Framework for using online social networks for sustainability awareness

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Abstract

Purpose – This study aims to contribute to the field of computer systems for sustainability research. It proposes a framework for sustainability awareness using online social networks (OSNs) by analyzing major research streams of the current state of knowledge and different bibliometric variables, and identifies a future research agenda in the field.

Design/methodology/approach – The preferred reporting items for systematic review and meta-analysis (PRISMA) methodology, content analysis and bibliometric tools were employed to identify, select, collect, synthesize, analyze and evaluate all research published on sustainability awareness using OSNs to provide complete insight into this research area.

Findings – This study proposed a framework comprising four categories for sustainability awareness using OSNs. These four categories are: the key factors to success, analysis of existing tools, proposal of new methods, approaches and theoretical frameworks, and case examples. In addition, this study synthesized the future research challenges for each category of the proposed framework.

Originality/value – Fostering sustainability awareness and sustainable behavior using OSNs is a growing area of research that seeks cultural change in society to achieve sustainable development. Through OSNs, people can discover and become aware of the consequences of unsustainable practices and habits in society, and learn how to develop sustainable behavior.

Peer review – The peer review history for this article is available at https://publons.com/publon/10.1108/OIR

Keywords Online social networks, Computer systems, Information systems, Sustainable development, Sustainable behavior

Paper type Research paper

1. Introduction

The world is not only facing economic challenges but also social and environmental challenges. In 1987, members of the World Commission on Environment and Development (WCED) mentioned the concept of sustainable development in the Brundtland Report for the first time. It was defined as "*one that meets the needs of present generations without compromising the ability of future generations to meet their own needs*" (Brundtland *et al.*, 1987). To accomplish sustainable development, the United Nations (UN) launched the 2030 Agenda in 2015, comprising 17 sustainable development goals (SDGs). Therefore, over the next decade, an urgent transition is required for society models with economic, social, and environmental sustainability (Sierra and Suárez-Collado, 2021), which requires the participation of all actors in society: governments, the private sector and civil society.

Human behavior plays an important role in this transition because there is a link between human behavior and choices and sustainability (Allen, 2021). Therefore, a cultural change in people's values, norms, beliefs and sense of responsibility is necessary to generate individual and collective concerns about sustainability and transform them into effective actions to achieve sustainable development (Keitumetse, 2013). As humans are social creatures that live in a community, many norms and behaviors are unconscious and established by society and people's backgrounds. Therefore, sustainable community behavior boosts an individual's sustainable behavior (Sorkun, 2018).

Online social networks (OSNs) are a type of computer system that allow the creation of online communities sharing interests and activities (Tang *et al.*, 2023). Currently, OSNs are among the most important communication platforms (Pang *et al.*, 2022) with a high socioeconomic value. They are used by billions of people and many companies for collaborating, disseminating content and opinion, making recommendations, interacting with scouting, alerting, professional and social networking, and fostering stakeholder engagement (Saraite-Sariene *et al.*, 2022). OSNs such as Facebook, Twitter and YouTube provide users (people, companies, public administrations, etc.) with various opportunities to interact and share with people they have something in common (Wong *et al.*, 2022). OSNs have democratized the production and dissemination of content, generating a revolution, both in communication and interaction and in access to information (Khatri, 2021).

OSNs can help promote cultural change toward human sustainability awareness and sustainable behavior because they affect how people see themselves and the world around them (Nguyen *et al.*, 2023; Wang *et al.*, 2021). Through OSNs, people can discover and become aware of the consequences of unsustainable practices and habits in society and of their inaction, thereby learning ways to develop sustainable behavior.

Additionally, people's sustainability awareness through OSNs encourages them to share, post or repost green messages on OSNs (Chang *et al.*, 2023). Therefore, a green message becomes a chain message that reaches a larger audience and facilitates the implementation of new sustainable models. Some examples of changes toward sustainability that have been promoted through OSNs are local consumption that fosters the local economy and reduces environmental impact (Schubert *et al.*, 2021; Lam *et al.*, 2021); conscious consumption that promotes choosing products, not only in terms of price or quality but also in their environmental footprint (Gossling, 2021; Schubert *et al.*, 2021; Song *et al.*, 2021); and sustainable brands, companies that have made their products and processes more sustainable and use OSNs to showcase them, thus obtaining a strong positive reputation (Beyers and Leventon, 2021).

This awareness of sustainability can be the effect of both formally planned and executed initiatives carried out by different organizations, such as public administrations, NGOs and private companies (Yan *et al.*, 2021), or deliberate or unintended access to information related to sustainability posted by individuals.

Two main research gaps must be filled to efficiently use OSNs for sustainability awareness and advance the state-of-the-art in this body of knowledge. First, in the literature, scholars have explored how different factors, tools and approaches affect the success of sustainability awareness through OSNs (Chou and Huang, 2021; Sysoieva and Osadcha, 2020); proposed new methods, theoretical frameworks and approaches (Vasseur *et al.*, 2022; Al-Marghilani, 2022); and showed different case examples (Bellantuono *et al.*, 2022; Hurajova *et al.*, 2022). The contributions of these studies should be considered in designing and developing OSNs and sustainability initiatives using OSNs. However, the literature remains dispersed, and a comprehensive review of the primary contributions is currently lacking, making it difficult to keep track of the various findings. Therefore, it is

necessary to combine and synthesize the main findings of these studies, as they could offer valuable knowledge for academics and practitioners (Post *et al.*, 2020).

Second, it is necessary to discern important underexamined areas in this field (Lytras *et al.*, 2018), providing a strategic platform for future scholarship. Therefore, academics and practitioners could develop novel and interesting research questions, ideas, theories and empirical studies (Linnenluecke *et al.*, 2020).

To address the aforementioned research gaps, the study proposes three research objectives:

(1) Analyze the current state-of-the-art in sustainability awareness using OSNs.

(2) Define a framework that organizes the research developed by identifying significant common items and main findings and guides on how to use OSNs for sustainability awareness.

(3) Proposing a future research agenda for the field.

The study hypothesizes that the current research on sustainability awareness through OSNs can systematize scientific knowledge of the phenomenon and set directions for future research.

The remainder of this study is organized as follows. Section 2 describes the research methods and tools used to perform the systematic literature review and category identification. Section 3 presents the findings of bibliographic and content analyses. Section 4 discusses the findings, and finally, Section 5 presents the conclusions along with future work and research limitations.

2. Research methodology
To answer these three research questions, we conducted a systematic literature review of articles published until June 2022. A systematic literature review is a research method that allows to identify, select, collect, synthesize and evaluate all studies published in a particular research area. The results are presented in Section 3.

This research was conducted according to the criteria of preferred reporting items for systematic review and meta-analysis (PRISMA) (Liberati *et al.*, 2009). The PRISMA approach guarantees a replicable, scientific and transparent process to minimize bias and provides an audit trail of the reviewers' decisions, procedures and conclusions. The following steps were followed: (1) eligibility criteria, (2) information sources, (3) search terms, (4) study selection, and (5) data collection and synthesis (see Figure 1 in the Supplementary Material).

2.1 Eligibility criteria
Studies were eligible for inclusion if they were research or review papers because they are regarded as true knowledge, directly relevant to sustainability awareness using OSNs, written in English and published in peer-reviewed journals until June 2022.

We excluded studies if they were not written in English; books, theses, congress papers and conference proceedings; papers that focused on other sustainability domains, such as the government sustainability approach; and papers that were not available in full text.

2.2 Information sources
We conducted an organized, systematic and comprehensive wide-ranging search of two online databases, Web of Science and Scopus. These two databases were selected because they combine a rigorous selection process and wide interdisciplinary coverage. Therefore,

they are the main sources of bibliographic citations used in bibliometric analyses (Martínez-López *et al.*, 2018).

2.3 Search terms
Papers were collected by selecting those that had specific keywords related to the research aims and questions in the title, abstract or keywords sections. The keywords used were learning, teaching, education, sustainability, corporate social responsibility and social networks. Logical operators were connected with different sets of keywords and designed as follows: (learn* OR teach* OR educat*) AND (sustainab* OR "corporate social responsibility") AND ("social networks").

2.4 Study selection
The study selection process attempted to analyze, evaluate and identify relevant articles based on the systematic review's goals. This process was performed independently by the two co-authors of this study. First, records were identified from different information sources (online databases) using keywords. Second, once all records were obtained, they were excluded based on duplicate records. Third, once all duplicates were removed, records were screened based on "title, abstract and keywords." Studies that did not meet eligibility criteria were excluded. Finally, "full-text" screening of all the studies was performed. A meeting was held to discuss and agree on the final studies included in this systematic review.

The search concentrated on research and review papers published until June 30, 2022. In the initial search, we found 991 papers (494 from the Web of Science and 497 from Scopus). There were 177 duplicate articles. After applying the eligibility criteria, we excluded papers that were not directly relevant to sustainability awareness using OSNs by screening titles, abstracts and keywords. Finally, we excluded studies that were not directly relevant to sustainability awareness using OSNs based on full-text screening. For example, papers that mentioned "social networks" in the abstract but did not refer to Internet-based social networks platforms, or papers that used the concept "sustainable" in a way different to the one shown in section 1. The final sample comprised 117 papers.

2.5 Data collection process and synthesis
We used Microsoft Excel 2016 to collect basic publication data, such as date, title, authors, publisher, DOI, URL, pages, volume, issues and keywords.

Once the final sample of papers had been defined, the analysis tools provided by Scopus and Web of Science were employed to determine the evolution in the number of papers published by year; analyze the number of papers published by author, country, institution and journal; analyze the indicators of relevance, impact and prestige of the ten journals with the most published articles on the list, and analyze the content of the ten most-cited articles on the sample.

The comparative method proposed by Collier (1998) was used to identify the categories. This method enabled the identification of common points shared by papers through content analysis so that the categories emerged. Content analysis allows the objective identification of content in a dataset, such as selected articles (Sandberg and Jafari, 2018).

The first category classification was performed considering the study's aim and its contribution to the state-of-the-art. Then, the capacity of the category classification to arrange all papers was checked for each paper. If a paper did not fit into any category, the classification was redesigned to integrate incompatible papers. Category classification was reconsidered several times until all papers in the sample were properly distributed. Any disagreements between the co-authors were settled through consensus.

2.6 Finding analysis

First, the analysis of the collected data allowed the identification of the top contributing countries, authors, institutions and sources in the area of OSNs' use for sustainability awareness.

Second, a framework composed of four categories was identified. Category 1: Key factors to success; Category 2: Analysis of existing tools; Category 3: Proposal of new methods, approaches and theoretical frameworks; and Category 4. Case examples. We also created qualitative and quantitative evidential narrative summaries of the main findings and future research challenges for each category.

3. Findings

3.1 Bibliometric analysis

3.1.1 Trends in paper publication. The first article identified in the systematic literature review dated back to 2005. Since then, the number of papers has evolved significantly, and a growing trend has been observed (Figure 1). The number of papers published in 2022 corresponds to the period between January and June. Therefore, the number of publications at the end of 2022 should exceed the number of publications in previous years.

3.1.2 Most influential authors, countries, institutions, papers and sources. In author analysis, one author (Kollech, N) stood out significantly with seven publications, and three authors (Henry, AD; Shen, L and Tan, Y) with two publications. The remaining authors published only one paper. This may be owing to the limited number of specialists in the area (see Table 1 in the Supplementary Material).

Regarding the most influential countries, the distribution by country shows the United States in the lead. It accounted for approximately 31% of the total number of publications related to the study area (Table 2 in Supplementary Material).

However, in institution analysis, there was no significant difference in the number of publications. Therefore, there is no institution with a higher level of specialization in the research area (see Table 3 in the Supplementary Material).

Regarding the most-cited papers, they have a total of 197 citations, which can be considered a high number for the total of 117 related articles. Table 4 in the Supplementary Material lists the ten articles with the highest number of citations.

Finally, the source analysis reveals that the journal with the most publications is sustainability with 31 articles. The following journals are the *International Journal of Sustainability in Higher Education* with six articles, the *European Journal of Sustainable Development, the Journal of Cleaner Production* with four articles and the *International Journal of Management Education* with three articles. The ten journals with the most articles
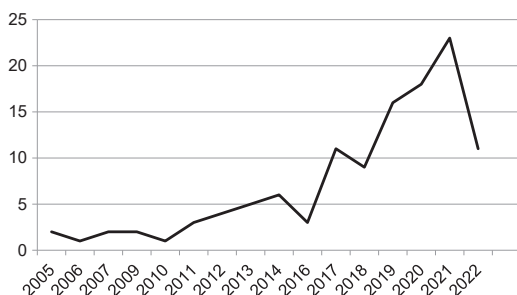
Source(s): Author's own (2023)
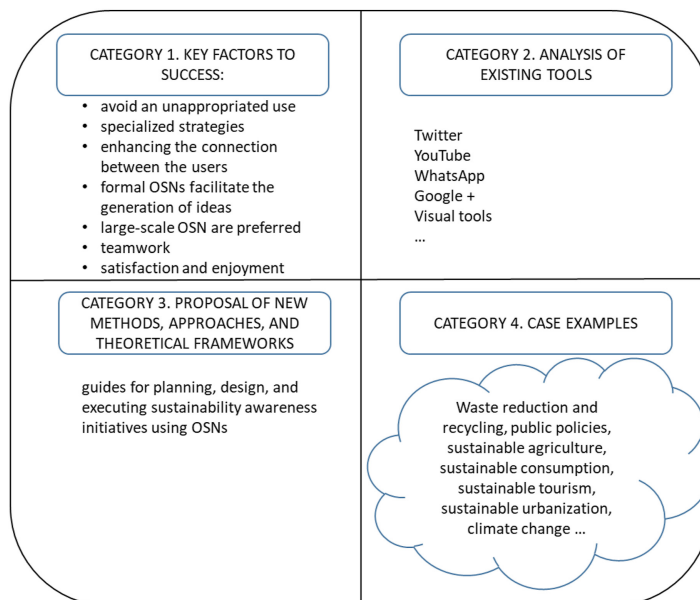
Figure 1.
Trend in the
publication of papers

(see Table 5 in the Supplementary Material) published approximately 43% of the papers in the sample; therefore, it can be concluded that there is no specialized journal in the research area. Three impact indicators were used to determine the relevance of the sources: CiteScore, Source Normalized Impact per Paper (SNIP) and SCImago Journal Rank (SJR). Table 5 in the Supplementary Material shows the results of the journal evaluation according to these three indicators.

3.2 Framework to support using OSNs for sustainability awareness

A framework comprising four categories was developed. This framework integrates the fragmented literature on OSNs for sustainability awareness and offers recommendations to support the design and development of OSNs and sustainability initiatives. The four categories of the framework are the key factors for success, analysis of existing tools, proposal of new methods, approaches and theoretical frameworks, and case examples (see Figure 2).

Category 1: Key factors to success. This category identifies and analyzes the positive and negative effects of various factors on the success of using OSNs in sustainability awareness. The main conclusions drawn are as follows:

First, social networks are an appropriate means of carrying out actions to achieve sustainable behavior in different areas, such as reducing environmental degradation, designing sustainable landscapes, sustainably consuming financial products, using sustainable transport systems and promoting green entrepreneurship. These actions can be developed in formal and informal academic settings, even with higher learning achievements and skills than those acquired in normal classrooms or mass media campaigns. However, when they are not appropriately employed, OSNs can exhibit the opposite effect (Abbas *et al.*, 2019).

Figure 2.
The four categories of the proposed framework

Source(s): Author's own (2023)

Second, in the development of sustainability initiatives using OSNs, specialized strategies must be developed considering the demographic and socioeconomic characteristics (such as age, gender, income, education and number of family members) of the users who are going to use OSNs, as the learning process and future sustainable behavior of the users will depend on their characteristics (Delcea *et al.*, 2020).

Third, the relationship between the users who are going to use the OSNs influences the results. Studies have shown that peer and family communication, as well as others' advice, influence sustainable behavior. Simultaneously, it is important to note that the generation of sustainable behavior in others produces a sensation of well-being among sustainable behavior promoters. Therefore, it is necessary to encourage friends and families to share the same OSNs and enhance people's connection in the network because strong cohesion among the members of the network has a positive influence on sustainable behavior and restores users' motivation to overcome setbacks (Redman *et al.*, 2021).

Fourth, formal OSNs must be created to facilitate the generation of ideas and sharing of knowledge on different issues related to sustainability, such as sustainable entrepreneurship (Padilla-Melendez *et al.*, 2020).

Fifth, OSNs with more users have greater possibilities for achieving their objectives (Knoot and Rickenbach, 2011).

Sixth, Teamwork and participatory approaches provide creative sustainable solutions and enhance user engagement. Therefore, sustainability initiatives using OSNs should promote sustainability (Boyle *et al.*, 2021).

Seventh, satisfaction and perceived enjoyment with OSNs have a great influence on determining users' habit formation (Choi *et al.*, 2021). Therefore, learning strategies, such as gamification, are effective tools for involving citizens in environmentally conscious mobility habits.

These seven conclusions were identified from the analysis of 27 studies that used different research methods (inferential statistics, qualitative studies, social network analysis, etc.) on different types of subjects (university students, consumers, managers, etc.). Table 6 in the Supplementary Materials lists these 27 studies. For each study, the author, year, people studied, research method, objective and findings were presented. The papers are listed in Table 6, from the most cited to the least cited.

Category 2: Analysis of existing tools. This category analyzes the results of using different tools for sustainability awareness using OSNs in 22 empirical studies. The main conclusions drawn are as follows:

(1) Twitter helps teachers in promoting reflective writing in their students (Garcias *et al.*, 2020) and enables inclusive education (Schuster and Kolleck, 2020).

(2) YouTube favors both teachers by promoting a greater commitment to student learning (Trivino-Cabrera *et al.*, 2021) and students who value YouTube videos as a key resource to improve their school performance, rating youtubers better than teachers (Gil-Quintana *et al.*, 2020).

(3) WhatsApp is the messaging application that is most widely used by young people for sharing academic and personal information because of convenience, lack of time or shyness (Fernandez-Martinez *et al.*, 2017).

(4) The use of collaborative tools such as Google + allow users to shape lifelong learning paths and personalize training according to their individual values and needs (Martinez-Nunez *et al.*, 2016; Jirgensons and Kapenieks, 2018)

(5) The use of visual tools in collaborative learning is important to achieve higher academic performance and greater student satisfaction, especially in blended studies (Martin-Garcia *et al.*, 2020).

(6) Informal OSNs promote transformative social learning and reflexivity at particular moments in the learning processes, beyond the formal mechanisms of organizational learning that foster instrumental learning (Pallett and Chilvers, 2013).

(7) Twitter, Facebook and Instagram are good tools to give prominence and spread the awareness actions that take place in educational centers such as school gardens (Alvarez-Herrero *et al.*, 2021) as a critical tool to involve and mobilize staff, the faculty and students toward sustainability (Chuvileva *et al.*, 2017).

(8) Social Web 2.0 used by school networks in divided societies, for example by political and economic inequalities due to ethnic and racial problems, change the way students relate with each other. They promote interactions and help to overcome systemic separation in these divided societies (de Kraker *et al.*, 2013; Robinson *et al.*, 2020).

(9) OSNs generate learning dynamics that improve key skills of future teachers (Diaz-Pareja *et al.*, 2021).

(10) The training of the initiative executors in the OSNs is important. They generate strong links and deep interactions with users and must maintain a pedagogical focus (Coburn *et al.*, 2012). However, their success may be conditioned by teachers' digital skills (Sysoieva and Osadcha, 2020; Sackney and Walker, 2007) and awareness of the responsible management of social networks (Schulz *et al.*, 2020).

(11) Although OSNs offer several advantages in terms of sustainability awareness, they also have some limitations. The rapid migration to e-Learning during the lockdown posed numerous challenges that negatively affected the effectiveness and sustainability of awareness activities (Cavus *et al.*, 2021). The benefits of attending seminars (Miller *et al.*, 2021) should not be forgotten to avoid social distancing (Chuang and Liao, 2021) or other individual limitations (cognitive and emotional), social (privacy and ethics) and structural (Xanat and Toshimasa, 2019), which compromise the role of OSNs in generating awareness.

Category 3: Proposal of new methods, approaches and theoretical frameworks. This category includes 29 proposals for methods, frameworks or approaches that can be used for planning, designing and executing sustainability awareness initiatives using OSNs. These proposals are mainly conceptual/theoretical without any empirical application. Table 1 summarizes these proposals.

Category 4: Case examples. This category shows real initiatives for sustainability awareness in different areas. Table 2 summarizes these initiatives.

3.2.1 Future research agenda. Table 3 summarizes the future challenges in sustainability awareness through OSNs. Challenges were organized into categories.

4. Discussion
4.1 Contributions to the theory
The findings of this study contribute to the literature on sustainability awareness through OSNs as follows:

(1) According to Paul *et al.* (2021), a systematic literature review should be conducted when there is a substantial body of work in the domain (at least 40 articles for review), and no systematic literature review has been conducted in the field in recent years (within the last five years). Therefore, this paper covers a gap in the domain of sustainability awareness using OSNs because this is the first systematic review in the field. Other systematic reviews related to sustainability and social networks focused

Author	Proposal
Henry and Vollan (2014)	An approach for linking sustainability knowledge with action, in a way that enhances collective actions and promotes active social learning using OSNs
Bakht *et al.* (2018)	An approach that fosters the use of sustainable urban systems using OSNs
Gómez-Marín *et al.* (2022)	An approach that fosters the promotion of sustainable Research and Development Projects, efficient management of knowledge, resources and dynamics of the stakeholders, and implements a sustainable long-term plan using OSNs
Atstaja *et al.* (2022)	An approach to use OSNs to foster sustainable decision-making for raising finance, develop sharing economy, and create environment-friendly trends
Seo *et al.* (2017)	An approach to teach the central concepts of sustainable development using OSNs
Henry (2009)	An approach to achieve successful learning of sustainability using OSNs
Ungar and Strand (2012)	An approach for the co-production of biological and cultural knowledge for decision-making using OSNs
Vasseur *et al.* (2022)	An approach to examine the role of social capital to respond and adapt to climate change, especially when dealing with extreme weather events
Beyers and Leventon (2021)	An approach to assess a multi-stakeholder initiative to provide spaces for sustainability learning transformation
Henry (2020)	An approach to examine the effect of organizations' different policies in sustainability learning
Wojcik *et al.* (2021)	An approach to analyze how environmental learning occurs
Lam *et al.* (2021)	An approach to foster fundamental societal change and increase the impact of local actors' sustainability initiatives
Shaharudin *et al.* (2019) Garcia *et al.* (2020)	A method to establish strategies for sustainability initiatives in OSNs
Smith and Sharicz (2013)	A method to use OSNs to promote sustainability inside organizations
Baggio and Hillis (2018)	A method to assess the success of the sustainability initiatives in OSNs
Hamann (2009) Tan *et al.* (2020) Ballie (2012)	A method to allow companies to make a positive contribution to sustainable development using OSNs
Strasser *et al.* (2019)	A method for managing the role of leaders that act as agents to promote transformative changes for sustainability
Groce *et al.* (2019)	A method to use OSNs for environmental awareness
LaMendola (2019)	A method to use OSNs for sustainable community development
Bernarda *et al.* (2017)	A method to develop a strategy that fosters the construction and rehabilitation of social cohesion
Al-Marghilani (2022)	A method to develop an artificial intelligence-enabled cyberbullying-free OSN to encourage sustainability
Landau *et al.* (2021)	A method to use OSNs to prepare society to deal with future negative events
Poliakova *et al.* (2021)	A theoretical framework to use education to promote sustainability using OSNs
Bisaso (2016)	A framework to integrate knowledge from various disciplines, such as sociology, management, economics, technology development, environment, communication, religion and health for sustainability awareness using OSNs
Lytras *et al.* (2018)	A conceptual framework (maturity model) that integrates OSN research, the debate on TEL, and the emerging concept of smart education
Reed *et al.* (2014)	A framework to instill collective learning and action strategies across a multi-level, multi-partner network to advance in sustainability

Source(s): Author's own, 2023

on different subjects, such as the sustainability of health-focused community networks (Simpson *et al.*, 2022), the use of OSNs for sustainability research (Bixler *et al.*, 2019), and the development, dissemination, implementation and sustainability of health behavior interventions for adults (Shelton *et al.*, 2019).

Author	Objective
Ishimura (2013), Severo et al. (2019), Joshi et al. (2021)	Encourage people to change their attitudes and behavior to foster waste reduction and recycling
Folke et al. (2005)	Awareness of public policies toward sustainable development
Vargas et al. (2019), Kurland (2011), Purcell (2019), Winkler et al. (2022), Albanesi et al. (2014), Evans and Powell (2007), Jiang et al. (2019), Reeves (2019), Hurajova et al. (2022), Cabezas-Gonzalez et al. (2021), Srebotnjak and Norgaard (2017)	Implementation of sustainable development concepts in higher education institutions
Kolleck et al. (2011), Goritz et al. (2019), Kolleck (2019) Maruyama et al. (2021), Akhtar et al. (2018), Cui and Wang (2022)	Encourage people to change their attitudes and behavior to avoid climate change
Kolleck et al. (2017), Kolleck and Yemini (2020)	To promote sustainability awareness and sustainable behavior by intergovernmental organizations
Bellantuono et al. (2022), Franquesa-Soler and Sandoval-Rivera (2019), Hays et al. (2020)	Awareness about the 17 sustainable development goals
Abid et al. (2017), Delgadillo et al. (2020), (2018), Chiffoleau (2005), Furman et al. (2014)	To promote sustainable agriculture
Gossling (2021), Schubert et al. (2021), Song et al. (2021), Kim et al. (2020)	To promote sustainable consumption
Kolleck and Bormann (2014)	To promote innovation
Zhang and Zhang (2018)	To promote sustainable tourism
Tan et al. (2017)	To promote sustainable urbanization in China
Westoby and Lyons (2017)	To use transformative social learning to foster a more sustainable society

Source(s): Author's own, 2023

Table 2.
Case example of initiatives for sustainability awareness

(2) According to Linnenluecke et al. (2020), descriptive statistics (e.g. frequency tables) should be used to summarize basic information on the topic gathered over time in systematic reviews. This study used bibliometric statistical analysis techniques to show significant information in the research area of sustainability awareness through OSNs such as the top contributing countries, authors, institutions and sources.

(3) According to Post et al. (2020), to make a theoretical contribution, it is not sufficient to merely report on the previous literature. Systematic literature reviews should focus on identifying new frameworks, promoting the objective discovery of knowledge clusters and identifying major research streams. Through content analysis, this study proposes a framework composed of four research categories that show different ways of contributing to the current knowledge on the topic. Category 1: Key factors to success; Category 2: Analysis of existing tools; Category 3: Proposal of new methods, approaches and theoretical frameworks; and Category 4: Case examples. Although other frameworks have been proposed in the fields of sustainability and OSN, they focused on other subjects. The frameworks by Lytras et al. (2018) and Poliakova et al. (2021) focused on technology-enhanced learning (TEL) and smart education; the framework by Bisaso (2016) attempted to integrate knowledge from various disciplines, such as sociology, management, economics, technology development, environment and health, for sustainability research using OSNs, and the framework by Reed et al. (2014) focused on strategies to advance sustainability using OSNs. Therefore, none of these frameworks considered in an integrated way

Categories	Future research lines
Category 1: Key factors to success	• Evaluate whether the promotion of sustainable habits is more effective when it is done between peers than between teacher and students • Employ big data analytics to evaluate results • Determine the benefits and limitations of social networks to promote sustainability and sustainable habits • Analyze communication techniques to improve awareness messages about sustainable development through social networks
Category 2: Analysis of existing tools and pedagogical approaches	• Identify improvements to OSNs design and content to facilitate actions to promote sustainability • Identify the teaching–learning methodologies adequate for awareness as well as the triple sustainability dimensions: economic, social and environmental • Compare different social networks to find the one that best suits different types of people (adolescents, youth, adults and seniors) • Analyze the adequacy of existing methodologies for the evaluation of learning outcomes • Evaluate if schools are favorable environments to teach sustainability using OSNs
Category 3: Proposal of new methods and theoretical frameworks	• Develop guidelines for the planning and design of training actions in sustainability through OSNs • Develop theoretical frameworks that consider the three dimensions of sustainability to promote sustainable development using OSNs • Create theoretical frameworks to implement sustainability skills in school curricula using OSNs • Propose methods to measure the effectiveness of public policy awareness campaigns on sustainable development using OSNs • Propose methods to guide during the teaching–learning processes in sustainability through OSNs in formal settings such as school classrooms
Category 4: Case examples	• Replicate success stories in other geographies or business sectors to compare the results • Develop case studies that favor the reduction of resource use through new materials, techniques or more sustainable products

Source(s): Author's own, 2023

Table 3.
Future research
challenges

key success factors, methods, frameworks, approaches, tools and case examples to support researchers and practitioners as the proposed framework does.

(4) According to Post *et al.* (2020), systematic literature reviews can focus on identifying a research agenda to make theoretical contributions. However, this research agenda should follow and be accompanied by another form of synthesis, such as a taxonomy or framework. This study synthesizes future research challenges for each research category of the proposed classification framework, being the first study to do this.

4.2 Contributions to society

This study will make significant progress toward sustainability awareness in society because it will lead to an increase in the number of green and sustainability-conscious people with ethical and sustainable behavior, while also transforming business processes, products and services, making them more sustainable. This implies, among other benefits, the promotion of sustainable mobility and lifestyles, and the achievement of SDGs; fairer treatment of customers and employees; a reduction in the environmental impact of business activity to combat climate change; the production of goods and satisfaction of needs from a zero carbon emission perspective, and the cessation of biodiversity loss and the degradation of terrestrial and marine ecosystems.

4.3 Academic and practical implications

This study contributes to the different research domains involved in the field, such as computer engineering, communication, management, education and psychology, by integrating the fragmented literature on OSNs for sustainability awareness and proposing a future research agenda. To the best of our knowledge, this is the first study to do this. The classification into four research categories supports the future work of academics in this multidisciplinary research area because it establishes the common elements and patterns shared in each research category, synthesizes the main findings and shows aspects that have been less studied in each category and requires future research.

However, the categorization revealed that, regardless of the category and volume of research in the area, few studies address an integrated vision of sustainability. In some cases, sustainability refers to economic sustainability or something that lasts, while in others, sustainability has been addressed only from an environmental or ecological perspective. Therefore, there is an important cross-disciplinary challenge for academics to consider the three sustainability dimensions: economic, social and environmental.

Regarding practical implications, this study shows that OSNs can be used to boost sustainable behavior in society. The findings of this study offer several practical recommendations to support the design and development of both OSNs and sustainability initiatives using OSNs. These practical recommendations include positive and negative factors that influence project success; appropriate tools, pedagogical approaches, methods, and frameworks to be used in each case; and case examples that can be used as reference models. Organizations, such as public administrators, NGOs, private companies, and practitioners involved in the field interested in developing sustainability campaigns using OSNs, should follow these recommendations to minimize the risks in achieving their goals.

5. Conclusion

This study has allowed us to advance the state-of-the-art body of knowledge of OSNs for sustainability because it addresses two current research gaps in the field: the fragmented research that makes it difficult to keep track of the main findings and the necessity of providing a strategic platform for future scholarship.

Employing a systematic review of the literature, this study proposes a framework that classifies the current knowledge on sustainability awareness using OSNs into four research categories; analyzes major research findings in each category and bibliometric variables, such as citation numbers, leading authors, institutions, sources and countries; and identifies a future research agenda in the field.

The following conclusions were drawn from the results of this study. Regarding the proposed framework, several factors, such as specialized strategies, enhancing the connection between users, use of formal and large-scale OSNs, teamwork, satisfaction and enjoyment, have a positive effect on the success of using OSNs for sustainability awareness. In addition, existing OSNs such as Twitter, YouTube, WhatsApp and Google + have proven to be good tools for sustainability awareness. Additionally, OSNs can be used to boost sustainable behavior in different areas, such as tourism, urbanization, consumption, agriculture and waste reduction.

Regarding bibliometric analysis, the main conclusions are as follows. *First*, the number of published articles is low, although the trend has been increasing in recent years, both in the number of citations and in the publications per year. *Second*, the analysis of the influence of authors and institutions did not reveal any trends or patterns. *Third*, in terms of authors, Kolleck N, Henry AD, Shen L and Tan Y contributed the most, and the United States, Spain and Germany had the most publications, demonstrating their commitment to sustainability.

Fourth, the publications with the highest number of articles were Sustainability, *International Journal of Sustainability in Higher Education*, and *Journal of Cleaner Production*.

The study had some limitations. (1) There was a language bias because the search was carried out only in English, (2) different keywords could have been used to produce other findings, and (3) Collier's (1998) comparative method was used. Other methods, such as network analysis, could have been used to identify research categories, leading to other classifications.

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Supplementary material
The supplementary material for this article can be found online.

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