Frontiers: Journal of Social, Technological and Environmental Science
http://periodicos.unievangelica.edu.br/fronteiras/
ISSN 2238-8869

Article

Sustainable Consciousness in Education

José Luis Silva Munar[1] , **Emilio Moyano Díaz**[2] , **Carlos Galleguillos Cortés**[3]

[1]Doctoral candidate at the Institute of Humanistic Studies Abate Juan Ignacio Molina and Faculty of Psychology, University of Talca, Talca, Chile. ORCID:0000-0003-4884-8847 . E-mail: jose.silva@uda.cl

[2]PhD in Psychology, Faculty of Psychology, Universidad de Talca, Talca, Chile. ORCID: 0000-0003-2433-9271. E-mail: emoyano@utalca.cl

[3]PhD in Management Sciences, School of Engineering, Universidad de Atacama, Copiapó, Chile. ORCID: 0000-0002-8680-0097. E-mail: carlos.galleguillos@uda.cl

RESUMEN
El concepto de consciencia sostenible (CS) es el foco de un creciente número de investigaciones y en este estudio se busca identificar y describir el volumen y características de los artículos publicados acerca de CS en educación. Se utiliza la metodología PRISMA aplicada a las bases de datos Web of Science y Scopus entre 2014 y 2024 con base a nueve criterios de clasificación: antecedentes conceptuales, factores determinantes, paradigma, tipo de problema, alcance, unidad de análisis, nivel de aplicación, publicaciones por año y por países. Se observa que los estudios son principalmente cuantitativos (χ^2=24,725 *gl* (2), $p < .005$), empíricos (χ^2=197,591 *gl* (3), $p < .005$), descriptivos (χ^2=22,108 *gl* (3), $p < .005$), centrados mayoritariamente en estudiantes (χ^2=128,774 *gl* (3), $p < .005$), de la educación terciaria (χ^2=117,677 *gl* (5), $p < .005$). La CS está relacionada con factores educacionales, sin embargo la disimilitud en su definición requiere una atención para contribuir efectivamente a los objetivos de desarrollo sostenible.
Palabras clave: sostenibilidad; consciencia de la sostenibilidad; desarrollo sostenible.

ABSTRACT
The concept of sustainable consciousness (SC) is the focus of a growing body of research and this study aims to identify and describe the volume and characteristics of the articles published about CS in education. The PRISMA methodology is applied to the Web of Science and Scopus databases between 2014 and 2024, based on nine classification criteria: background of the concept, determining factors, paradigm, type of problem, scope, unit of analysis, level of application, publications by year and by country. It is observed that the studies are mainly quantitative (χ^2=*24*,725 *Df.* (2), $p < .005$), empirical (χ^2=*197*,591 *Df.* (3), $p < .005$), descriptive (χ^2=*22*,108 *Df.* (3), $p < .005$), mostly focused on students (χ^2=*128*,774 *Df.* (3), $p < .005$) from tertiary education (χ^2=*117*,677 *Df.* (5), $p < .005$). CS is related to educational factors, however the dissimilarity in its definition requires attention to effectively contribute to sustainable development objectives.
Key words: sustainability; sustainability consciousness; sustainable development.

Submission: 18/07/2024 Oil: 29/04/2025 Publication: 05/06/2025

v.14, n.2, 2025 • p. 58-73. • DOI http://dx.doi.org/10.21664/2238-8869.2025v14i2p.58-73

Introduction

The adoption of the 2030 Agenda and Sustainable Development Goals (SDGs) by the United Nations in 2015 represent a guide for global transformation towards sustainability (Bornemann and Weiland 2021), awakening challenges from political, environmental, social, economic perspectives, and an increased interest in the topic among researchers (Bautista et al. 2021).

Generally, sustainability is defined as a harmonization of interactions between economic development, environmental management and social equity (Jorat and Manousiouthakis 2019). Also, as an effort in raising the world's population above a basic standard of living (Cohen 2017). Moving toward a more sustainable society constitutes an effort to meet the needs of human development by protecting the Earth's life support systems (Sanchez et al. 2022) and bringing together equity, efficiency, education, and research in the service of environmental health for all (Hicks and Nergard 2023).

Among the 17 SDGs are the end of poverty, quality education, responsible consumption, and production, climate action (Li and Zhu 2019), whose implementation seeks to achieve sustainable values in the formation of students as creative, responsible, and critically thinking global citizens (Kopnina 2020).

The educational system could be the central axis where participatory methods are introduced to deliver the knowledge, competences, attitudes, and the values that might be required for a sustainable future (Litzner and Rieß 2019), trying to ensure that current and future generations have a healthy and good environment, with economic, social, fair and equitable welfare (Olsson et al. 2016). In this sense, it is considered relevant to raise the environmental literacy of children (Orbanić and Kovač 2021), raise awareness of young people towards sustainable habits (Mylonas et al. 2018) and move towards sustainability in higher education (Washington et al. 2018).

Education for sustainable development (ESD) could be an alternative for individuals, societies, and nations to achieve a harmonious balance between social, economic, and environmental imperatives (Ferguson et al. 2021). The issues related to sustainability undertand that the concept of ESD is not static and it is under constant review (Shulla et al. 2020). Thus, it is stated that it is desirable and beneficial to strengthen awareness and knowledge about sustainability in new generations (Colston et al. 2017). The United Nations Educational, Scientific and Cultural Organization (2017) suggests that education plays an important role in increasing SC.

CS is a holistic concept that includes the three psychological constructs of knowledge, attitude, and behavior for the investigation of people's cognitive and affective views of SD (Gericke et al. 2019). As a complex outcome of cognitive, affective and behavioral learning, the formation of CS would be the result of interactions between educational, motivational, cultural and other personal factors (Zhao et al. 2020) or a composite notion, which unifies environmental, social and economic contents, as well as psychological constructs related to sustainability knowledge, attitudes and behaviors (Berglund and Gericke 2015; Merino et al. 2020; Pauw et al. 2015).

CS is also defined as awareness of sustainability issues from environmental, social, and economic perspectives, in addition to its interconnections with sustainable attitudes and behaviors (Berglund et al. 2014; Kalsoom et al. 2017; Nousheen and Kalsoom 2022). An experience or awareness of sustainability phenomena, including experiences and perceptions commonly associated with ourselves, such as beliefs, feelings, and actions (Gericke et al. 2019).

It has been described by researchers that the concept of CS is the main effect or expected outcome of specific sustainability training (Olsson and Gericke 2017; Zhao et al. 2020), explained mainly by defining CS as students' knowledge of sustainability issues, including awareness of the urgency of moving towards more sustainable development (Servant et al. 2023).

Thus, Olsson et al. (2019) affirm that education would play a central role in the formation of awareness based on sustainable development (SD), including environmental issues (Heyl et al. 2013) and being a crucial goal in teaching and learning processes at any educational level (Colás et al. 2018). ESD appears as a response to the problems and solutions related to sustainability (Pauw et al. 2015), being a challenge to examine the curricular factors in the formation of students' awareness inside and outside the classroom (Zhao et al. 2020).

In spite of said above, the concept of sustainability cannot be easily adopted in every society. Some capitalist societies would not be willing to sacrifice their economic growth in favor of sustainable objectives (Madroñero and Guzmán 2018). The economicist vision of industrialized countries that maintain levels of resource exploitation in countries with lower technological levels, poverty, ideological and cultural dependence, inhibits their progress (Bustillo and Martínez 2008). While efforts are made on environmental issues in education based on a system of principles and norms of sustainability, in the global space the interests of the states are not the same (Castro and Leal 2023). Additionally, in the case of education in Latin America, there are problems regarding coverage and quality causing unequal progress towards SD goals (Madroñero and Guzmán 2018).

According to Pauw et al. (2015) empirical studies connecting concepts related to sustainability with sustainability practices were incipient and it is of interest to identify whether this is still the case today. This is also given the relatively recent nature of the definition of SC, its operationalization and application in the educational context.

The studies commonly include a definition of CS. The conceptualization of the term is defined as a set of knowledge, attitudes and behaviors connected with environmental, social and economic dimensions, alluding to their relationship with SD elements. However, it is not known whether there is consensus regarding its concept, the elements or dimensions that comprise it, its background, the general paradigm that guides research, the volume of production, types of problems, scopes of studies, units of analysis (employment of teachers, students, managers or others), levels at which they were applied (pre-infancy to tertiary education). The present study seeks to answer these questions in addition to identifying years and countries in which CS research has been developed in the field of education. A review in this regard will provide an overview of conceptual and methodological approaches to the subject that can serve as a basis for other researchers in the field. This considering that systematic review is a research process in which relevant literature is identified and assembled using explicit methods, including reporting inclusion/exclusion criteria, search methods, and details of included studies (Pollock et al. 2018). For this review, the following question is posed: What is the scientific production of CS in education?

Method

This systematic review is quantitative and qualitative, with a descriptive scope. We analyzed scientific articles on CS in education published in the Web of Science (Wos) and Scopus databases between 2014 and 2024, which include the term sustainable consciousness following the PRISMA criteria (Yepes et al. 2021).

Sample

In this systematic review, the search was conducted using the terms: “sustainability awareness”, “sustainable awareness”, “sustainability consciousness”, and “sustainable consciousness”, generating combinations with AND Educational, AND Education, AND School, AND Higher, AND Heis, AND Students, AND Teachers.

The sample was constructed using the Wos and Scopus databases, following a progressive refinement process according to the elimination parameters in the PRISMA method adapted from Hachicha and Ghorbel

(2012), Fragoso et al. (2017) and Kabak and Ervural (2017). Figure 1 shows the PRISMA flowchart, where from a first total of N = 76 articles, fourteen studies were excluded (thirteen duplicates between Wos and Scopus and one for being incomplete), leaving 62 articles included for final analysis.

The criteria for inclusion of articles for this study are as follows: a) articles and reviews that include the CS concept, its application, or its adaptation within an educational context, considered both in the title and in the abstract. b) Exclusion: articles that appeared in the databases as duplicates and conference proceedings. The Excel database constructed with the selected articles was reviewed, carefully applying the eligibility criteria to each full text.

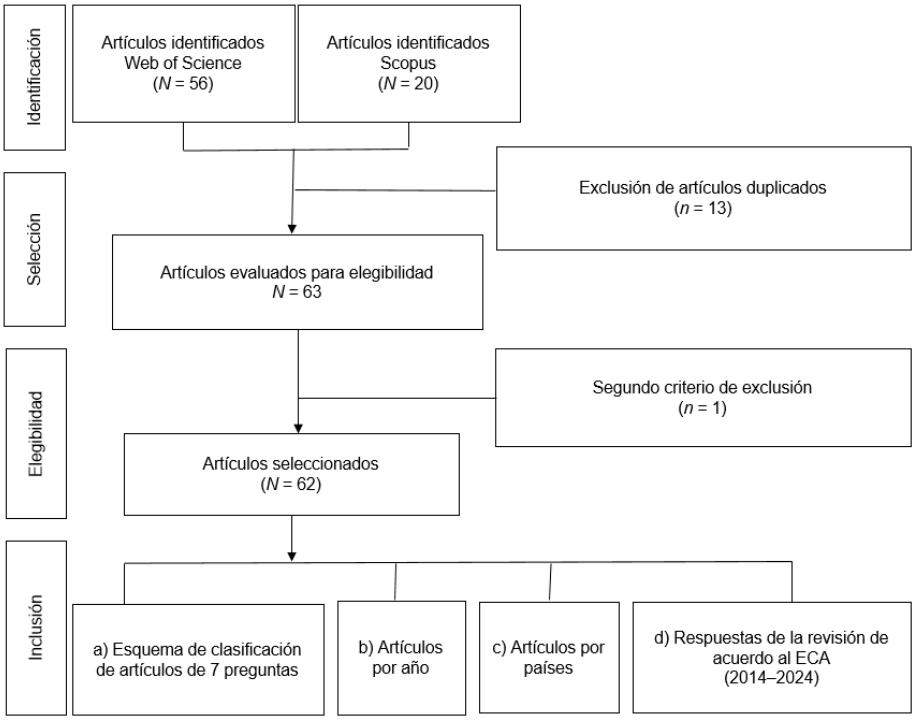


Figure 1. PRISMA diagram. Source: Own elaboration.

Instrument

The selection of articles was carried out using the Clarivate and Scopus platforms. Subsequently, an Excel file was compiled with all the information analyzed from the articles. For this, a scheme called article classification scheme (ECA) was used with specific questions aligned with the objective of this study. All articles that did not meet the eligibility criteria, whose titles and abstracts were not related to the aforementioned search parameters, were discarded. All references were confirmed using *Mendeley software* to ensure their correspondence.

The RCT used here (Table 1) for the analysis of the 62 articles was based on Fragoso et al. (2017), Hachicha and Ghorbel (2012), Kabak and Ervural (2017), Moyano (1999) and Navarro and Moyano (2017) and, in addition to the foundations of Chan (1998) and Forer and Zumbo (2011). It contains seven questions aimed at identifying the conceptual contents of CS in the field of education and the methodologies used in the studies.

Thus, the articles were classified and analyzed according to the following criteria based on Moyano (1999), Sierra (2001), Hernández et al. (2014) and Navarro and Moyano (2017): 1) background of the concept and 2) determinants of CS, whose options in both cases are shown in the results of this study; 3) general paradigm guiding the research, with three possible options: (a) quantitative, (b) qualitative or (c) mixed; 4) the type of problem with four options: a) empirical, b) conceptual, c) methodological or d) evaluative; 5) scope of the research with four options: a) exploratory, b) descriptive, c) correlational or d) explanatory. To these criteria

are added: 6) the unit of analysis with three options: a) teachers, b) students or c) education in general (or others); 7) educational level where the study was applied: a) early childhood, b) primary education, c) secondary education, d) tertiary education or e) education in general (or others), along with the calculation of publications per year and per country.

Table 1. List of RCT questions and answer alternatives

Id	Questions		
I	What aspects does the CS definition consider?		
II	What have been the determining factors of CS?		
III	What is the general paradigm guiding the research?		
(III.1)	Quantitative	(III.3)	Mixed
(III.2)	Qualitative		
IV	What is the type of problem analyzed in the research?		
(IV.1)	Empirical	(IV.3)	Methodological
(IV.2)	Conceptual	(IV.4)	Valuation
V	What is the scope of the research?		
(V.1)	Exploratory	(V.3)	Correlational
(V.2)	Descriptive	(V.4)	Explanatory
VI	What was the unit of analysis?		
(VI.1)	Teachers	(VI.3)	Education in general (or others)
(VI.2)	Students		
VII	What was the level at which the study was applied?		
(VII.1)	Pre-infancy	(VII.4)	Tertiary education
(VII.2)	Primary education	(VII.5)	Education in general (or others)
(VII.3)	Secondary education		

Source: Own elaboration, 2024.

Procedure

To ensure reliability in the search and selection process and to minimize bias on the part of the participating researchers, Cohen's *Kappa* concordance coefficient (Girolami et al. 2019) was applied among those who ranked the articles. This also reduces the effects of chance and improves the legitimacy and authority of the resulting evidence (Hachicha and Ghorbel 2012). For this, a subsample with n = 16 (25%) was randomly selected, which two reviewers had to classify and to whose result Cohen's *Kappa* index was applied for validation of the classification of both reviewers, as has been used in other systematic reviews (Gauld et al. 2022).

The calculation of the index was made following Landis and Koch (1977), whose interpretation of values corresponded to: < 0.00 = Poor; 0.01 - 0.20 = Slight; 0.21 - 0.40 = Fair; 0.41 - 0.60 = Moderate; 0.61 - 0.80 = Substantial; 0.81 - 1.00 = Almost perfect.

In this study, the concordances and discordances between the investigators were evaluated: Reviewer 1 (JLS) and Reviewer 2 (CG), with a final refinement by Reviewer 3 (EM). The 16 articles were analyzed using seven questions included in the RCT, so that the results should yield concordances and discordances for a total of 112 sub-classifications or sub-items. The inter-rater results yielded a value of 0.81, corresponding to an almost perfect rating range, so it is considered a reliable inter-rater result.

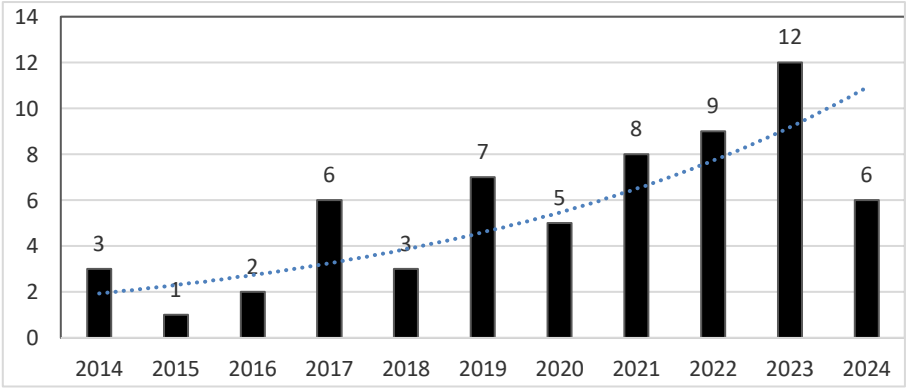
The procedure subsequently contemplated frequency and percentage calculations of the data and nonparametric statistical significance tests (χ^2), contributing to the adequate description of the results related to the objective of this study.

Results

The results of the analysis of the articles are presented in tables and figures containing the most relevant systematized information. First, we report the distribution of publications by year and scientific production by country. Subsequently, the background of the concept, the determinants of CS, the frequency and percentage of articles according to the methodological criteria of general research paradigm, type of problem and scope of the study. Then, the analysis of the educational level of the establishment where the study was conducted is reported. In the development of this section, the results of a nonparametric association test (χ^2) are shown. Finally, a characterization of the most relevant results is shown.

Classification of Articles by Year of Publication and by Country

As shown in Figure 2, the number of articles published on CS in the field of education is distributed over a period of 10 and a half years, ranging from 1 to 12 articles per year and their number is growing. On the vertical axis, there are the number of papers and on the horizontal axis shows the years reported.



Distribution of publications by year. Source: Own elaboration, 2024.

Figure 3 shows the distribution of articles reviewed by country, showing that the largest number of articles published on the subject correspond to Sweden (10 articles), Saudi Arabia (7 articles), Spain (7 articles) and Pakistan (5 articles). On the vertical axis are the number of papers and on the horizontal axis are the countries reported.

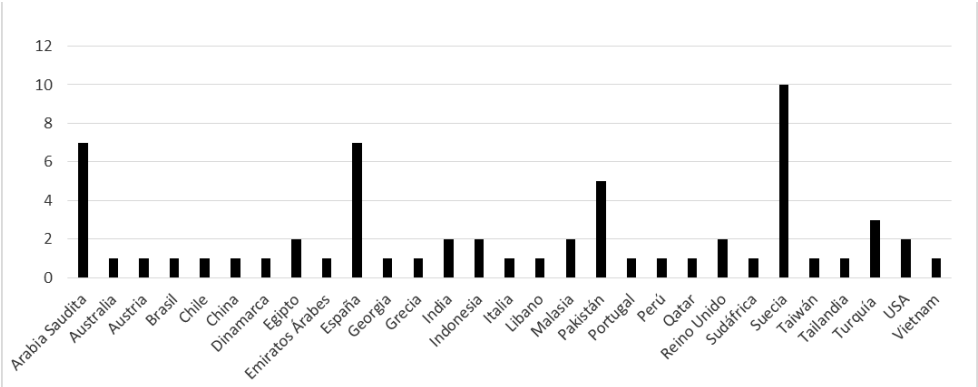


Figure 3. Scientific production by country. Source: Own elaboration, 2024.

RCT Review Responses (2014-2024)

The results of frequency and percentage of items according to the questions contained in the RCT of this research are reported below.

Regarding the components of the CS concept, Table 2 shows that the highest frequency corresponds to studies that consider three aspects - knowledge, attitude, behavior- with 36 articles (58.1%), 14 consider only the knowledge aspect (22.6%), three articles are linked to knowledge and attitude, one to knowledge and behavior and one only to attitude, each one representing 1.6% of the total, three articles with the use of the attitude and behavior aspects (4.8%) and four with other aspects (6.5%).

The production of studies on SC in the educational field mainly includes environmental, social, and economic dimensions (54 articles representing 87%).

Regarding the determinants of CS, 31 articles consider ESD implementation (50%); ten curricular emphasis (16.1%); three articles on curriculum, campus and scientific production; two articles on curriculum, competencies and teaching method (3.2% each); four on ICT applications (6.5%); seven on project-based learning (11.3%); and five others (8.1%).

Table 2. Frequency, distribution and percentage of articles on sustainable awareness, according to conceptual background and determining factors (N=62)

Conceptual background			**Determining factors**		
Knowledge, attitude and behavior	36	58,1%	EDS implementation	31	50%
Saber	14	22,6%	Curricular emphasis	10	16,1%
Knowledge and attitude	3	4,8%	Curriculum, campus and scientific production	3	4,8%
Knowledge and behavior	1	1,6%	Curriculum, competencies and teaching methods	2	3,2%
Attitude	1	1,6%	ICT application	4	6,5%
Attitude and behavior	3	4,8%	Project-based learning	7	11,3%
Other aspects	4	6,5%	Others	5	8,1%

Source: Own elaboration, 2024.

Table 3 shows that, with respect to the research paradigm, the majority of studies adopt a quantitative method, with 33 articles identified (53.2%), 22 articles (35.5%) correspond to qualitative methodology, and seven articles (11.3%) use mixed methodology. Statistical analysis confirmed significant associations regarding the existence of a predominantly quantitative research paradigm ($\chi^2=24.725$ *gl* (2), $p < .005$).

Regarding the type of problem analyzed, there is a clear predominance of empirical type problems, with 57 articles of this type, representing 92% of the total number of articles analyzed constituting a significant association ($\chi^2=197.591$ *gl* (3), $p < .005$).

Regarding the scope of the research and its distribution, 46.8% of the studies used a descriptive approach (29 articles), 19.4% an explanatory approach (12 articles), 21% an exploratory approach (13 articles) and 12.8% (eight articles) a correlational approach. The descriptive approach has a higher frequency of articles than the exploratory approach (55%), which is in second place, leaving the explanatory and correlational approaches in third and fourth place, respectively. Thus, it is observed that descriptive articles predominate over the other subcategories ($\chi^2=22.108$ *gl* (3), $p < .005$).

Table 3. Frequency, distribution and percentage of articles on sustainable awareness, according to methodological characteristics (N=62)

General Paradigm			Type of problem			Scope of research		
Quantitative	33	53,2%	Empirical	57	92%	Exploratory	13	21%
Qualitative	22	35,5%	Conceptual	2	3,2%	Descriptive	29	46,8%
Mixed	7	11,3%	Methodological	2	3,2%	Correlational	8	12,8%
			Valuation	1	1,6%	Explanatory	12	19,4%

Source: Own elaboration, 2024.

Table 4 shows that most of the studies have been carried out with student samples; 49 of the 62 articles, representing 79%. Particular attention was paid to the tertiary education level, with 39 articles corresponding to 62.9% of the total. The statistical analysis allows us to confirm significant associations regarding the predominance of studies in students ($\chi^2=128.774$ *gl* (3), $p < .005$) and in tertiary education ($\chi^2=117.677$ *gl* (5), $p < .005$).

Table 4. Frequency, distribution and percentage of articles on sustainable awareness, by unit of analysis and educational level of application (N=62)

Unit of analysis			Educational level of application		
Teachers	4	6,5%	Pre-infancy	1	1,6%
Teachers, managers and students	5	8,0%	Primary education	3	4,8%
Students	49	79%	Primary and secondary education	7	11,3%
Education in general (or other)	4	6,5%	Secondary education	7	11,3%
			Tertiary education	39	62,9%
			Another	5	8,1%

Source: Own elaboration, 2024.

Results about CS in Latin America

From Mexico Southward, there is a very incipient production with only three articles in total. One belongs to Brazil with emphasis on the quantitative paradigm, empirical type of problem, exploratory in scope and focused on students in tertiary education. Chile and Peru have one study both emphasizing qualitative paradigm, empirical, exploratory in scope, focused on teachers and tertiary education.

Figure 4 shows a summary of all the results reported so far, with their highest frequencies.

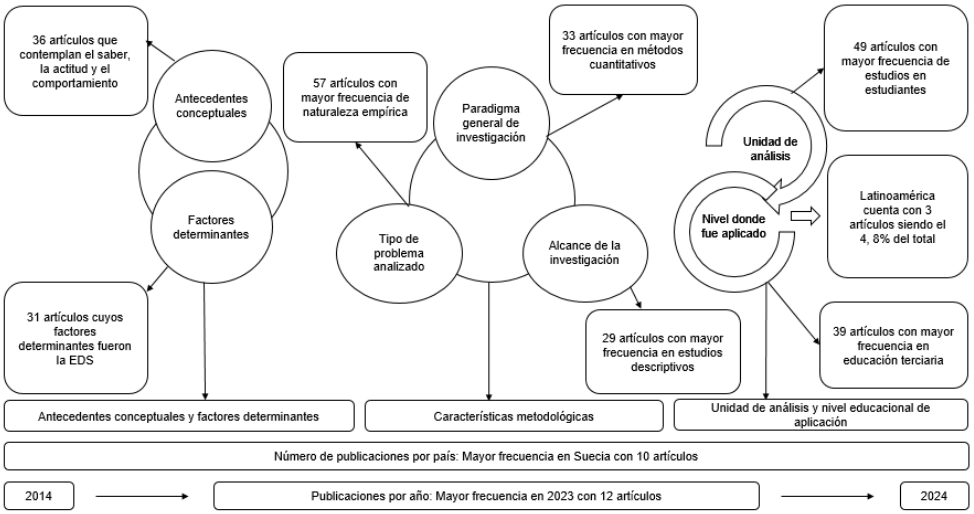


Figure 4. General characterization of scientific production. Source: Own elaboration,2024.

In general terms it is shown that the highest frequency of articles was observed in the year 2023, where the majority are from Sweden (10 articles) with a predominance of quantitative (33 articles), empirical (57 articles) and descriptive (29 articles) research. The participants in 49 articles were students of which 39 from tertiary education. However, the review cut-off date was July 15, 2024 with half of the year still remaining.

Discussion

The systematic review applied to the analysis of the scientific production indexed in the Wos and Scopus databases from 2014 to 2024, showed that the terms "sustainability awareness", "sustainable awareness", "sustainability consciousness", and "sustainable consciousness" are available in international research corresponding to sustainable consciousness in the educational field.

The analyses revealed a heterogeneous treatment of SC, since some articles include within their conceptualization aspects such as knowledge, attitude and sustainable behavior – representing the majority - while other articles include only some of these aspects or combinations among them.

The first proposed definition of CS was published in 2014 (Berglund et al. 2014) and after 10 years it has not yet become a consensus definition. This might suggest that 10 years is insufficient to install a concept in a consensual way. This could reinforce the idea of how incipient the CS construct is (Berglund et al. 2014; Gericke et al. 2019; Kalsoom et al. 2017; Nousheen and Kalsoom 2022; Zhao et al. 2020). Notwithstanding that, there has been a growth in the production of articles on the subject from three and one in 2014-2015 to nine and twelve in 2022-2023, with six already in 2024. There is a predominance of production in European countries, especially Sweden and Spain, followed by Saudi Arabia and Pakistan in Asia. Research on the subject in Latin America is very restricted, representing 4.8% of the total, in a territorial region that corresponds to approximately 13.5% of the planet's land surface but also has a great and rich biodiversity (and where practically all the world's climates are found), hosting six of the top 10 countries in terms of biodiversity in the world: Brazil, Colombia, Ecuador, Mexico, Peru, Venezuela (Galindo 2000).

The identified studies subscribe to approaches of the United Nations Organization with strong commitment and projects in execution of countries called first world, leaving the challenge of to conduct future studies in the countries of the Latin American region collecting concepts of their ancestral culture that may perhaps cover the sustainability and its relationship with CS as *sumakausay* or Good Living (Padilla et al. 2017).

Thus, there is a wide field of inquiry for research on the subject in the Latin American region, eventually including other perspectives of alternative education that emphasize planetary ethics and degrowth, indigenous learning, ecopedagogy, ecocentric education, education for the circular, and steady state economy, empowerment and liberation (Kopnina 2020). From the point of view of SD, it is worth looking for future differences or similarities between CS in the Latin American educational reality, with its enormous inequalities in education, its limitations and scarcity of resources, with respect to what is happening in Europe or North America in this regard.

From a theoretical perspective, the results found allow us to maintain that the concept of CS is in an incipient state. The RCT created for this study allowed us to adequately analyze the articles.

From the conceptual point of view, the results show a predominance of studies that include the aspects of knowledge, attitude and behavior connected with the environmental, social and economic dimensions, alluding to their relationship with the elements of SD. However, not all the studies did so in the same way, since regardless of the fact that the term CS is used in the title and in the abstract, there were articles that contemplated only some aspects or there were combinations among them. Notwithstanding, there were also other aspects included such as perception, opinion, values, beliefs or skills. For this reason, it is suggested that greater attention be paid to standardizing their definition, adaptation, components and application.

The definition of CS in its evolution has been marked from the beginning by its predecessor concept called environmental awareness (Gericke et al. 2019), which in turn, comes from aspects used in Canada by Michalos et al. (2012) to measure knowledge, attitude and behavior linked to SD training. From this perspective, in its conceptualization, a constant linkage with ESD or education for sustainability is reported, which led to study the determinants of SC, suggesting a dominance in the implementation of ESD at different levels of educational institutions. An important factor was also the curriculum, the teaching method, the campus (as inclusive infrastructure), ESD competencies, application of ICT in training or project-based learning in sustainability. In the other rankings, the frequency was determined by systematic reviews and the creation of a measurement instrument for use in education. Such an instrument is called Sustainability Consciousness Questionnaire (SCQ) operationalizing the concept of CS in 2019 by Gericke et al. (2019). The usefulness of the instrument has been to measure through some aspects, elements of sustainability connected to the environmental, social and economic aspects, contributing to understand knowledge, attitudes or behaviors with a comprehensive approach to SD.

From the methodological point of view, the results show the predominance of quantitative studies and a lower presence of qualitative or mixed studies. This could leave an open field for new qualitative research that could contribute with more subjective objectives related, for example, to understanding the complex world of people's lived experience of the environment and the current climate crisis, which could suggest new categories of analysis.

Empirical studies predominate, with conceptual, methodological and evaluative studies being less frequent. There is thus an open opportunity to generate research towards a better conceptualization or the creation of new measurement instruments. Likewise, the analysis of the studies according to their scope showed a predominance of descriptive studies, thus leaving open the possibility of investigating with other scopes either from an initial stage of knowledge through exploratory studies or from correlation studies with the use of new factors as suggested by Ramos (2020). Or also, with the incorporation of new variables or greater association with other phenomena towards the explanatory, seeking to establish the causes of the phenomena, explaining why and how they occur, as expressed by Martínez (2006).

The results of the review show the predominance of applications in students, leaving in uncertainty background regarding teachers, managers and directors or general public. The results also showed a higher frequency in tertiary education, leaving unknowns regarding the importance of generating sustainability learning at an early age as suggested by Ricoy and Sanchez (2022).

This research did not consider studies that include theories, methodologies, strategies, appropriate educational techniques that can shed light for greater effectiveness in the generation of CS. Then advancing in devising and testing new educational methodologies, strategies, techniques or advancing in more advanced technologies such as virtual reality, augmented and metaverse or testing the effectiveness of alternative pedagogical models (Mikelatou and Arvanitis 2021; Pirchio et al. 2021), would be of high interest. Neither were studies identified that are related to the participation of a wider number of *stakeholders* or a review in the field of regenerative sustainability, whose new meaning could be useful to enhance new lines of research.

Conclusions

This article has provided evidence of the concept of SC in the field of education for sustainability, showing a growth in the production of articles in the last 10 and a half years. This, although slow, augurs promising results for the future in terms of continuity of the subject, increasing the possibility of advancing in SC from education.

Most of the production on SC in the world for the period 2014-2024 according to Wos and Scopus article databases corresponds to Sweden, Saudi Arabia, Spain and Pakistan. The production of Latin American countries corresponds to 4.8% of the total, with Brazil, Chile and Peru having one article each in the period.

It can be seen that after the operationalization of the concept in 2019, which had been under construction since 2014, there has been concern among researchers for a greater consolidation of its construct, evidencing a greater production of articles on the subject. However, it will be relevant to reach a consensus on its conceptualization, consideration of aspects and dimensions.

Although some limitations have been identified in this study, one of the most relevant has been the impossibility of generating a meta-analysis, since the articles found did not provide either a sufficient number or standardized statistical measures of variables to serve for an accurate estimation of the overall effect. Our study offers a first approach to CS and its applications in education.

Other limitations of the present study correspond to the choice of databases used, since Web of Science and Scopus were used, not considering all the existing databases in scientific sources. Another limitation corresponds to the fact that we chose to study CS in studies in the field of education, since if we were to include other -non-educational- fields, the production might be greater, particularly in Latin America in local databases and in Spanish.

The panorama shown in terms of sustainable consciousness in the field of education is expected to have left open and inspired new research questions regarding conceptual theory, as well as its methodological applications at different levels of education**.**

Acknowledgments

This work has been carried out with the support of National Doctorate Grants (National Doctorate/2022-21220067) from ANID-Chile and the study commission granted to José Luis Silva Munar by the Universidad de Atacama, Chile.

References

Bautista N, Mauleon E, Casado ES 2021. Analysis of social, environmental and economic sustainability core: a bibliometric overview. *International journal of innovation and sustainable development* 15(4):356-381. https://doi.org/10.1504/IJISD.2021.118374

Berglund T, Gericke N, Rundgren SN 2014. The implementation of education for sustainable development in Sweden: investigating the sustainability consciousness among upper secondary students. *Research in Science & Technological Education* 32(3):318-339. https://doi.org/10.1080/02635143.2014.944493

Berglund T, Gericke N 2015. Separated and integrated perspectives on environmental, economic, and social dimensions - an investigation of student views on sustainable development. *Environmental Education Research* 22(8):1115-1138. https://doi.org/10.1080/13504622.2015.1063589

Bornemann B, Weiland S 2021. The UN 2030 Agenda and the Quest for Policy Integration: A Literature Review. *Politics and Governance* 9(1):96-107. https://doi.org/10.17645/pag.v9i1.3654

Bustillo L, Martínez JP 2008. Approaches to sustainable development. *Interscience* 33(5):389-395.

Castro A, Leal DM 2023. Environmental education or education for sustainable development? The ethical sense of environmental education. *Kawsaypacha Magazine: Society and Environment (*11):A-007. https://dx.doi.org/10.18800/kawsaypacha.202301.a007

Chan D 1998. Functional relations among constructs in the same content domain at different levels of analysis: A typology of composition models. *Journal of Applied Psychology* 83:234-246. https://doi.org/10.1037/0021-9010.83.2.234

Cohen M 2017. A Systematic Review of Urban Sustainability Assessment Literature. *Sustainability* 9(11):2048. https://doi.org/10.3390/su9112048.

Colás P, Magnoler P, Conde J 2018. Identification of Levels of Sustainable Consciousness of Teachers in Training through an E-Portfolio. *Sustainability* 10(10):3700. https://doi.org/10.3390/su10103700

Colston N, Thomas J, Ley MT, Ivey T, Utley J 2017. Collaborating for Early-Age Career Awareness: A Comparison of Three Instructional Formats. *Journal of Engineering Education* 106(2):326-344. https://doi.org/10.1002/jee.20166

Ferguson T, Roofe C, Cook LD 2021. Teachers' perspectives on sustainable development: the implications for education for sustainable development. *Environmental Education Research,* 1-17. https://doi.org/10.1080/13504622.2021.1921113

Forer B, Zumbo B 2011. Validation of Multilevel Constructs: Validation Methods and Empirical Findings for the EDI. *Soc Indic Res* 103:231-265. https://doi.org/10.1007/s11205-011-9844-3.

Fragoso TM, Bertoli W, Louzada F 2017. Bayesian model averaging: a systematic review and conceptual classification. *International Statistical Journal* 86(1):1-28. https://doi.org/10.1111/insr.12243

Galindo C 2000. Conservation science in Latin America. *Interciencia* 25(3):129-135.

Gauld C, Lopez R, Philip P, Taillard J, Morin CM, Geoffroy PA, Micoulaud JAA 2022. Systematic Review of Sleep-Wake Disorder Diagnostic Criteria Reliability Studies. *Biomedicines* 10:1616. https://doi.org/10.3390/ biomedicines1007161616.

Gericke N, Boeve-de Pauw J, Berglund T, Olsson D 2019. The Sustainability Consciousness Questionnaire: The theoretical development and empirical validation of an evaluation instrument for stakeholders working with sustainable development. *Sustainable Development,* 1-15. https://doi.org/10.1002/sd.1859

Girolami I, Pantanowitz L, Marletta S, Brunelli M, Mescoli C, Parisi A, Barresi V, Parwani A, Neil D, Scarpa A, Rossi ED, Eccher A 2019. Diagnostic concordance between whole slide imaging and conventional light microscopy in cytopathology: A systematic review. *Cancer* Cytopathology. https://doi.org/10.1002/cncy.22195

Hachicha W, Ghorbel A 2012. A survey of the control chart pattern recognition literature (1991-2010) based on a new conceptual classification scheme. *Computer Science and Industrial Engineering* 63(1):204-222. https://doi.org/10.1016/j.cie.2012.03.002.

Hernández R, Fernández C, Baptista P 2014. *Research methodology*. Sixth edition, McGraw Hill, Mexico DF, 634 pp.

Heyl M, Moyano E, Cifuentes L 2013. Environmental attitudes and behaviors of university students: a case study conducted in a Chilean university. *Revista Latinoamericana de Psicología* 45(3):487-500. https://doi.org/10.14349/rlp.v45i3.1489

Hicks A, Nergard M 2023. Sustainability infrastructure insights from a campus sustainability Survey. *Environ. Res: Infrastruct. Sustain.* 3:011004. https://doi.org/10.1088/2634-4505/acc354

Jorat M, Manousiouthakis VI 2019. From sustainability to sustainizability. *AIChE Journal, e16704*. https://doi.org/10.1002/aic.16704

Kabak Ö, Ervural B 2017. Multiple attribute group decision making: A generic conceptual framework and a classification scheme. *Knowledge-Based Systems* 123:13-30. https://doi.org/10.1016/j.knosys.2017.02.011.

Kalsoom Q, Khanam A, Quraishi U 2017. Sustainability consciousness of pre-service teachers in Pakistan. *International Journal of Sustainability in Higher Education* 18(7):1090-1107. https://doi.org/10.1108/ijshe-11-2016-0218

Kopnina H 2020. Education for the future? Critical evaluation of education for sustainable development goals. *The Journal of Environmental Education*. https://doi.org/10.1080/00958964.2019.1710444

Landis J, Koch G 1977. The measurement of observer agreement for categorical data. *Biometrics* 33:159-74. https://doi.org/10.2307/2529310.

Li Y, Zhu X 2019. The 2030 Agenda for Sustainable Development and China's Belt and Road Initiative in Latin America and the Caribbean. *Sostenibilidad* 11(8):2297. https://doi.org/10.3390/su11082297

Litzner L, Rieß W 2019. Education for Sustainable Development at the Bolivian university. Perceptions of the faculty. Teoría De La Educación. *Revista Interuniversitaria* 31(1):149-173. https://doi.org/10.14201/teri.19037

Madroñero S, Guzmán T 2018. Sustainable development. Applicability and its trends. *Tecnologia en Marcha Journal* 31(3):122-130. https://dx.doi.org/10.18845/tm.v31i3.3907

Martinez PC 2006. The case study method: methodological strategy of scientific research. *Thought & Management* 20: 165-193

Merino M, Corbacho I, Hernández M 2020. Analysis of Sustainability Knowingness, Attitudes and Behavior of a Spanish Pre-Service Primary Teachers Sample. *Sustainability* 12(18):7445. https://doi.org/10.3390/su12187445

Michalos AC, Creech H, Swayze N, Kahlke M, Buckler C, Rempel K 2012. Measuring knowledge, attitudes and behaviors concerning sustainable development among tenth grade students in Manitoba. *Social Indicators Research* 106(2):2013-2038.

Mikelatou A, Arvanitis E 2021. Pluralistic and equitable education in the neoliberal era: paradoxes and contradictions. *International Journal of Inclusive Education,* 1-16. https://doi.org/10.1080/13603116.2021.1904018

Moyano E 1999. Towards the integration of qualitative and quantitative methods in social research. *Revista de la Facultad de Humanidades de la Universidad de Santiago de Chile 4*:59-86.

Mylonas G, Amaxilatis D, Chatzigiannakis I, Anagnostopoulos A, Paganelli F 2018. Enabling Sustainability and Energy Awareness in Schools Based on IoT and Real-World Data. *IEEE Pervasive Computing* 17(4):53-63. https://doi.org/10.1109/mprv.2018.2873855. https://doi.org/10.1109/mprv.2018.2873855

Navarro J, Moyano E 2017. Methodology, themes and disciplines in current research on international migration. *Sociedade e Cultura, Goiânia* 20(2). https://doi.org/10.5216/sec.v20i1.53069

Nousheen A, Kalsoom Q 2022. Education for sustainable development amidst COVID-19 pandemic: role of sustainability pedagogies in developing students' sustainability consciousness. *International Journal of Sustainability in Higher Education.* https://doi.org/10.1108/IJSHE-04-2021-0154

Olsson D, Gericke N 2017. The effect of gender on students' sustainability consciousness: A nationwide Swedish study. *The Journal of Environmental Education* 48(5):357-370. https://doi.org/10.1080/00958964.2017.1310083

Olsson D, Gericke N, Boeve-de Pauw J, Berglund T, Chang T 2019. Green schools in Taiwan - Effects on student sustainability consciousness. *Global Environmental Change* 54:184-194. https://doi.org/10.1016/j.gloenvcha.2018.11.011.

Olsson D, Gericke N, Rundgren SN 2016. The effect of implementation of education for sustainable development in Swedish compulsory schools - assessing pupils' sustainability consciousness. *Environmental Education Research* 22(2):176-202. https://doi.org/10.1080/13504622.2015.1005057

Orbanić N, Kovač N 2021. Environmental awareness, attitudes, and behavior of preservice preschool and primary school teachers. *Journal of Baltic Science Education* 20(3):373-388. https://doi.org/10.33225/jbse/21.20.373

Padilla A, Moyano E, Padilla J 2017. The path of Sumak Kawsay towards the 2008 Constitution of Ecuador: the role of the indigenous movement. *Estado & comunes* 2(5):95-118. https://doi.org/10.37228/estado_comunes.v2.n5.2017.54

Pauw J, Gericke N, Olsson D, Berglund T 2015. The Effectiveness of Education for Sustainable Development. *Sustentabilidad* 7(11):15693-15717. https://doi.org/10.3390/su71115693

Pirchio S, Passiatore Y, Panno A, Cipparone M, Carrus G 2021. The Effects of Contact With Nature During Outdoor Environmental Education on Students' Wellbeing, Connectedness to Nature and Pro-sociality. *Front. Psychol.* 12:648458. https://doi.org/10.3389/fpsyg.2021.648458

Pollock A, Campbell P, Struthers C, Synnot A, Nunn J, Hill S, Goodare H, Morris J, Watts C, Morley R 2018. Stakeholder involvement in systematic reviews: a scoping review. *Systematic Reviews* 7(1). https://doi.org/10.1186/s13643-018-0852-0.

Ramos C 2020. The scopes of an investigation. *CienciAmerica* 9(3). http://dx.doi.org/10.33210/ca.v9i3.336

Ricoy MC, Sanchez C 2022. Raising Ecological Awareness and Digital Literacy in Primary School Children through Gamification. *Int. J. Environ. Res. Public Health* 19:1149. https://doi.org/10.3390/ ijerph19031149.

Sánchez F, Romero D, Sureda B, Moreno F 2022. Education for Sustainable Development in Spanish Higher Education: an assessment of sustainability competencies in engineering and education degrees. https://doi.org/10.1108/IJSHE-02-2021-0060

Servant V, Holgaard JE, Kolmos A 2023. Sustainability Matters: The Evolution of Sustainability Awareness, Interest and Engagement in PBL Engineering Students. *Journal of Problem Based Learning in Higher Education* 1(1):124-154. https://doi.org/10.54337/ojs.jpblhe.v11i1.7374

Shulla K, Filho WL, Lardjane S, Sommer JH, Borgemeister C 2020. Sustainable development education in the context of the 2030 Agenda for sustainable development. *International Journal of Sustainable Development & World Ecology*, 1-11. https://doi.org/10.1080/13504509.2020.1721378

Sierra R 2001. *Social research techniques. Theory and exercises*. Fourteenth edition, Editorial Paraninfo, Madrid, 703 pp.

United Nations Educational, Scientific and Cultural Organization (UNESCO) 2017. *Education for Sustainable Development Goals - Learning Objectives* [accessed June 15, 2024] Available at: https://unesdoc.unesco.org/ark:/48223/pf0000247444

Washington C, Washington G, Newman J 2018. Campus sustainability in the US: Environmental management and social change since 1970. *Journal of Cleaner Production* 196:564-575. https://doi.org/10.1016/j.jclepro.2018.06.012

Yepes JJ, Urrútia G, Romero M, Alonso S 2021. PRISMA 2020 statement: an updated guideline for the publication of systematic reviews. *Revista Española de Cardiología* 74(9):790-799. https://doi.org/10.1016/j.recesp.2021.06.016.

Zhao Q, Liu X, Ma Y, Zheng X, Yu M, Wu D 2020. Application of the Modified College Impact Model to Understand Chinese Engineering Undergraduates' Sustainability Consciousness. *Sustainability* 12(7):2614. https://doi.org/10.3390/su12072614