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Geçmişten Günümüze Sürdürülebilir Kalkınma ve Eğitim Alanında: Bibliyometrik Bir Analiz

Mustafa DOĞRU[1*], Cem Oktay GÜZELLER[2], Melahat ÇELİK[3]

[1]*Akdeniz Üniversitesi, Eğitim Fakültesi, Antalya, Türkiye*
[2]*Akdeniz Üniversitesi, Turizm Fakültesi, Antalya, Türkiye*
[3]*Akdeniz Üniversitesi, Eğitim Fakültesi, Antalya, Türkiye*

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ÖZET

Çalışmanın amacı, Sürdürülebilir Kalkınma ve Eğitim alanında 2009-2018 yılları arasında yayımlanan 7000 çalışmayı bibliyometrik açıdan inceleyerek, alanda son 10 yıldaki eğilim ve trendleri ortaya koymaktır. Bu kapsamda, Web of Science Core Collection veri tabanında "Sustainable Development" ve "Education" konu başlıklarında tarama gerçekleştirilmiş ve çalışmalara ait bibliyometrik verilere ulaşılmıştır. Sürdürülebilir Kalkınma ve Eğitim ile ilgilenen akademisyen ve araştırmacılara katkı sağlamak amacıyla, sürdürülebilir kalkınma kavramıyla ilgili güncel konular, bu çalışma ile birlikte ortaya çıkarılmıştır. Çalışmalar; yıllara göre yayın sayıları, yayın türleri, yayın dilleri, atıf analizleri, ülke işbirliktelikleri, ortak atıf ağları ile kavram-konu yönelimleri bağlamında incelenmiştir. Ayrıca ortak atıf ağları ile kavram-konu yönelimlerinin belirlenmesinde sosyal ağ analizi kullanılmıştır. Analiz sonuçlarına göre, hem yayın hem de atıf sayıları bağlamında alana olan ilginin 2015 yılından sonra çarpıcı bir şekilde arttığı söylenebilir. Çalışmalar ağırlıklı olarak makale-bildiri türünde ve İngilizce dilinde gerçekleştirilmiştir. Amerika Birleşik Devletleri (ABD) ülke işbirlikteliklerinde kilit rol oynadığı, en fazla atıf sayısına sahip derginin Journal of Cleaner Production, yazarın ise Anonymous adı altındaki ismi belirlenemeyen yazarlar olduğu belirlenmiştir. Öte yandan Arnim Wiek, Lauren Withycombe ve Charles L. Redman (2011) ise alanda en çok atıf alan kaynaktır. Eğitim, sürdürülebilirlik ve Endonezya alanda en çok çalışılan konulardır.

Anahtar Kelimeler: Sürdürülebilir Kalkınma, Eğitim, Bibliyometri, Sosyal Ağ Analizi, Atıf

Genişletilmiş Özet

Amaç

Bir bilim dalının, dünyadaki durumunu ve gelişimini görebilmek, anlayabilmek ve de bu neticede değerlendirebilmek için önemli veri tabanlarında yer alan yayınları takip etmek gerekmektedir. Herhangi bir bilim dalında yapılmış çalışmaların literatürün belli dönemlerinde incelenmesi, bu alandaki araştırmacılara yol göstermesi, o alandaki gelişmelerin seyri açısından önemlidir. Bu şekilde ortaya çıkarılacak bulgular hem o bilim dalının zaman içerisinde göstermiş olduğu gelişmeyi, baskın olan eğilimleri hem de var olan sorunları tespit

* Sorumlu Yazarın Adresi: Akdeniz Üniversitesi, Eğitim Fakültesi, Antalya.
e-posta: mustafadogru@akdeniz.edu.tr

etme kolaylığı sağlayarak çözüm odaklı tartışma olanağı sağlayabilmektedir (Üsdiken & Pasedeos, 1993). Elde edilecek bulguların önemli veri tabanlarından ve akademik yayınlardan sağlanması bulguların ve sonuçların nesnelliğini sağlamaktadır. Bu doğrultuda bu çalışmanın amacı *Sürdürülebilir Kalkınma ve Eğitim* alanında 2009-2018 yılları arasında yayımlanan çalışmaları bibliyometrik açıdan inceleyerek alanda son 10 yıldaki eğilim ve trendleri ortaya koymaktır.

Yöntem

Sürdürülebilir Kalkınma ve Eğitim konu alanının bibliyometrik özelliklerinin belirlenmesi amacıyla yapılan bu çalışmada, araştırma probleminin çözümüne yönelik betimsel araştırma modeli kullanılmıştır. Betimsel araştırma modeli, belirli bir olay, durum veya olgunun var olan özelikleri ile açıklanmasıdır (Büyüköztürk, 2008).

Veri toplama Süreci ve Veri Analizi

Bu araştırmanın verilerini, Sürdürülebilir Kalkınma ve Eğitim alanında 2009-2018 yılları arasında yayımlanan ve Web of Science veri tabanında taranan 7000 çalışma oluşturmaktadır. Web of Science veri tabanı bilimsel yayınların atıf istatistikleri ve yayınların bibliyografik verilerine ulaşma imkânı sağlar (Meho & Yang, 2007). Web of Science Core Collection veri tabanında " *Sürdürülebilir Kalkınma"* ve "*Eğitim"* alanlarında yayımlanan 7000 çalışmanın yayın türleri, yayın dilleri, başlıkları, yazar adları, yazarların ülkeleri, kaç kaynağa atıfta bulundukları ve Web of Science'da taranan kaç kaynaktan kendilerine atıf yapıldığı ve kaynakça bilgilerine ulaşılmıştır. Ortak atıf ağları ile kavram-konu yönelimlerinin belirlenmesinde sosyal ağ analizi olan Cite Space uygulaması kullanılmıştır. Web of Science veri tabanında 7000 çalışmaya ait veriler Cite Space programına uygun formatta yüklenerek analizler yapılmıştır. Diğer veri tabanlarının literatür taramasına dahil edilmemesinin sebebi, analizlerin gerçekleştirildiği Citespace uygulamasının, Web of Science veri tabanı ile entegre çalışan güvenilir bir yazılım olmasıdır.

Bulgular ve Tartışma

Sürdürülebilir Kalkınma ve Eğitim alanında 2009-2018 yılları arasında yayınlanan 7000 çalışmanın yıllara göre dağılımında en çok çalışmanın 2017 yılında yapılmış olduğu görülmüştür (n=1201). Çalışmalar yayın türlerine göre incelendiğinde 11 farklı türde yayın yapıldığı belirlenmiştir. Bu türler makale, bildiri, eleştiri, editoryal materyal, kitap incelemesi, kitap bölümü, toplantı özeti, düzeltme, mektup, geri çekilen yayın, biyografik öge, haberler ve yeni baskıdır. Sürdürülebilir Kalkınma ve Eğitim alanında en çok çalışma yapılan yayın türlerine bakıldığında makale ve bildiriler ağırlıkta olup, bunların toplam içerisindeki oranı % 95.34'dir.

Sürdürülebilir Kalkınma ve Eğitim alanında yapılan çalışmalara yer verilmiştir. Çalışmalar toplamda 25 farklı dilde kaleme alınmıştır. 7000 çalışmadan, %91.61'sının dili İngilizce'dir. Bunu %3.11 ile İspanyolca takip etmektedir. Çalışmalar arasında Türkçe yayın da bulunmaktadır. Bulunan Türkçe yayın sayısı 7 tane olup %0,01'ini oluşturmaktadır. Yıllara göre atıf sayıları incelendiğinde, 7000 çalışmaya en fazla atfın 2018 yılında gerçekleştirildiği gözlenmiştir (n=8593).

Çalışmadaki veriler incelendiğinde, Amerika Birleşik Devletleri (ABD) hem diğer ülkelerle en fazla işbirliği içinde yer alan ülke (n=1034) hem de en yüksek merkezilik derecesine sahip ülke olduğu ortaya çıkmıştır. Ülkelerin atıf patlama değerlerine bakıldığında, en yüksek atıf patlamasına sahip ülke 2009-2010 yılları aralığında Romanya'dır (8. 8148). Romanya 2009-2010 yılları arasını kapsayan süreçte alana yön veren çalışmaların yapıldığı ülke konumunda olduğu görülmektedir. Ayrıca Sürdürülebilir kalkınma ve eğitim alanında yayımlanan güncel çalışmalara sıklıkla atıfta bulunan ülke ise Şili olmuştur.

Sürdürülebilir Kalkınma ve Eğitim alanında yayımlanan çalışmaların en çok atıfta bulunduğu dergi Journal of Cleaner Production dergisidir (n=844). Aynı zamanda Environmental Education Research dergisi en yüksek merkezilik derecesine sahip dergi konumundadır. Çalışmamızda dergilerin yıllara göre atıf patlama değerleri gösterilmiştir. Buna göre Our Common Future dergisi, en fazla atıf patlaması değerine sahiptir (31. 6808). Sürdürülebilir kalkınma ve eğitim alanında en çok atıf yapılan 10 yazar arasından bu alanın teorik hatlarını belirleyen Anonymous adı altındaki ismi belirlenemeyen yazarlar (n=1412), UNESCO (n=796) ve UNITED NATIONS (615) 'da ilk 3 sırada yer almaktadır. Yazarların atıf patlama değerlerine baktığımızda elde dilen veriler içerisinde en yüksek değerin 2009-2010 yılları arasında UNESCO (24.663) 'ya ait olduğu görünmektedir.

Yayın ortak analizinde yapılan kümeleme işlemi sonucunda 291 tane küme oluşmuştur. En büyük küme 192 elemanlı UNITED NATIONS tarafından 2015 yılında gerçekleştirilen sürdürülebilir kalkınma hakkındaki genel kurul raporudur. Bu rapor önemli ilk 10 kaynak içerisinde en güncel referans kaynak olarak gösterilebilir. Sürdürülebilir kalkınma ve eğitim alanında yayımlanan çalışmalarca en çok atıfta bulunulan kaynak Arnim Wiek, Lauren Withycombe ve Charles L. Redman tarafından 2011 yılında kaleme alınan makaledir. Bu kaynak alana yön veren ve ışık tutan en önemli referans kaynaktır.

Sonuç

Sürdürülebilir Kalkınma ve Eğitim alanında 2009-2018 yılları arasında uluslararası atıf indekslerinden Web of Science veri tabanında yayımlanan çalışmaların Bibliyometrik analizine odaklanan bu çalışmanın literatüre pek çok yönden katkısı bulunmaktadır. Öncelikle çalışmamız vasıtasıyla tüm dünyada "*Sürdürülebilir Kalkınma*" ve "*Eğitim*" alanlarında önde gelen çalışmaların hangileri olduğu ortaya koyulmaktadır. Bu da

bahsettiğimiz alanlarda çalışma yapanların dünya çapındaki çalışmaları daha yakından tanımaları ve gerçekleştirecekleri çalışmalarda bunları göz önünde bulundurmaları sürecine katkı sağlayacaktır. Bunun yanında alanyazına yön veren yazarlarla birlikte, onların odaklandıkları konular ve onların çalışmalarını yayınlanan dergiler de çalışmamız vasıtasıyla okuyucuların bilgisine sunulmaktadır. Alanyazına yön veren yazarlar ve dergiler yanında söz konusu alanlarda çalışma yapılan ülkeler ve ülkeler arasındaki ortak çalışmaların durumu da çalışmamız sayesinde ortaya konulmaktadır. Ortaya konulan bu bilgiler vasıtasıyla da dünyada "*Sürdürülebilir Kalkınma*" ve "*Eğitim*" alanlarındaki genel eğilimlerin hangi yönde geliştiği tarihsel bir bütünlük içerisinde takip edilmektedir. Çalışmamız vasıtasıyla tüm dünyada güncel tartışma ve gelişmelerin odağında olan "*Sürdürülebilir Kalkınma*" ve "*Eğitim*" kavramlarının hangi ülkeler tarafından aktif olarak işlendiği ve yönlendirildiği de okuyucuların dikkatine sunulmaktadır.

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A Bibliometric Analysis in the field of Sustainable Development and Education from Past to Present

Mustafa DOĞRU[1*], Cem Oktay GÜZELLER[2], Melahat ÇELİK[3]

[1] *Akdeniz University, Faculty of Education, Antalya, Turkey*
[2] *Akdeniz University, Faculty of Tourism, Antalya, Turley*
[3] *Akdeniz University, Faculty of Education, Antalya, Turkey*

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ABSTRACT

The purpose of this study is to show the tendencies and trends of the last 10 years in the field of Sustainable Development and Education by analyzing 7000 studies published between 2009-2018 bibliometrically. For this purpose Web of Science Core Collection database was scanned for "Sustainable Development" and "Education" headings and the bibliometric data of the studies were acquired. Current issues concerning sustainable development were revealed through this study for the purpose of making a contribution to those academicians and researchers interested in Sustainable Development and Education. The studies were analyzed according to: number of publications per year, types of publication, language of publication, citation analysis, country collaborations, common citation networks and concept-topic tendencies. In addition, social network analysis was employed for determining common citation networks and concept-topic tendencies. According to the results of this analysis, it can be said that the interest towards the field dramatically increased after 2000, in terms of both the number of publication and citations. The studies were mainly presented in the form of article or paper and in English. It was found that United States played a key role in country collaborations, the journal with the highest number of citations is Journal of Cleaner Production, whereas the author with the highest number of citations is Anonymous under which many citations were gathered. On the other hand, the study realized by Arnim Wiek, Lauren Withycombe and Charles L. Redman in 2011 is the most important reference source that has guided the field. Education, Sustainability and Indonesia are the most studied topics in the field.

Keywords: Bibliometrics, Citation Analysis, Education, Social Network Analysis, Sustainable Development.

Introduction

Although the impact of environmental and socio-economic problems emerged in the 17th century (Mittler, 2001), the period where they spread very rapidity was the 20th century (Sağdıç and Şahin, 2015). Environmental problems such as: depletion of the ozone layer, air pollution, global warming, and socio-economic problems, such as, hunger, migration and rapid population growth, increased in the 20th Century. The

* Corresponding author's address: Akdeniz University, Faculty of Education, Antalya.
e-mail: mustafafdogru@akdeniz.edu.tr

reason of them is the human-driven damage made to the environment while conducting improvement and development activities. In this process, people tended to look for various solutions for recovering this damage and preserving the natural balance. As a result, the concept of "*Sustainable Development*" was created. Sustainable Development was defined as "*the ability to make development sustainable to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs*" (WCED, 1987). After the creation of the concept of sustainable development, there was the need to disseminate this understanding. It was understood that the solution of this problem is education. It was emphasized that education will be the key aspect in providing sustainable development awareness and a perspective of sustainable development to the community (UNCED, 1992; WSSD, 2002). In addition, people today recognized that the progress and trend of the economy does not fit with the concept of sustainability, thus they concluded that the efforts should be directed towards rising community awareness and education (McKeown, Hopkins, Rizzi, Chrystalbride, 2002). It is assumed that in this case the ideas, values and behaviors of the community will fundamentally change in favor of sustainable development, which will be positively reflected in people's behavior (Leiserowitz, Kates & Parris, 2006).

In the modern world, it is emphasized that the concept of Sustainable Development can be provided to the society only through education and that the necessary cognition, feeling and behavior change can be ensured in individuals by means of Sustainable Development-centered education. This worldwide general trend is also important for Turkey, as a developing country (Ozturk, 2017). The education concept of our age should aim to give individuals the main themes of "one world, coexistence and world citizenship" and this idea is constantly promoted. Therefore, sustainable development and education are inseparably integral concepts. Based on the relationship between these two concepts many concepts, including, environmental education, ecopedagogy, ecological learning, sustainability education, sustainable pedagogy, etc. have been emerged. The meaning attributed to all of these concepts is to emphasize the role of educational activities in transforming societies in order to have a sustainable future for the whole world (Öztürk, 2017).

The concept of "Education for Sustainable Development", whose foundations date back to the 1970s, was first adopted in 1987 at the United Nations General Assembly. Under this concept, which has matured in many different practices from 1987 to the present, an important start took place with the Agenda 21 Action Plan adopted in the United Nations Conference on Environment and Development in 1992, in the 36th section under the title "Development of Education, Public Awareness and Training". The three subheadings adopted here clearly reveal the role of education in Sustainable Development (Kabadayı, 2015). The concept of education for sustainable development has also come to the fore in the 4th meeting of the United Nations Commission on Sustainable Development in 1996, where it was decided to make radical changes in education, which are necessary to promote sustainable development. In the general assembly meeting of the United Nations on

20 December 2002, the period between 2005 and 2014 was declared as “Ten Years of Education for Sustainable Development”. Thus, it has been decided to develop many new policies and practices related to the contribution of education to the sustainable development process. This process ended with the “*UNESCO World Conference on Education for Sustainable Development*” held in Japan in 2014. In the conference, it was seen that, in many world countries social, environmental and economic dimensions of education were more considered compared to the past, the modifications were made in education systems in accordance with the decision taken. It was revealed that more and more countries have set new strategies for sustainable development (Kabadayi, 2015).

Regarding the institutions that give direction to the trends that have started in the field of sustainable development, the Foundation for Environmental Education (FEE) can be mentioned first. The Foundation carries out activities for the implementation and development of the projects in the field of education for sustainable development, across Europe and South Africa. Thanks to their projects, the Agenda 21 Action Plan adopted by the United Nations gains functioning. The Eco-Schools Project is another example of activity in the field of education for Sustainable Development. This project, which aims to provide environmental awareness, environmental management and sustainable development education in schools, includes schools from all over the world. In our country, Environmental Education Foundation is engaged in the coordination of the Eco-Schools Project. Despite all the efforts mentioned above, the desired status has not been reached yet. In order to achieve the desired level of education for sustainable development, this issue needs to become a state policy (Yapıcı, 2003). In order to establish the concept of sustainable development in society, the awareness of society on this issue should be developed first. Education is one of the most important tools in the creation and development of this awareness. However, there are some problems that education is facing regarding sustainable development. One of them is that the response of the people to environmental problems didn’t improved since the 17th century because of their ignorance about their personal responsibility. This also means that no lessons have been learned from the past. For this reason, education for sustainable development should be given by providing values for the future. In addition, providing personal perceptions besides developing global perceptions should be targeted as well (Teksöz, 2014).

The most significant way of integrating sustainable development philosophy into education is through imparting this philosophy to educational institutions and to ensure that it is covered in their curriculums. Thus, concerns about the common future of the world can be shared and the collective consciousness required for producing and executing solutions can be generated in new generations. The economic competition of today’s world and the huge budget allocated for armaments are giving serious damage to the philosophy of sustainable development. The way of preventing it, is equipping all systems related to education with a common sprit and philosophy and motivating them. The only negative aspect of it, is that it takes time to see the outcomes of the investments made in education. However, the investments

made on education should be seen as an effort worth trying for the common future of the world (Yapıcı, 2003).

It is obvious that education is alone insufficient for the establishment of sustainable development and a sustainable future, but this is the main difficulty encountered while establishing a sustainable world. The educators in all nations of the world should make contribution to this process, in this way it may be possible to end seeing a sustainable world as a dream (Unesco, 2005). In this process, the community should take responsibility in addition to the contribution and responsibilities of the educators. McKeown et al. (2002), emphasized that all disciplines could not focus solely on education for sustainable development and that they should not.

In order to visualize, understand and correctly evaluate the status and development of a discipline in the world, publications in the important databases should be followed. Analyzing the studies made in a discipline during a certain period of the literature is important in terms of guiding the researchers, and establishing the course of the progress in this field. The findings that will be revealed in this way will allow us to determine the progress of the discipline over time, dominant trends and existing problems, thus it may provide the opportunity for solution-oriented debates (Üsdiken and Pasedeos, 1993). Obtaining the data for this research from important databases and academic publications ensure the objectivity of the findings and results.

In order to reveal the patterns, intellectual characteristics and up-to-dateness of the researches conducted in a scientific area, the studies that have mostly affected the researches on this area and accordingly the most studied sub-fields and the most cited authors in the field should be analyzed (Åström, 2007; White, 2003; Shiffrin and Börner, 2004; Small, 1973; Zhao and Strotmann, 2008). There is no such study revealing intellectual characteristics of the field of Sustainable Development and Education, either domestically, or internationally. However, bibliometric characteristics of all publications published in the citation directory of a particular field or discipline were examined. In these researches many attributes were analyzed, including type of publication, language of publication, the country with most publication, the authors with most publications, and the most cited sources. Many researchers have bibliometrically analyzed the studies published in SCI (Science Citation Index): for example, Gökçeoğlu and Sezer (2009) concerning landslides; Uzun (2002) concerning renewable energy outputs of twenty-five big nations and Konur (2011) concerning moss and bioenergy. Scientific progress is the most important factor for the economic and cultural development of society. Therefore, an objective evaluation of the researchers, educational institutions and research activities of the countries will help to understand the current state of the scientific structure in a given area and its possible future development (Matcharashvili et al., 2014, 346). Bibliometric analysis is an analysis technique used to reveal the current state of a particular discipline, field or subject and to predict future trends. Bibliometric methods provide quantitative analysis of written publications. The use of bibliometric methods stems from the need of assessing scientific production clearly

and presenting the obtained results in a way allowing policy-makers, scientists or other stakeholders to benefit from them (Ellegaard, 2015, 1810-1812). In our study, scientific researches on sustainable development and education will be examined using bibliometric techniques. Thus, prominent writers, countries, studies in this field and the concepts that emerged in the context of these studies will be identified and inferences will be made about their future trends.

Purpose of the Research and Sub-Problems

The purpose of this study is to determine the tendencies and trends in the last 10 years through the bibliometric analysis of 7000 studies published in the field of Sustainable Development and Education, between 2009 and 2018. Determining the bibliographic characteristics of 7000 studies published in the field of Sustainable Development and Education in 2009-2018 and scanned in the Web of Science database constitutes the problem of the study. In this context, the following sub-problems determined within the scope of the research were addressed:

Regarding scientific studies performed in the field of sustainable development and education:

1- What is the distribution according to the number of publications on an annual basis?

2- What is the distribution according to the type of publication?

3- What is the distribution according to the language of publication?

4- What is the distribution according to the number of citations?

5- What is the distribution according country collaborations and productivity?

Regarding Sustainable Development and Education;

6- What are the journals guiding the field?

7- Who are the researchers guiding the field

8- What are the researches guiding the field?

9- What are the emerging trendy topics and how they are shaped?

Methodology

In this study, which aims to determine the bibliometric properties of Sustainable Development and Education subject area, the descriptive research model was used to address the research problem. Descriptive research model is the explanation of a particular event, situation or phenomenon with the existing features (Büyüköztürk, 2008).

Data Collection Process

In the study, the data on Sustainable Development and Education were obtained from the Web of Science database, which provides access to the citation statistics of scientific publications and the bibliographic data of the publications (Meho and Yang, 2007). In the Web of Science database, “sustainable development

and education" was used as the term to search. In the literature, bibliometric studies have an approach that periodically examines the scientific studies at specific time intervals (Palmer et al., 2005; Wei & Zhao, 2015). This allows researchers to examine current trends in a particular area for research design (such as the last decade) or periodically make temporal comparisons. Since the study was designed to reveal current developments and trends in the last decade (2009-2018), in the field of sustainable development and education, it has been restricted in terms of time. As a result of the review, 7000 studies have been accessed. The reason of excluding other databases in the literature review is that the Citespace application, by which the analyzes were performed, is a reliable software that is integrated with the Web of Science database.

The types of publication, languages of publication, titles, name of the authors, country of the authors, number of sources cited in the study, number of sources (scanned in Web of Science) that cited the study as a source and references data of 7000 studies contained in the fields of "Sustainable Development" and "Education" were reached through Web of Science Core Collection database. The reason of including all types of publications in the analysis is that each type of publication adds a separate scientific quality and richness to the topic of sustainable development and education. For example, the book chapters provide a summary of the content of a basic work written in the field, whereas proceedings are useful sources for identifying current scientific discussions and foci in the field, etc.

Data Analysis

Cite Space application, which is a social network analyzer, was used to determine common citation networks and concept-topic tendencies. The data of 7000 studies obtained from Web of Science database was uploaded to Cite Space software in the appropriate format. Cite Space is a Java application to visualize and analyze the emerging trends and the changes on scientific literature (Chen, Ibekwe-San Juan & Hou, 2010.

As a result of the analysis conducted, several characteristics of the created network were calculated, including network density, modularity and mean silhouette (Q) values of the network. The figure showing the amount of connection in a network is network density (Al and Doğan, 2012). The concept indicating the strength of division of a network into modules is modularity value, which varies between 0-1 and has particular meaning according to its magnitude. A high modularity value shows a well-structured network, whereas low modularity value indicates an ill-structured network that cannot be reduced into modules with clear boundaries (Chen et al., 2010). Modularity value being equal or higher than 0.6 means that the division is meaningful (Newman, 2004). On the other hand, mean silhouette value varies between -1 and 1 (Chen et al., 2010). This value, which indicates the number of clusters, should be higher than 0.7 in order to show a strong clustering (Simovici, 2007).

The positions of country collaborations, cited journals and publications, and concepts in the network were determined according to their betweenness centrality

value, which indicates the degree of the connection between a node and other nodes that are not connected to each other (Ni, Sugimoto, Robbin, 2017). Another important finding of the study is citation bursts, which indicate statistically significant fluctuations of a frequency over the total time period (Chen et al., 2010).

Findings

Findings of the First Sub-Problem

Number of Publications According to Years

Table 1. Distribution of Publications by Years

Years	Frequency (n)	Percentage (%)
2009	314	4.48
2010	428	6.11
2011	468	6.68
2012	476	6.80
2013	566	8.08
2014	550	7.85
2015	927	13.24
2016	1.053	15.04
2017	1.201	17.15
2018	1.017	14.52
TOTAL	**7000**	**100**

Regarding the distribution of the 7000 studies in the Sustainable Development and Education field between 2009-2018 according to years displayed in Table 1, it is seen that the highest number of studies was performed in 2017 (n=1201). The number of published studies generally increased in each time period.

Findings of the Second Sub-Problem

Types of Publication

Table 2. Distribution of Publications According to Type

Type of Publication	Frequency (n)	Percentage (%)
Article	4055	57.92
Paper	2620	37.42
Critics	251	3.58
Editorial Material	109	1.55
Book Review	27	0.38
Book Section	10	0.14

Table 2 shows the studies according to publication type; it was found that 11 different types of publication were made, which are article, paper, critics, editorial material, book review, book section, meeting summary, correction, letter, retreated publication, biographical items, news, and new edition. The top 6 types of publication made in the field of Sustainable Development and Education are displayed in Table 2. Since some studies are included in more than one category, the percentages were calculated over 7089 publications. The ratios of the publication in the form of the article and paper are quite high; their percentage in overall is 95.34 %.

Findings of the Third Sub-Problem

Language of publication

Table 3. Distribution of Publications According to Languages

Language	Frequency (n)	Percentage (%)
English	6413	91.61
Spanish	218	3.11
Chinese	96	1.37
Portuguese	93	1.32
German	47	0.67

Table 3 shows the studies made in Sustainable Development and Education field according to the publication language. The studies were written in 21 different languages. The top 5 publication languages are shown in the table. 91.61% of 7000 studies are in English, followed by Spanish with 3.11%. There are some studies in Turkish as well; but the number of publications in Turkish is only 7, which constitutes 0.01% of the publications.

Findings of the Forth Sub-Problem

Citation Analysis

A total of 30,829 sources were cited by 7000 studies published in the field of Sustainable Development and Education in 2009-2018.

Table 4. Number of Citations Received according to Years

Years	Number of Received citation	Percentage (%)
2009	70	0.22
2010	277	0.90
2011	672	2.19
2012	1156	3.77
2013	1902	6.24
2014	2558	8.39
2015	3827	12.50
2016	4657	15.21
2017	6886	22.50
2018	8593	28.08
TOTAL	**30.598**	**100.00**

Regarding the number of citations received according to years displayed in Table 4, it was observed that the maximum number of citations made to 7000 studies have been realized in 2018 (n=8593). The citations received in the determined time periods constantly increased over the years.

Findings of the Fifth Sub-Problem

Country Collaborations

Social network analysis was performed to determine the researches that researchers from different countries have performed together. The countries were scaled according to the degree of centrality and showed in Figure 1.

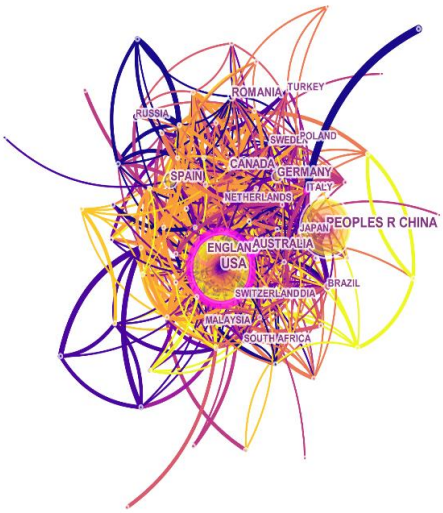

Figure 1. Country Collaborations

N=83 E=0 Density= 0 Modularity Q= 0.21 Mean Silhouette= 0.25 Number of Cluster= 7

As a result of this analysis, a network consisting of 83 nodes was obtained. The network is divided into 7 clusters. While analyzing country collaborations, a country was counted once for the publications containing two or more authors from the same country. Each node of the network represents a country, whereas each connection represents the relationship between countries. The lines between nodes get thicker as the number of connections increases. The modularity value of the network was found to be Q= 0.21, whereas mean silhouette value is 0.25. The network values of top 10 countries, which have a significant place in the network, are given in detail, in the table below.

Findings of the Sixth Sub-Problem

Table 5. Country Collaborations and Degree of Centrality

Countries	Frequency	Year	Cluster#	Countries	Frequency	Year	Cluster#
USA	1034	2009	2	USA	0.23	2009	2
Chinese	947	2009	2	England	0.12	2009	1
England	573	2009	1	Australia	0.12	2009	2
Australia	397	2009	2	Italy	0.10	2009	3
Spain	354	2009	1	Netherland	0.09	2009	1
Germany	352	2009	1	Canada	0.08	2009	1
Romania	317	2009	3	Scotland	0.07	2009	0
Canada	247	2009	1	Spain	0.06	2009	1
Brazil	231	2009	2	Swiss	0.06	2009	0
Sweden	221	2009	1	Belgium	0.06	2009	1

According to the data presented in Table 5, USA seems to be the country making the most collaborations with other countries (n=1034). Moreover, USA is the country with the highest centrality.

Table 6. Citation Burst Values of the Countries according to Years

Countries	Burst	Start	End	2009-2018
Romania	8.8148	2009	2010	
Latvia	8.4508	2010	2014	
China	6.1831	2011	2012	
Chile	5.9149	2015	2016	
Bulgaria	5.1208	2009	2012	

Regarding citation burst values of the countries according to years in Table 6, the country with the highest citation burst is Romania, in 2009-2010 (8.8148). Again, Romania is seen to be the country that guided the field in 2009-2010. In addition, Chile is the country that was frequently cited in the recent studies published in the area of Sustainable Development and Education.

Journal's Common Citation Network

The common citation network analysis of the journals aims to determine the journals, in which the significant scientific studies that were cited by other studies have been published in the field of Sustainable Development and Education.

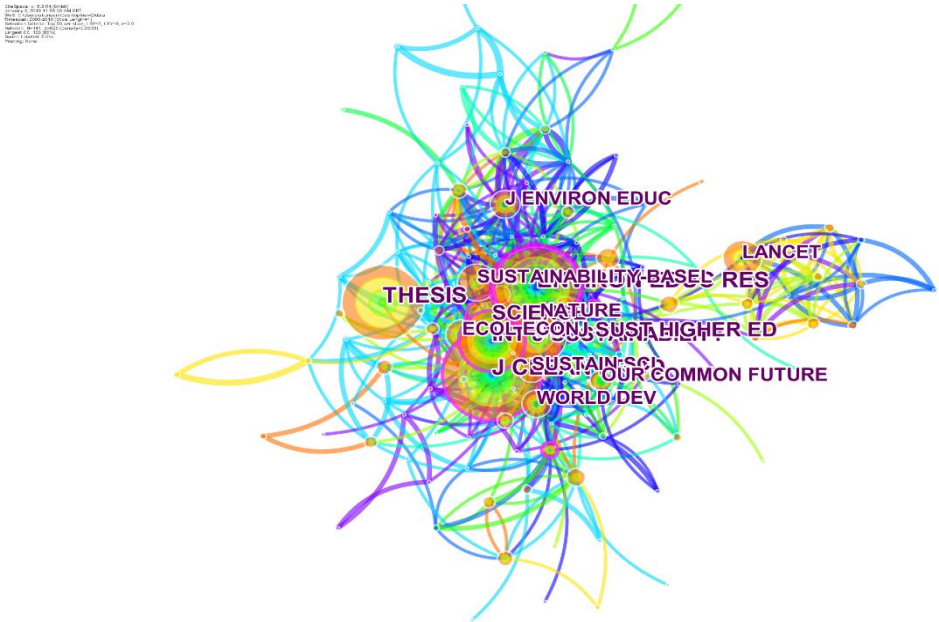

Figure 2. Journal's Common Citation Network

Journal's Common Citation network in Figure 2 consists of 140 nodes (journals that are source of the citations), its modularity value is Q= 0. 51, whereas mean silhouette value is 0.35. Citation bursts are displayed in Table 8.

Table 7. Journals Receiving Common Citations and Degree of Centrality

Journals	Frequency	Year	Cluster #	Journals	Centrality	Year	Cluster #
Journal of Cleaner Production	844	2009	2	Environmental Education Research	0.25	2009	0
Environmental Education Research	744	2009	0	Journal of Cleaner Production	0.16	2009	2
Thesis	694	2011	0	Ecological Economics	0.16	2009	1
International Journal of Sustainability	576	2009	2	Proceedings of the National Academy of Sciences of the United States of America	0.15	2009	1
International Journal of Sustainability in Higher Education	539	2010	2	International Journal of Sustainability	0.14	2009	2
Science	472	2009	1	Science	0.11	2009	1
The Lancet	388	2009	3	Science Education	0.10	2009	0
Ecological Economics	352	2009	1	Academy of Management Review	0.10	2010	4
Sustainability-Basel	348	2013	0	Conservation Biology	0.09	2009	1
Journal of Environmental Education	331	2009	0	World Development	0.09	2009	1

As can be seen from Table 7, the journal that has been cited the most by the studies published in the field of Sustainable Development and Education is Journal of Cleaner Production (n=844), but Environmental Education Research is the journal with the highest degree of centrality.

Table 8. Citation Burst Values of the Journals according to Years

Journals	Burst	Start	End	2009-2018
Our Common Future	31.6808	1990	2012	
Science Education	22.7705	2009	2015	
Journal of Engineering Education	20.3134	2013	2014	
Education Research	19.3053	2013	2014	
International Journal of Engineering Education	14.2882	2008	2012	

The citation burst values of the journals according to years are shown in Table 8. Our Common Future journal has the highest citation burst value (31.6808). On the other hand, Science Education (2009-2015) journal is among the journals cited by the most recent researches in the field.

Findings of the Seventh Sub-Problem

Author's Common Citation Network

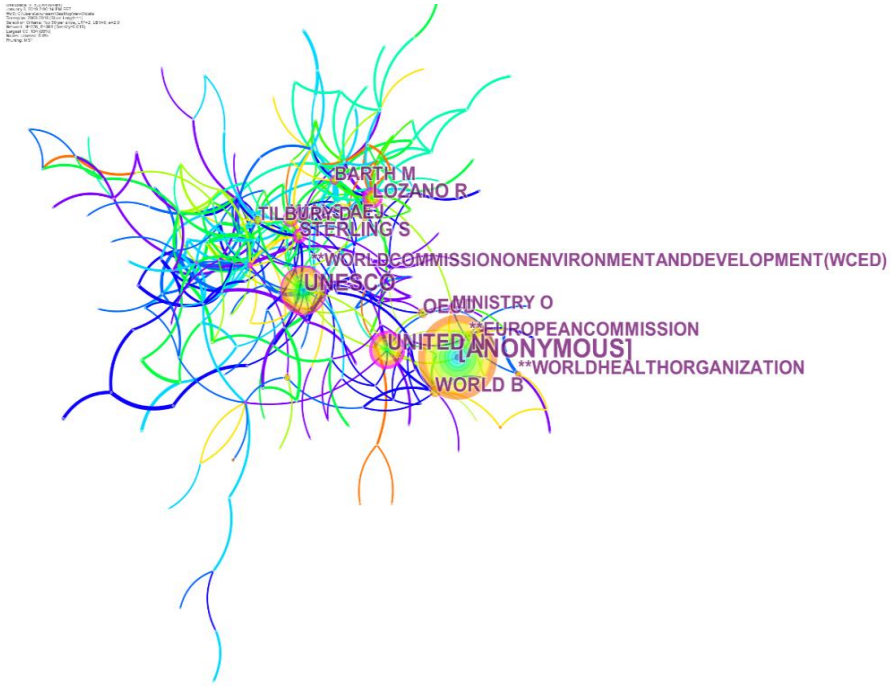

Figure 3. Author's Common Citation Network

Author's common citation network shown in Figure 3 consists of 222 nodes (authors that are source of the citations) and 377 clusters. Its modularity value is Q= 0. 46, and mean silhouette value is 0.16.

Table 9. Number of Citation for Commonly Cited Authors

Authors	Number of Citation	Year	Cluster#
Anonymous	1412	2009	2
UNESCO	796	2009	5
United N.	615	2009	2
Lozano R.	312	2009	0
World B.	298	2009	2
Wals AEJ	295	2009	1
Sterling S.	289	2009	3
OECD	277	2009	2
Tilbury D.	244	2009	5
European Commission	225	2010	2

Table 9 shows top 10 authors that get common citations. It can be seen from Table 9 that regarding the mostly cited authors in Sustainable Development and Education area, the ones that determine the theoretical shapes of this area are unnamed authors gathered under title Anonymous (n=1412), followed by UNESCO (n=796) and UNITED NATIONS (615). Both Lozano R. (n=312) and World B (n=298), who contributed on the development of the field, come after them.

Table 10. Citation Burst Values of the Authors According to Years

Authors	Burst	Start	End	2009-2018
UNESCO	24.663	2009	2010	
Scot W.	14.7298	2009	2013	
World B.	14.6627	2009	2011	
Fien J.	12.4364	2009	2013	
UN	11.3953	2009	2011	
WHO	10.8513	2009	2011	
Gough S.	9.8534	2009	2012	
Fullan M.	8.1492	2009	2012	
Senge P.M.	8.1492	2009	2012	
Jensen B.	7.776	2010	2012	

According to citation burst values of the authors in Table 10, it can be seen that the highest value in 2009-2010 belongs to UNESCO (24.663). It can be said that the studies of UNESCO have leaded the researches made in the 1-year period. In terms of topicality, it can be said that the researches of Fien J. (2009-2013) and Scott W. (2009-2013) attract attention in the recent years.

Regarding the results of citation burst values, it can be seen that there are only 4 authors common in mostly cited authors and popular authors, which are UNESCO, UNITED NATIONS, World B. and WHO.

Findings of the Eighth Sub-Problem

Publication's Common Citation Network

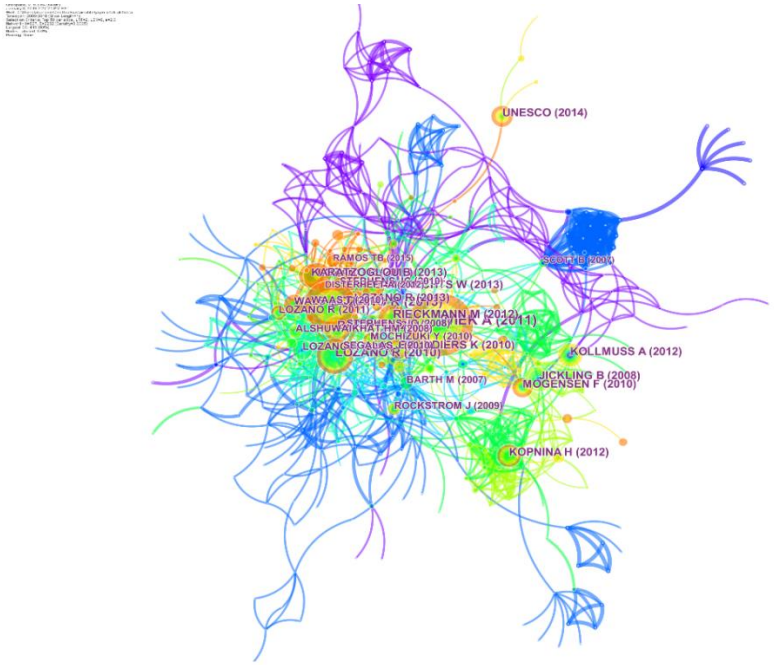

Figure 4. Publication's Common Citation Network

Publication common citation network analysis include the publications mentioned in the references. As a result of the analysis 825 publications have been covered in the analysis. The map formed by this analysis is shown in Figure 4, its modularity value is 0.78 and mean silhouette value is 0.15.

Table 11. Number of citations taken by Citation Sources

Sources	Number of Citations	Year	Cluster#
Wiek, A., Withycombe, L. & Redman, C. L. (2011). Key Competencies in Sustainability: A Reference Framework for Academic Program Development. *Sustain Sci* 6, p. 203-218.	126	2011	0
Lozano, R., Lukman, R., Lozano, F. J., Huisingh, D. & Lambrechts, W. (2013). Declarations for Sustainability in Higher Education: Becoming Better Leaders, Through Addressing the University System. *Journal of Cleaner Production*, 48, p. 10-19.	103	2013	1
United Nations, (2015). Transforming our World: the 2030 Agenda for Sustainable Development. *United*	87	2015	192

Nations Sustainable Development Summit 2015 (Resolutions and decisions A/RES/70/1, p. 1-35.			
Lozano, R. (2010). Diffusion of Sustainable Development in Universities' Curricula: An Empirical Example from Cardiff University. *Journal of Cleaner Production*, 18, p. 637-644.	75	2010	1
Barth, M. & Rieckmann, M. (2012). Academic Staff Development as a Catalyst for Curriculum Change Towards Education for Sustainable Development: An Output Perspective. *Journal of Cleaner Production,* 26, p. 28-36.	57	2012	0
Lozano, R., Ceulemans, K., Alanso-Almeida, M., Huisingh, D, Lozano, F. J., Waas, T., Lambrechts, W., Lukman, R. & Huge, J. (2015). A Review of Commitment and Implementation of Sustainable Development in Higher Education: Results from a Worldwide Survey. *Journal of Cleaner Production,* 108, p. 1-18.	55	2012	1
Jickling, B. & Wals, A. E. J. (2008). Globalization and Environmental Education: Looking Beyond Sustainable Development. *Journal of Curriculum Studies*, 40, p. 1-21.	54	2015	1
Karatzoglou, B. (2013). An in-depth Literature Review of the Evolving Roles and Contributions of Universities to Education for Sustainable Development. *Journal of Curriculum Studies*, 49, p. 44-53.	52	2008	5
Kollmuss, A, & Agyeman, J. (2002). Mind the Gap: Why do People Act Environmentally and What Are the Barriers to Pro-environmental Behavior?. *Environmental Education Research*, 8/3, p. 239-260.	51	2013	1
Barth, M. & Rieckmann, M. (2012). Academic Staff Development as a Catalyst for Curriculum Change Towards Education for Sustainable Development: An Output Perspective. *Journal of Cleaner Production,* 26, p. 28-36.	49	2012	5

Table 11 shows the number of citations taken by citation sources. As a result of the clustering made in common publication analysis, 291 cluster were formed. The biggest cluster has 192 elements and it is the general assembly reports realized by UNITED NATIONS, in 2015. This report can be seen as the most recent reference source among the top 10 significant sources. The source that has been cited the most by the studies published in Sustainable Development and Education area is the article included in Cluster#0, written by Arnim Wiek, Lauren Withycombe and Charles L. Redman, in 2011.

Table 12. Citation Burst Values of the Sources according to Years

Authors	Burst	Start	End	2009-2018
Scott, W. & Gough, S. (2003). *Sustainable Development and Learning*. Routledge Press, New York.	6.3519	2009	2011	
Cash, D. W., Clark, W. C., Alcock, F., Dickson, N. M., Eckly, N., Guston, D. H., Jager, J. & Mitchell, R. B. (2003). Knowledge Systems for Sustainable Development, (Ed.) Cozzarelli, N. R., *Proceedings of the National Academy of Sciences of the United States of America*, 100/14, p. 8086-8091.	5.3373	2010	2011	
Cortese, A. D. (2003). "The Critical Role of Higher Education in Creating a Sustainable Future", *Planning for Higher Education Journal* 31/3, p. 15-22.	4.3605	2009	2011	
Thomas, I. (2004). Sustainability in Tertiary Curricula: What is Stopping it Happening?, *International Journal of Sustainability in Higher Education*, 5/1, p. 33-47.	4.0719	2010	2012	
Mckeown, R & Hopkins, C. (2003). EE ≠ ESD: Defusing the Worry, Enviromental Education Research, 9/1, p. 117-128.	3.9629	2009	2011	

Table 12 includes top five sources with the highest citation burst. The frequency of the citations made to the sources may vary because in some periods particular studies received intense citations on the basis of the examined subject. Regarding the periods of the sources aroused as a result of the citation bursts in Table 12, "Scott, W. & Gough, S. (2003), *Sustainable Development and Learning*. Routledge Press, New York" is the publication that has drawn interest for the longest time in the literature.

Findings of the Ninth Sub-Problem

Sustainable Development and Education Topic Clusters

The publication's common citations network is also used to identify the trend of the topics in a field. Numerous citations made to a particular source in a certain area, by different studies is an indicator that these studies are working on similar-related topics (Ukşul, 2016).

Table 14. Topic Clusters Formed according to Citation Sources

Cluster	Size	Mean Silhouette	Label (TFIDF)	Label (LLR) p-value	Average Citation Year
0	38	0.503	Education	Sustainability Education (1077,54, 1.0E-4)	2011
1	38	0.462	Education	Young People (1272,6, 1.0E-4)	2011
2	36	0.483	Education	Haor Livelihood (2128,27, 1.0E-4)	2010
3	19	0.682	Sustainability	Ng e-course (1294,6, 1.0E-4)	2010
4	19	0.674	Education	Science Teachers Selection (1308,79, 1,0E-4)	2010
5	2	1	Indonesia	Rural Development (71,97, 1.0E-4)	2009

As can be seen from Table 13, it can be said that the largest cluster is Cluster #0, including the studies related to Education (n=38). The silhouette value of the cluster is 0.503. The most recent research topics in the field is Education.

Discussion

Regarding the distribution of 7000 studies published between 2009-2018 in the field of Sustainable Development and Education, it is seen that the highest number of studies was conducted in 2017 (n = 1201). The review of the studies according to the publication types showed 11 different types of publications, which are article, paper, critics, editorial material, book review, book section, meeting summary, correction, letter, retreated publication, biographical items, news, and new edition. Regarding mostly performed publication types in the field of Sustainable Development and Education, articles and papers constitutes the majority, with a percentage of 95.34% in overall.

The studies were written in 25 different languages. 91.61% of 7000 studies are in English, followed by Spanish with 3.11%. There are some studies in Turkish as well; but the number of publications in Turkish is only 7, which constitutes 0.01% of the publications. Regarding the number of citations according to years, it was observed that the maximum number of citations made to 7000 studies have been realized in 2018 (n=8593).

According to the data of the study, USA was found to be the country making the most collaborations with other countries (n=1034), and the country with the highest centrality degree. Regarding citation burst values of the countries, the

country with the highest citation burst is Romania in 2009-2010 (8.8148). Romania appears to be the country where the studies that guided the field in 2009-2010 have been performed. In addition, Chile is the country that was frequently cited in the recent studies published in the area of Sustainable Development and Education.

The journal that has been cited the most by the studies published in the field of Sustainable Development and Education is Journal of Cleaner Production (n=844). At the same time, Environmental Education Research is the journal having the highest degree of centrality. The citation burst values of the journals according to years are shown in our study. Accordingly, Our Common Future journal has the highest citation burst value (31.6808). Regarding the mostly cited authors in Sustainable Development and Education area, the top three that determine the theoretical shapes of this area are unnamed authors gathered under title Anonymous (n=1412), followed by UNESCO (n=796) and UNITED NATIONS (615). Regarding citation burst values of the authors, it can be seen that the highest value in 2009-2010 belongs to UNESCO (24.663).

As a result of the clustering made in common publication analysis, 291 cluster were formed. The biggest cluster has 192 elements and it is the general assembly reports realized by UNITED NATIONS, in 2015. This report can be pointed as the most recent reference source among the top 10 significant sources. The source that has been cited the most by the studies published in Sustainable Development and Education area is the article written by Arnim Wiek, Lauren Withycombe and Charles L. Redman, in 2011. This is the most important reference source that guided and brought light to the area.

Conclusion and Suggestions

The concept of sustainable development and addressing it through education, allocating more place for it in education programs, is a subject on which researchers, who are academically interested in this topic and who examine this topic, have worked extensively. Sustainable Development and Education is an area of academic interest. Thus, it is important to reveal the general situation of this subject.

This study, which focuses on the bibliometric analysis of studies published in the Web of Science database of international citation indexes between 2009-2018 in the field of Sustainable Development and Education, contributes to the literature in many ways. First of all, the most important works in the fields of "*Sustainable Development*" and "*Education*" all around the world were revealed, which will contribute to those who study in the mentioned areas to know better the studies conducted around the world and to take them into account. In addition to this, the authors who guide the literature, the topics they focus on and the journals that publish their works are presented to the readers through our study. Along with the authors and journals that guided the literature, the countries working in the mentioned fields and the status of the joint studies between the countries were also revealed by our study. With this information, the direction of general trends in the

fields of "*Sustainable Development and Education*" in the world can be followed with a historical integrity. The countries actively processing and guiding the concepts of "*Sustainable Development and Education*", which are the focus of current discussions and developments all over the world, were also brought into the attention of the readers.

This bibliometric analysis method performed in the field of Sustainable Development and Education can also be applied to different subject areas. The data of the research topic can be obtained through Web of Science database and the number of publications by years, publication types, publication languages, citation analyzes, country collaborations, common citation networks and concept-topic tendencies can be determined. Globally prevalent tendencies and current trends can be determined through the bibliometric study performed here and similar ones, which may provide new studies with the opportunity of following successful publications, and processing current topics. It is quite obvious that nowadays, the issue of being aware of the current situation is a necessity in all areas. In addition to identifying successful publications, this type of work will also increase the request for accessing these publications. In this way, this research should also increase the quality of the research process.

Bibliometric analysis of international journals that are pioneers in Sustainable Development and Education can be performed. With the help of this analysis, the articles published in the popular journal of the field in certain years and scanned in the Web of Science database can be accessed and the bibliometric characteristics of these articles can be determined. For example the following can be identified: the distribution of the publications in a certain journal according to years, types, languages, authors, institutions and countries; the presence of common characteristics; the distribution of the authors by titles; the distribution of the citations taken by the publications and authors; literature aging of the journal; the distribution of the sources cited in the publications by being domestic and foreign and according to their age; the pattern formed by the journals and authors cited in the publications; and topic trends in the publications and the position of the journal in Citation Reports

The increase in the number of international studies in the field of Sustainable Development and Education in Turkey is expected to carry our country one step ahead in the world literature.

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