Review

Sustainability Education in Formal and Non-Formal Education Materials. A Scoping Review

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Sustainability Education in Formal and Non-Formal Education Materials. A Scoping Review

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Abstract: Education for sustainable development seeks transformative learning in order to empower learners to change the ways they understand the world. In order to achieve its goals, teaching materials are needed, that reflect its principles and goals in their content and pedagogy they promote. The study of the epistemological background on which the teaching material is structured is a research proposal, which is addressed to researchers, authors and practitioners for sustainable development, pointing out that the structuring and development of the materials should be based on a theoretical framework that effectively link the teaching activity with all 17 Sustainable Development Goals with a focus on Quality Education. This scoping review attempts to map the existing literature that assesses the effectiveness of formal and non-formal educational materials that seek to promote education for sustainability. In addition, research is presented that evaluates the effectiveness of teaching materials from the perspective of sociocultural learning theory, considering that education for sustainable development (an ideal to be achieved) is in a dynamic relationship with constructivism (a learning theory) on the basis of knowledge construction, learning and sustainability's sociocultural aspects. It was found that the international literature investigating the contradictions presented by educational materials in relation to the objectives they set and achieve and the way in which the activities they propose are implemented in practice, is limited.

Keywords: quality education; sustainability; educational material; socio-cultural theory

1. Introduction

We live in an era of global interconnection, rapid technological changes and environmental, economic, social challenges that lead to the questioning of social values and norms and their renegotiation, a process not necessarily perceived as a positive one. As a response to this uncertainty we seek an education that will "empower learners to take informed decisions and responsible actions for environmental integrity, economic viability and a just society, for today's and for tomorrow's future generations, with respect to cultural diversity.' [1] (p. 12).

Considered to be a key initiative to achieve a sustainable world, education for sustainability, which is a vision, an ideal of education that seeks to cultivate competencies that will allow students to participate in the transformation of unsustainable paradigms and find sustainable solutions to challenging issues and prevent conflicts. Education for sustainability is a pedagogical approach that envisions a better future, focuses on transformative learning as a developmental process [2] and concepts such as "making meaning in diverse groups", "interacting with complex learning environments of the real world' [3] and 'collaborative learning' [4] and is considered to be a change agent [5]. For scientifically, socially, economically, environmentally literate citizens, we need interdisciplinary, collaborative, participatory and action-oriented educational approaches that facilitate authentic interdisciplinary thinking and foster the cultivation of creative thinking, agency, critical thinking and reflective capacity.

Education for sustainability must be transformative, in the sense that it challenges the basic assumptions of students and society at large. Education for sustainability is oriented towards building a transformative learning culture that transforms uncertainty from a factor of paralysis and acceptance of the existing status quo to a transformative and proactive engagement [6]. Transformative learning [7] empowers students to make informed decisions and act, both

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individually and collectively, to change society and care for the planet [8]. It is a process in which we reflect, questions and become enabled to transform frames of reference (attitudes, habits of mind, perspectives)—sets of assumptions and expectations—to make them open, reflective, and receptive of change [9]. Transformative agency is the most important outcome of expansive learning, especially in situations of complex change [10,11] as education for sustainability. In education for sustainability as activities are co-created within a mould context, observing individual's transformative agency is an important way of reflecting on the transformative potential of expansive learning. This is a qualitative process of empowerment that differs from measuring or mapping learning outcomes because enhances agency, self-efficacy, self-esteem and leads to emancipatory.

Sustainable Development Goal 4.7 recognizes the critical importance of transformative education for a sustainable living on a just and green planet. However, understanding and adopting sustainable thinking, as a different way of thinking and teaching, requires moving away from the concept of pre-determined knowledge that is imparted to the learner. Education for sustainability needs a pedagogical approach that adequately responds to the understanding of sustainability issues by taking into account the complexity, diversity and variability of the issues, as well as the socio-cultural, economic and political dimensions of the conflicting interests affecting contemporary pressing socio- ecological issues such as climate change [12]. Additionally, sustainability education seeks to use approaches that will provide the conceptual and pedagogical framework for developing students' action competence to actively and critically engage in issue-based inquiry and take political action and contribute to a more sustainable community [12,13].

We need an education system that enables learner to engage in critical inquiry [14–16] and systems thinking [17–19] and to understand knowledge as a continuous process. Pedagogy for sustainability is based on constructivist learning theories [20,21] (such as the cognitive theories, sociocultural theories) and is informed by experiential learning, problem-based and project-based learning, social learning and critical pedagogy among others. Sociocultural learning theory approaches provide the adequate framework and emphasize meaningful development and learning in social settings [12]. Socio-cultural theory and activity theory (a 3rd generation Cultural Historical Activity Theory) indicate that transformative expansive learning is one of the factors that activates and contributes to transformative agency in the learning process [4] avoiding the conservative neutrality and balance that dominates current educational practices [22]. As for sociocultural theory, teaching focuses on how individuals interact with the world not only through other people, but also through the use of tools and signs. Students participate actively in the learning process and rediscover meanings or concepts with which they interact. Teachers' role is mediating and supportive, as well as the role of teaching and learning tools. Collaborative teaching expresses the importance of culture in human interactions. Students have to develop their own vision and opinion that leads to critical thinking and instead of learning facts they realize the usefulness of the knowledge [20]. The connection of emotion and knowledge [23] has led to the inclusion of the students' environment (parents, community) in the process of building meaningful knowledge to solve real-life problems [24].

Education, as Vygotsky explains, can potentially enable one to become what one is not yet, while Engestrom shows that communities can transform their activity through expansive learning and co-create of their world and themselves through joint efforts that each individual makes a difference and matters in the totality of social practices [25]. Education is a shared practice and learning is a social activity mediated through social and cultural interactions. For the sociocultural theory, teaching focuses on the interaction of individuals with the context in which they operate and live. Individuals interact with their surroundings not only directly or indirectly through other people, but also by using tools and signs. The role of teachers in the teaching process is mediating and supportive, as is the role of teaching and learning tools. Teaching in collaborative groups highlights the importance of culture in human interactions, while students' active and experiential participation in group projects presupposes an understanding of the importance of a collaborative culture. Sociocultural theory establishes a dialogue between emotion and knowledge [23] and an expression of this is the

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integration of the students' environment (parents, community) in the process of building meaningful knowledge to solve real-life problems.

Achieving the desiring learning outcomes requires, among other things, appropriate teaching materials. Teaching materials are recognized as the key tool in the learning process since, depending on its form and its epistemological background, it contributes to the construction of new knowledge and the development of various competences in learners. The design and creation of teaching materials are basic and common practice for environmental education and sustainability education, both in the context of formal and non-formal education as well [26]. The content of teaching materials can partly act as an inhibiting factor in mastering sustainability education goals [27,28]) when it does not support the active engagement of learners in the learning process [29,30]. The teaching context, as an integral element of the teaching and learning process that is influenced decisively, can also act as an inhibitor to the achievement of sustainability education goals when it is not in line with the pedagogical framework of sustainability education[31,32].

According to sociocultural theory (Vygotsky,) and cultural historical activity theory [33] teaching is a system described as a process of action whose central goal is mediated by cultural artefacts – tools. Educational material should be presented as a pedagogical instrument, a mediator between the goals and intentions, designing the materials and the teachers who implement them in practice [34–36]. The system of teaching is an activity system defined by rules, embedded in a community in which the activity takes place and makes a division of labor pursuing certain goals and achieving certain results. The design of the educational material and the teaching practice are two separate systems of activity that interact with each other. Activity systems generally develop tensions and contradictions either within the system or because of their interaction. The tensions and contradictions shed light on the respective problematic points and at the same time give directions for solving them. A dialectical relationship develops between the field of material design and its application in practice. The educational material directs the activity according to the cultural and scientific background that was built. This is because the design of the material expresses political and social practices, which are transformed into activities by the teachers and the available cultural and material resources, and which illuminate various fields of knowledge and knowledge development and form conditions of reflection for the activities [[37]. The role of artefacts in 21st century education is considered vital especially in complex learning environments where knowledge is not simply given but is co-constructed and often in the face of uncertainty [37].

The international literature that explores how teaching materials reinforce learning objectives and support education for sustainability is limited [38]. This article is a scoping review that maps the present literature on evaluating the effectiveness of formal and non-formal education materials that seek to promote education for sustainability. In this context, it particularly seeks to map the literature that evaluates the effectiveness of teaching materials from the perspective of sociocultural activity theory. This specific research field is very limited although extremely promising taking into account the dynamic relationship between knowledge construction, learning, and sustainability [39].

2. Methodology

2.1. Aim, Objectives and Research Questions

The aim of this scoping review is to map the existing literature on evaluating the effectiveness of educational materials, both formal and non-formal education, that seek to promote education for sustainability. The objectives of the study are: (1) to present the findings of studies on educational material, both formal and non-formal education, that seek to promote education for sustainability and (2) to present the perspective of sociocultural theory regarding findings of studies on the educational materials that seek to educate for sustainability. The research questions that guided the study were formulated as follows: How are the principles and goals of education for sustainability presented in formal and non-formal education teaching materials? How does sociocultural theory assess teaching materials for sustainability education?

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2.2. Scoping Review of Scientific Literature

The steps for developing and conducting the scoping review were the following. Based on the research questions, a research plan was formulated to search for the appropriate literature and evidence. The scoping review was conducted during the period winter 2021 - summer 2022 using keywords, the selection criteria of which were determined by the research questions. Specifically, the first research question formed the keywords "textbooks for education for sustainability" for the first part of the research question and the keywords "educational materials for education for sustainability", "evaluation of educational materials for sustainability" for the second part of the question. The second question formed the keywords "sociocultural theory and education material for sustainability".

The research utilized the Google Scholar database in order to include so-called gray literature sources, such as doctoral theses and master's theses. This decision was made considering that the field of education for sustainability is new and the inclusion of gray literature could provide perspectives and dimensions to address biases such as decolonization [40] .

The research was conducted in the English language, which is a key limitation for the research, as non-English literature related to the subject was not used. Another limitation of the research is the limited range of English-language literature related to the research topic. Research on education for sustainability is limited considering that it is a new research field. The research concerning the educational materials of education for sustainability in formal and non-formal education is even more limited, while the evaluation of educational materials through the perspective of socio-cultural theory is minimal.

After reading the titles and abstracts, 72 articles were collected, which were considered to match the research questions. The exclusion process was meticulous in order to reduce any potential for misreporting, misattribution, and bias. The inclusion-exclusion process began by limiting the search to studies written in English and published between January 2005 and July 2022, non-empirical studies were excluded. The selection process involved reading the title, abstract and keywords of all retrieved studies , followed by full text review. Papers deemed to not satisfactorily answer the research questions were excluded. After reading the articles - papers, articles were selected.

3. Results

To answer the research questions, descriptive analysis and content analysis were conducted as suggested in boundary-setting research [41]. The descriptive analysis (Appendix A) present the title of the research, the aim of the research, the method of analysis and the pedagogical background. The content analysis categorized the articles and papers into two sections: (1) sustainability education in formal education textbooks, (2) sustainability education in non-formal education. The articles and papers are from Australia (1), Taiwan (1), Spain (3), Luxembourg (1), Iran (1), Finland (1), Chile (2), Sweden (1), Germany (1), Brazil (1), Africa (1) and all over the world (1).

3.1. Education for Sustainable Development in Formal Education's Textbooks

The content analysis of the research that examines how education integrates sustainability into school textbooks, highlighted two dimensions. The first indicates the way in which the concept of sustainability is approached in school textbooks, while the second is about the proposed educational activities for sustainability education.

Regarding the presentation and organization of the content of sustainability education, it is found that in school textbooks there is no section exclusively dedicated to sustainability, but there are references to the concept, principles and goals of sustainability [42]. Research suggests that the finding that the implementation of ESD [27,28] in school education does not provide the desired results may be partly due to the content of school textbooks when they do not support action orientation for sustainability education [29,30,43]. Regardless of the teaching subject and the teaching units, the most common approach to sustainability is through ecology [43–45], or economics [46] while few are the cases where the concept is approached holistically taking into account the pillars of

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sustainability [45]. To help students understand the conflicts and complexities involved in achieving sustainability, textbooks should present the complex relationship between the ecological, economic and social dimensions of sustainable development, as well as the political conflicts and controversies involved in achieving it [43]. In some cases, especially at basic or elementary education, issues of sustainability are presented or can be presented through stories and myths that use the pillar of culture [42]. The inclusion of legends and myths in school textbooks, because they have inherent sustainability values [47], can be supportive in education for sustainability.

In the textbooks of Eastern and non-European countries, the materials' imagery depicts the environment and sustainability issues with minimal human influence, while the textbooks of Western Europe tend to show more images that express an anthropocentric concept that highlights human power over nature [48]. Biström & Lundström [43] point out that when the content of textbooks is not organized in a wide range of topics, but focuses mainly on the ecological dimension, providing less space and attention to the economic and especially the social dimension, and is permeated by anthropocentric perceptions [43], then it fails to promote the objectives of sustainability education. Sustainability and environmental issues are well presented in secondary education without being developed in relation to the pillars of sustainability [38,43]. Sustainability issues in primary education are presented in a very simplistic way [38] or are limited and present the issues in an indirect way [30]. Liu, Yang, Shiau [49] investigated the primary education materials for environmental and sustainability education in Taiwan and found that sustainability objectives are not accomplished because the materials focus only on the ecology dimension and aims at declarative knowledge.

In cases where the content of textbooks does not highlight the complexities and tensions that develop ways of achieving sustainability, education presents a dualistic view of things and sustainable development education is approached in an instrumental way [50]. When the impacts of human actions are not mentioned at a time when we are experiencing huge environmental and social changes [46], when issues are not connected to the community and its problems and anxieties [51], students still believe that school knowledge is only useful and functional in school and that the world needs another kind of knowledge. Considering that language is a key tool, as it works as a medium for all social interactions between individuals and their environment and their mental activities (writing, reading and knowing) [52], the importance of exploring the language in textbooks as an ideological mechanism for shaping perceptions of the environment and sustainable development is highlighted [46]. Researchers, such as García-González, García Palencia, Sánchez Ondoño [38] note that although there are policy decisions that highlight the importance of sustainability education, this interest is not transferred to textbooks, where the impact of human actions on the environment is presented in a fantastic and optimistic way, giving the sense of an ideal reality. Textbooks fail to highlight the conflicts and complexities associated with sustainability education because they tend to obscure the complex relationships that develop between the pillars of sustainability and the political debates over achieving sustainable development [43,46,50].

Regarding the proposed educational activities for sustainability education, the majority of textbooks seek mainly declarative knowledge [45], focus on environmental problems without addressing them in a systemic way. As a result, do not offer a comprehensive approach to sustainability.

Textbooks that do not support active learning, abstract thinking, action competence, reflection, and learning processes that support the accomplishment of sustainability goals [30] cannot be a source for education for sustainability. Textbook activities do not promote students' ability to take action on sustainable development as their teaching approaches are outdated [50], do not apply an interdisciplinary approach or suggestions for critical problem solving at the collective and individual level [43]. Moreover, do not foster critical thinking, nor do they promote active learning and student engagement [53]. When students do not know that active participation and citizenship are a key process of transition to sustainability, this is an obstacle, not only to their personal development, but also to the transition to sustainable development processes aimed at sustainability. This is because students do not learn how sustainability affects their daily lives, they understand that as individuals

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they have no personal responsibility for the transition to sustainability, changes happen through institutions, collectively or simply through the efforts of other people.

Vasquez et al., [51] claim that, activities do not discuss about issues that connect school to everyday life so they are not meaningful to students and do not allow them to understand the data and information. The activities do not utilize instructional practices to differentiate learning [54], therefore they do not pursue an inclusive and quality school that promotes Lifelong Learning.

3.2. Education for Sustainable Development in Non-Formal Education Materials

The existing literature on non-formal sustainability education is limited, despite being an area of growing importance [55]. Non-formal education is a critical component of the education sector, an organized and structured education programme, non-part of the formal curriculum [56]. Non-formal education is more holistic than formal education and provides students with a more enriching learning experience. The reason for its effectiveness could be that the non-formal education sector is able to provide a specific curriculum that is based on locally relevant issues [57]. The researchers argue that many characteristics of ECD occur mainly in the context of non-formal education [58] and point out that non-formal education can be a powerful driver of change towards sustainable development [55].

This research includes 3 empirical studies and focuses on educational materials - learning tools that are used in the learning situations these studies describe and analyze. The educational materials - learning tools highlight how social interaction takes place, collaborative learning is implemented and learning outcomes are expressed.

Adams, Farrelly, Holland, [56] investigated how non-formal education is implemented in the Zambezi region and found that integrating sustainability principles and including sustainability goals in the non-formal education curriculum are much easier than in formal education, when the teaching context is relevant to sustainability goals. The project used all the possibilities offered by flexible non-formal education to form networks of schools, connect formal education with parents and open schools to the wider community. The rich learning experience for the children and the relationships established between schools, parents and the wider community facilitated the spreading and sharing of knowledge and skills, providing benefits for all stakeholders. The program provided an opportunity to incorporate traditional knowledge into what students were taught through the formal curriculum and is an example of an attempt to de-marginalize traditional knowledge [10,11] to empower communities and motivate them to make changes for a sustainable future suitable for them.

Aguayo and Eames [59] in their research refer to the possibilities provided by the use of ICT tools to promote ecological literacy and the development of action competence among community members in southern Chile. The case study they describe concerns the ecological degradation of a lake in southern Chile and the profound social, economic and cultural impacts locally. The researchers developed a framework for designing, implementing and using ICT for community learning for sustainability. They transformed a website on environmental education issues from a learning tool to a mediating tool, forming a network of knowledge, information exchange, development of collective activities and actions. The researchers found that the non-formal environmental and sustainability education program led to the expansion of learners' zone of proximal development through a meaningful learning process which was directly linked to their interests and everyday life. Activity theory provided a framework for addressing general socio-cultural elements when using technology as a mediating tool for community learning.

Calvente et al., [60], present the experience of a non-formal environmental education program carried out in schools in the Petrópolis district of Rio de Janeiro, a vulnerable area facing severe environmental problems. The implemented practices aimed to enhance students' capability for sustainable transformations by encouraging them to engage in local socio-environmental challenges. The researchers formulated an educational framework for the development of skills based on Information, Communication, Mediation. Information was achieved through one-way transfer and instruction of gardening skills. Communication was achieved through a two-way flow of information

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which cultivated students' understanding on the subjects. Mediation was achieved through the intertwined developed the principles of communication, which facilitated their learning, communication and active engagement. Researchers by evaluating this non-formal education program, report that non-formal education teaching approaches for environment and sustainability should provide students with the space to reflect and act on issues that concern them and the community in which they live. Teaching approaches should take into account and build on the cultural characteristics and needs of learners in order to actively engage them in a meaningful process that support critical thinking and develop sustainable practices that are relevant to the local reality.

3.3. Teaching Materials for Sustainable Development from the Perspective of Sociocultural Theory

The process of transforming education into quality education (SDG Target 4.7) is a process of connecting theory with practice, a process that connects sustainability education programs with community interests and needs [61]. The practice of education for sustainability is a collective achievement and involves transforming people's unsustainable ways of life by changing the cultural, economic and socio-political arrangements that support the unsustainable practices. People change and adopt more sustainable ways of life when wider social changes take place in the existing cultural-historical structured practices, offering alternative ways of thinking about, acting and relating to others and the Earth. Changing these arrangements is a collective social achievement that begins with changing individuals' perceptions and actions and continues with changing the conditions (cultural and historical constructed) in which people are linked with others and the world [61].

Activity Theory functions as a lens that illuminates the way in which an educational program, an activity, an educational material, within a specific socio-cultural context, functions as a mediating tool between learning communities or learner and the object of the activity. In education for sustainability, education materials also act as a mediating tool that conveys explicit or implicit messages that enhance or hinder education for sustainability. In cases where education materials are means for conveying hidden ideological messages about society's organized knowledge system and reflect values of the dominant culture, sustainability education programs fail to utilize knowledge and concepts from other traditions of thoughts and fail to promote practice towards greater global integration and justice [62]. In these cases, the role of internalization of the mediating tool [63], is associated with the reproduction of the dominant culture.

Non-formal education provides more effective learning experiences for sustainable development. This is due to the flexibility, among other things, it has to organize educational proposals and/or educational materials on a specific topic of concern to the local community, taking into account the specific socio-cultural context. An educational material, not only functions as a learning tool, but also mediates the learning process in the community, forming a network of knowledge, information sharing, activity development and collective action [56,59,60]. Therefore, the design of effective activities for sustainability education at the local level (non-formal education), must take into account and use the socio-cultural characteristics and the needs and interests of students [64].

Sustainability education textbooks need to be investigated through two different but related systems of analysis. The first system has to do with textbook's design and the political and social practices it expresses. In this activity system the educational material is the object and the outcome of the activity, the expression of the relations that develop between the context of the activity (the political decisions, the dominant culture and social practices and the epistemological background), the designers and authors and the available tools. A textbook with an inclination *"towards neoliberal and instrumental approaches to institutionalized education for sustainability"* [6,50], does not encourage critical reflection on sustainable development and its inherent contradictions. Also, textbooks with content that have an anthropocentric perception do not form conditions for reflection on the understanding of sustainability [43].

The second activity system has to do with the instruction of education for sustainability. In this system textbooks act as tools to achieve the teaching objectives. Textbooks, depending on the teaching context in which they are applied, can either enhance learning or not. The teaching context is

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determined by the teaching method, the democratic rules of the teaching process, the role of the teacher and the connection between the content and the student's interests. Even the best education material in order to work effectively and benefit student's learning, must function as a mediated tool in a student-centered teaching and learning context [65]. Instead, a teaching context acts as an obstacle to education for sustainability goals when: (1) the interaction between teachers and students is determined by rules of hierarchy rather than equality; (2) there is no freedom to choose the knowledge and skills to be taught according to children's interests and needs. (3) teachers transform instructional materials from a tool to an end in themselves, and (4) when assessment is based on examining how well students reproduce the contents of the textbook [66]. This model of pedagogy runs counter to the principles of sustainability education.

The effectiveness of educational materials depends on the teaching context in which they are applied. In the system of teaching of education for sustainability when the context is not appropriate it turns into a mediator of learning and the education material is transformed from a tool for mastering the learning objective into an objective of the teaching process and ceases to function. The contradictions that come up between the intended goals of the teaching materials and the pedagogical practice applied prevent the effective implementation of sustainability education. The sociocultural theory comes to illuminate the contradictions that develop between the intended goals of the curriculum and the pedagogical practice in the classrooms.

Nguyen, Leder, Schruefer, [66] state that it is not enough for the teaching content to support constructivist learning for education for sustainable development and transformative pedagogical practice, since teachers need to be trained in this framework to put it into practice. The problem is that curricula, teaching materials and teachers do not understand the socio-cultural dimension of the educational context as a continuous dialectical process and apply a traditional authoritarian approach that is not suitable for education for sustainability [67]. Activities should support participatory and collaborative learning [67], build on children's cultural and educational capital [62], to meet education for sustainable development goals and have a significant impact on the community and ecosystems. Students should be encouraged to be actively engaged in acquiring knowledge, and putting what they have learned into practice in order to take action for sustainability. The practices of teachers implementing sustainability programs should emphasize on the quality of the teaching process, which makes sense when the practice is collaborative [68] connected to the local community and utilizes creative processes (e.g., art) as well as problematic situations [61].

4. Discussion

The present scoping review is not without limitations. Firstly, only the articles printed in English from 2005 to 2022 were included, therefore, relevant research in other languages is missing. The choice of using English-language studies is due to time constraints, but also due to the impossibility of finding resources to use translation services for articles in other languages. Also, we did not assess the quality of the articles although Arksey & O'Malley, [41] argue that this is not a limitation. A final limitation is the limited number of studies related to the area of research - an interesting finding given the need for quality education for sustainable development.

This scoping review, influenced by socio-cultural learning theories, shifts the research focus from content to the teaching context. Depending on the teaching context in which it is used, the education materials for education for sustainability may or may not enhance learning.

Considering the limited literature on the effectiveness of educational materials that seek to promote sustainability education, research needs to be continued.

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Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

Title of the research	Aim of the research	Method of data analysis
Formal Education textbooks		
Arrebola, J., Martínez-Medina, R. (2018). Sustainability in primary education in Spain: an approach through textbooks	How the concept of sustainability is focused in different Social Science's textbooks of sixth grade primary school in Spain	Grid analysis
Arrebola, J., Martínez-Medina, R. (2019). Analysis of sustainability activities in Spanish elementary education textbooks.	Primary education/ Social sciences/Spain	Content analysis based on Bloom's taxonomy and Costa's levels of questions
Barter, N. (2016). Strategy textbooks and the environment construct: are the texts enabling strategists to realize sustainable outcomes.	Strategy textbook in Australia and United Kingdom	Critical discourse analysis on the ideology and language use of texts to enable the identification of underlying themes and meanings
Vásquez, C.; García-Alonso, I.; Seckel, M.J.; Alsina, Á. (2021). Education for sustainable development in primary education textbooks-An Educational Approach from Statistical and Probabilistic Literacy.	Education for sustainability in in eight Chilean Primary Education Mathematics textbooks: articulation levels, cognitive demand and the authenticity of the statistical and probability tasks present	Qualitative and quantitative content analysis
Joutsenlahti, J., Perkkilä, P. (2019). Development in Mathematics Education-A Case Study of What Kind of Meanings Do Prospective Class Teachers Find for the Mathematical Symbol 2/3?	multi-semiotic approach to interpreting the kind of meanings the primary education teachers in Finland gave to the mathematical symbol "a/b"	Qualitative and quantitative content analysis.
Mohammadnia, Zh., Moghadam, F., (2019). Textbooks as resources for education for sustainable development: a content analysis	English Language Learning textbooks in Iran as potential useful resources for the implementation of ESD	Qualitative content analysis
García-González, J. A.; García Palencia, S.; Sánchez Ondoño, I. (2021). Characterization of environmental education in Spanish geography textbooks.	Analysis of nine primary and secondary education geography textbooks about environmental education in Spain	Quantitative analysis

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Pettig, F.; Kuckuck, M. (2021). Narratives of sustainability on energy-related topics: empirical findings from German geography textbooks for secondary schools	The dimensions of sustainability and an education for sustainable development on energy related topics in German textbooks for secondary school students	Qualitative content analysis
Biström, E., Lundström, R. (2021) Textbooks and action competence for sustainable development: an analysis of Swedish lower secondary level textbooks in geography and biology	the affordances and limitations of Swedish lower secondary level textbooks in geography and biology for promoting action competence for sustainable development	A thematic analysis approach moving between deductive and inductive modes of analysis
Carvalho, G., Tracana, R. B., Skujiene, G., Turcinaviciene, J. (2011) Trends in Environmental Education Images of Textbooks from Western and Eastern European Countries and Non-European Countries	A deepen understanding of how different aspects of citizenship can be promoted through biology, health and environmental education	Qualitative and quantitative comparative analysis of the pictorial material
Andersen, K. (2018). Evaluation of school tasks in the light of sustainability education: textbook research in science education in Luxembourgish primary schools	The study examines how action-based and task-based learning approaches are reflected in tasks that affect sustainability education	Content analysis Categorisation into action oriented and task oriented texts
Liu, Z.; Yang, H.-C.; Shiau, Y.-C. (2020) Investigation on Evaluation Framework of Elementary School Teaching Materials for Sustainable Development.	An evaluation framework of elementary school teaching materials in Taiwan for sustainable development	Quantitative and qualitative analysis
	Non Formal Education	
Calvente, A., Kharrazi, A., Kudo, S., & Savaget, P. (2018). Non-formal environmental education in a vulnerable region: insights from a 20-year long engagement in Petropolis, Rio de Janeiro, Brazil.	The experience of non-formal environmental education approaches held in schools in the Petrópolis region of Rio de Janeiro	A case study about how the socio-environmental values are reflected in the educational experiences of vulnerable communities
Adams, S., Farrelly, T., Holland, J (2020). Non-formal Education for Sustainable Development: a Case Study of the 'Children in the Wilderness' Eco-Club Program	The study aims to gauge the success and value of non-formal ESD in the Zambezi Region	Interviews and focus group discussions

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Aguayo, C and Eames, C. (2017). Promoting community socio-ecological sustainability through technology: A case study from Chile	A case study which evaluated the potential of ICT for promoting ecological literacy and action competence amongst community members in southern Chile.	A case study in two faces. (1) The development of a theoretical framework from existing theory in ESD, community education and ICT. (2) The evaluation and testing of the framework in a socio-ecological context in Chile

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