 | Journal of Environmental Psychology      | Academic Press Inc. |
3.3. Theme 3: Analysis based on journal and publisher

Table 4. The Top five journals published articles in the area of environmental awareness.

| No | Journal Name                                                                 | Numbers of Article | Publisher                        |
|----|------------------------------------------------------------------------------|--------------------|----------------------------------|
| 1  | Journal of Cleaner Production                                                | 11                 | Elsevier Ltd.                    |
| 2  | Eurasia Journal of Mathematics, Science and Technology Education             | 6                  | Modestum Ltd.                    |
| 3  | International Journal of Environmental and Science Education                 | 4                  | International Society of Educational Research. |
| 4  | International Journal of Environmental Research and Public Health            | 4                  | Digital Publishing Institute     |
| 5  | Journal of Environmental Management and Tourism                              | 4                  | ASERS Publishing                 |

Table 5. The top five publishers published articles in the area of environmental awareness.

| No | Publisher                        | Numbers of Article | Journal Name                                                                 |
|----|----------------------------------|--------------------|------------------------------------------------------------------------------|
| 1  | Elsevier Ltd.                    | 16                 | International Journal of Production Economics (3), European Journal of Operational Research (2), Journal of Cleaner Production (11) |
| 2  | Taylor and Francis Ltd.          | 14                 | International Journal of Environmental Studies (2), International Journal of Sustainable Development and World Ecology (2), European Journal of Engineering Education (1), International Journal of Bilingual Education and Bilingualism (1), International Journal of Fashion Design, Technology and Education (1), International Journal of Qualitative Studies on Health and Well-being (1), International Journal of Sport Policy (1), International Journal of Urban Sustainable Development (1) Journal of Agricultural Education and Extension (1), Journal of Environmental Education (1), Journal of Health Communication (1), World Leisure Journal(1) |
| 3  | Inderscience Enterprises Ltd      | 7                  | International Journal of Environment and Sustainable Development (3), International Journal of Risk Assessment and Management (1), International Journal of Continuing Engineering Education and Life-Long Learning (1), International Journal of Environment and Pollution (1), International Journal of Environment and Waste Management (1). |
| 4  | Modestum Ltd.                    | 6                  | Eurasia Journal of Mathematics, Science and Technology Education (6)         |
| 5  | Emerald Group Publishing Ltd.     | 5                  | International Journal of Sustainability in Higher Education (2), Management of Environmental Quality: An International Journal (2), Journal of Corporate Real Estate (1) |

Table 4 shows that the journals that produce the most articles on environmental awareness come from the Journal of Cleaner Production published by Elsevier Ltd as many as 11 articles. and in Table 5 shows the publisher who published the most articles on environmental awareness from 2010-2019. The first position is occupied by the publisher Elsevier Ltd with 16 articles from 3 journal sources, including the International Journal of Production Economics (3), the European Journal of Operational Research (2),
the Journal of Cleaner Production (11). The number of citations from an article can be a reference for researchers to publish the results of their scientific studies in reputable journals [12].

3.4. Theme 4: Analysis based on author keyword

588 author keywords were analyzed with three minimum number of occurrences and from this analysis, 22 keywords that have strong links were generated. Table 6 shows the clustering of author keywords based on color and number of items. Meanwhile, Figure 4 shows the author's keyword mapping of the network visualization version, Figure 5 shows the author keyword mappings of the overlay visualization version, and Figure 6 shows the author's keyword mapping of the density visualization version. Bibliographical mapping provides an overview for researchers to become a reference for the related research that has been produced as a basis for further research development [13].

Table 6. Clustering of author keywords.

| Cluster | Color | Number Of Item | Author Keywords                                      |
|---------|-------|----------------|------------------------------------------------------|
| 1       | Red   | 5              | Attitude (3), Environmental Attitudes (3), Environmental Behaviour (4), Environmental Knowledge (5), Malaysia (5) |
| 2       | Green | 4              | Awareness (18), Environmental Health (6), Knowledge (3), Pollution (4) |
| 3       | Blue  | 4              | Environmental Attitude (3), Environmental Awareness (61), Environmental Education (14), Gender (3) |
| 4       | Yellow| 3              | Education (3), Environmental (3), Sustainability (7) |
| 5       | Purple| 3              | Environment (8), Environmental Sustainability (4), Higher Education (4) |
| 6       | Aqua  | 3              | Environmental Protection (5), Sustainable Development (4), Waste Management (3) |

Figure 4. Network visualization of author keywords.
4. Conclusion
The conclusions in this study are based on the four questions that have been raised previously. The first is about the trend of environmental awareness research publication in 2010-2019 based on the number of articles produced experiencing a decrease-increase-decrease-increase-decrease-increase pattern with the highest publication trend in 2019. Second, based on the citation pattern of the articles that have been produced, it forms a pattern of decline-increase-decrease-increase-decrease-increase with the highest
number of citations occurring in 2012 with 329 citations in the scope of business. The three journals that produce the most articles on environmental awareness come from Journal of Cleaner Production a total of 11 articles, for the publisher in the first position is occupied by publisher Elsevier Ltd a total of 16 articles were sourced from three journals. And fourth The terms that are the most widely used by the author as the author keywords in the article within the area of environmental awareness is environmental awareness (61), followed by Awareness (18), and environmental education (14).

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