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Challenges and solutions to implementing education for sustainable development in geography classes: an international comparison of geography teachers' perceptions (Germany-NRW and Iran)

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This study examines the challenges and solutions related to implementing Education for Sustainable Development (ESD) in geography classes in two countries with different political and educational systems: Germany (North Rhine-Westphalia) and Iran. The research focuses on how teachers in both contexts perceive the integration of ESD into their teaching. A qualitative approach was used to conduct interviews with open-ended questions with 30 geography teachers from both countries to assess their perceptions of ESD implementation. The study identifies key barriers to implementing ESD and teacher-proposed solutions in three main categories: teaching practice, schools and educational organizations, and political and social framework conditions. The findings show that German teachers emphasized challenges and solutions more closely related to lessons, classes, and schools, such as curriculum-related issues. In contrast, Iranian teachers focused on challenges and solutions linked to the broader education system and national context. They highlighted the centralized education system and political and religious barriers. These results suggest that although there are barriers to ESD in both settings, the level at which they occur differs. German teachers concentrate on classroom and school structures, while Iranian teachers stress systemic, political, and societal constraints.

KEYWORDS

education for sustainable development, ESD implementation, geography education, teacher perception, social framework, political system

1 Introduction

From the very beginning of the promulgation sustainable development approach (SD), education has been recognized as the key factor and most critical tool for achieving sustainable development (Kazuaki et al., 2021, 57). The principles of schooling can be altered for empowering students to obtain skills and gain knowledge to participate in decision-making, and to espouse sustainable development as conscious and critical citizens (Leder, 2015, 17). With a glance at the evolution of sustainable development, the traces of education's role can be seen in the following significant events. The sustainable development approach was addressed as the current subject of the last decade of the 20th century by the UN and determined as Agenda 21 at international,

regional, and local levels (Roseland, 1997, 200; Finco and Nijkamp, 2001, 293). In fact, chapter 36 from Agenda 21 is the start point of the idea of Education for Sustainable Development (ESD), which has been considered by many countries to deal with international environmental crises (Agenda 21, UNCED, 1992, Chapter 36, 1). As the efforts to achieve sustainable development have been increased, the goals of this approach are evolving (Shi et al., 2019, 5–6). Finally, in 2015, the sustainable development goals (SDGs) -known as the 2030 agenda—were set up by the United Nations General Assembly (UN-GA) and are intended to be achieved by the year 2030. It is covering of 17 interlinked global goals and 169 specific objectives. The fourth goal of this agenda -Sustainable Development Goal 4 (SDG 4 or Global Goal 4) is in quality education and has been defined as "Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all." (United Nations, 2015, 7–14).

In 2007, geography educators from around the world agreed on a shared understanding of ESD, which then amounted to a common framework of implementation for ESD with the ratification of the Lucerne Declaration on Geographical Education for Sustainable Development (Bagoly-Simó, 2014, 128). Since that time, ESD has become one of the most prominent and frequently acclaimed goals of geographical education (*Ibid*, 129). ESD as a transformative pedagogic practice can contribute to gradually revising current geography teaching contents and methods towards promoting learner-centered teaching, critical thinking, and argumentation skill development (Leder, 2015, 17). Therefore, geography educators often implement ESD in many countries (Müller et al., 2021, 2).

As the efforts to achieve sustainable development grow and the goals of this approach evolve (Shi et al., 2019, 5–6), the role of ESD as the practical solution is becoming stronger. In the way of implementing ESD, although the countries confront different challenges and concerns related to sustainable development (Javanmardi et al., 2023, 2), sustainability-related concerns and problems are trans-local, trans-national, systemic, global, and interconnected (*Ibid.* 11). In consequence, ESD cannot be implemented in an isolated world and international cooperation is unavoidable, it must be said that the implementation of ESD in the school curriculum is necessary internationally to educate citizens who can solve the key problems of the future.

Although Germany and Iran have not signed a joint treaty to implement ESD, in both countries, but both countries have joined in numerus international contract, which among them and most related to implementation sustainable development and ESD, we can mention the five items including (1) United Nations Agenda 2030 for Sustainable Development (Jeffrey et al., 2023, 24), (2) The Paris Agreement (Izzet and Ramazan, 2017, 178), (3) UNESCO Global Action Program (GAP) on Education for Sustainable Development (ESD) (UNESCO, 2020, 4), (4) The Convention on Biological Diversity (CBD) (United Nations, 1992, 326), and (5) The Sendai Framework for Disaster Risk Reduction (Seddighi et al., 2023, 8, UNDRR, 2023, 90). In Germany (Bagoly-Simó, 2022, 55) and Iran (Parishani et al., 2018, 14) geography is among the main subjects that addresses sustainable development topics.

Germany and Iran are compelling cases for comparative analysis in the field of Education for Sustainable Development (ESD), given their markedly different educational structures, socio-political contexts and levels of sustainable development progress. Germany's decentralised education system provides significant flexibility and regional adaptability. This enables individual federal states, such as North Rhine-Westphalia, to develop and implement targeted sustainability strategies that integrate ESD across all educational sectors, from early childhood to higher and vocational education. Institutional support and multilevel governance have facilitated the extensive formalisation of ESD in curricula and policy frameworks, including the National Action Plan aligned with the SDGs (Müller et al., 2021). In contrast, Iran's centralised system prescribes uniform curricula nationwide, limiting local adaptation and innovation in ESD implementation. Although national documents such as the Fundamental Reform Document of Education (FRDE) and development plans recognise the importance of sustainable development, practical measures remain limited. ESD is largely confined to textbook content and lacks a coherent implementation framework (Rezaei, 2016). These contrasting contexts highlight the importance of comparing a developed country and a developing country in order to explore how educational governance, curriculum policy and institutional readiness influence the integration of sustainability into education. Such a comparison highlights systemic barriers and enablers, and provides transferable insights for regions seeking to enhance ESD implementation within diverse political and administrative frameworks.

This research aims to analyze and compare teachers' perceptions of ESD implementation in geography classes in Germany (North-Rhine Westphalia) and Iran. The following three research questions have been put forward to guide the study and are to be answered by a qualitative survey with 15 teachers from each case study:

- What are the main challenges and obstacles that the interviewed geography teachers from Iran and Germany see for the implementation of ESD?
- What solutions have German and Iranian geography teachers suggested to overcome the challenges of implementing ESD in geography lessons?
- What are the similarities and differences between the views of Iranian and German geography teachers regarding the challenges and solutions of ESD implementation?

2 Research background

2.1 From sustainability to education for sustainable development

The most commonly used definition of sustainable development has been formulated by the Brundtland Commission (Emas, 2015, 2). Sustainable development is "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987, p. 43). Kitamura (2014, p. 42) in expanding the concept of sustainable development, stated that: "Sustainable development refers to activities to create a fair and affluent future by advocating human rights, building peace, promoting cross-cultural understanding, promoting health, maintaining natural resources, preventing disasters, reducing poverty, promoting corporate responsibility among others while guaranteeing democratic social systems in which everyone can participate and social systems that consider environmental and social impacts and respect the uniqueness of individual cultures."

As the efforts to achieve sustainable development have increased, the goals of this approach are evolving (Shi et al., 2019, 5–6). In 2015, the Sustainable Development Goals (SDGs) -known as the 2030 Agenda—were set up by the United Nations General Assembly (UN-GA) and are intended to be achieved by the year 2030. It is covering of 17 interlinked global goals and 169 specific objectives. The fourth goal of this agenda—Sustainable Development Goal 4 (SDG 4 or Global Goal 4)—is about quality education and has been defined as "Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all" (United Nations, 2015, 7–14). According to the Sustainable Development Report (SDR) (Jeffrey et al., 2023), on the status of the SDGs at the midpoint on the way to 2030, 8 years after the implementation of the 2030 agenda, none of the 17 goals have been met yet. The status of six goals is in decreasing mode with major challenges, and nine goals have stagnating mode with significant challenges. At the same time, goal 4 (quality education) along with goal 12 (Responsible consumption and production) have a better status compared to other goals in the moderately improving mode with challenges remaining (Jeffrey et al., 2023, 24). As indicated by the scores and ranking in the above-mentioned report, Germany and Iran have 2 different statuses. While Germany is among the top 10 countries, with a score of 83.4, it comes in 4th in the achievement of 17 goals. Iran is in the middle of the table with a score of 69.1, ranking 86 out of 166 countries in the world (*Ibid*, 25).

Education plays a central role in forming the society's capacity to address some of the most pressing challenges faced today (Barth et al., 2016, 86). Embarking on the path of sustainable development will require a profound transformation of how we think and act. To create a more sustainable world and to engage with sustainability-related issues as described in the sustainable development goals, individuals must become sustainability change-makers. They require the knowledge, skills, values and attitudes that empower them to contribute to sustainable development. Education, is crucial for the achievement of sustainable development (Rieckmann, 2017, 7). According to Rieckmann (2017), Education for sustainable development is defined as an approach that empowers learners to take informed decisions and responsible actions for environmental integrity, economic viability and a just society for present and future generations (Rieckmann, 2017, 7). Biasutti (2015), discussed that education for sustainability is practically a complex concept including all aspects; such as being aware of issues regarding sustainable development, having active participation in decision-making, developing the knowledge, skills, concepts, and values towards empowering the citizens aimed at planning for a sustainable future (Biasutti, 2015, 3). ESD can be applied through learning, therefore students can realize the concept of sustainable development by providing them with in-depth related knowledge (Pasang and Mohd Najib, 2022, 1,099).

2.2 Geography teachers' attitudes about challenges and solutions of execution of ESD

Among the teachers implementing ESD, geography teachers have an important status due to the subject of geography. Geography explores nature and society at different scales and thus, compared to other subjects, has the highest degree of affinity to both the themes and skills of ESD (Bagoly-Simó, 2013, 14). In 2007, geography educators from around the world agreed on a common understanding of ESD, which then amounted to a common framework for implementing ESD with the ratification of the Lucerne Declaration on Geography Education for Sustainable Development (ibid., 2014, 128). Since then, ESD has become one of the most prominent and widely recognised goals of geographical education (*Ibid*, 129). ESD as a transformative pedagogical practice can contribute to the gradual revision of the current content and methods of geography education in order to promote learner-centred teaching, critical thinking and the development of argumentation skills (Leder, 2015, 17).

Research conducted by Sánchez (2011) in Catalonia highlighted significant challenges in the implementation of ESD among geography teachers. Although teachers recognized the importance of ESD and its relevance to the geography curriculum, they reported a lack of structured models and frameworks to integrate ESD effectively. A notable issue was the lack of appropriate teaching materials and in-service teacher training, which left educators relying on intuitive methods and limited knowledge. In addition, the lack of sustainable development plans within schools made ESD initiatives fragmented and spontaneous rather than systematic. As a solution, teachers emphasized the need to develop ESD-specific teaching resources and suggested that universities and textbook editors should collaborate in this effort. They also called for targeted in-service training programmes to enhance teachers' capacity to integrate ESD principles into their teaching practices.

Dube (2012) research into the implementation of ESD in South African secondary schools revealed a number of conceptual and practical challenges. Teachers often struggled to understand the differences between environmental education (EE), ESD and the integrated geography approach endorsed by curriculum frameworks. This conceptual ambiguity limited their ability to identify and effectively integrate ESD themes into their teaching. In addition, inadequate resources, organisational deficiencies at school level and limited support from curriculum advisors further hampered the practical implementation of ESD. As part of the solutions, Dube identified opportunities within the policy framework that could enable better integration of ESD. She emphasised the importance of teacher training programmes that focus on the interpretation and application of the curriculum, as well as promoting awareness of local environmental challenges as a means of grounding ESD in relatable, real-world contexts.

Nguyen (2017) explored Vietnamese geography teachers' perspectives on ESD, uncovering challenges rooted in both conceptual and contextual factors. Teachers' perceptions of ESD often differed from the dimensions proposed by UNESCO, revealing inconsistencies in how ESD was understood and implemented. These differences were shaped by the interplay of national curricula, practical teaching experiences and broader societal perceptions. In addition, certain ESD themes were considered less relevant or poorly adapted to the specific socio-cultural and educational contexts of Vietnam. In response to these challenges, Nguyen recommended that training programmes be adapted to the local context to ensure that teachers are equipped to adapt international ESD principles to their specific educational environments. The study also advocated for a clearer integration of ESD into national curricula to provide educators with practical and context-sensitive guidelines.

Guo et al. (2018), investigated sustainable development in geography education in China. The findings indicated that most of the geography teachers surveyed had sufficient knowledge and skills to teach SD. In addition, geography teachers used textbook activities and reading materials and extended the content based on the standards. And teachers with more than 10 years' experience could organise themselves freely and teach the required content. Finally, the research found that there may be a correlation between the ability to teach SD and the age of the teacher. As methodological comparison is crucial, this research was different from the presented research as the researchers used a quantitative method to survey 237 geography teachers' perceptions of ESD. In addition, the questionnaire used was a standardised format.

With a brief look at previous research that investigated the implementation of ESD among geography teachers, and by comparing them with the current research, we find that previous researches had not specifically investigated the challenges of geography teachers in the implementation of ESD. Although they have been counted some challenges in the above-mentioned research. We specifically addressed the challenges as well as the offered solutions in geography teachers' attitudes. Besides, we looked at these challenges and solutions in the social and political context of the two countries and compared them. All this distinguishes our research from previous research.

2.3 The effect of the social framework on implementing ESD

Education for sustainable development is a fundamental element in achieving the SDGs. The societal framework, including cultural norms, policies, economic systems, and community values, has a critical impact on the realization of ESD. Social frameworks significantly shape ESD by integrating international and national resolutions, societal demands, and interdisciplinary scientific analysis into educational practice. This orientation promotes a holistic understanding of sustainability by linking societal and individual capacities with global development challenges (Schreiber and Siege, 2016, 28). The social framework deeply influences ESD by embedding sustainability values and global perspectives into education systems, ensuring relevance across cultures. It empowers individuals with knowledge and skills to address collective societal challenges and promotes economic and social justice. This holistic approach fosters transformative learning, integrating sustainability into both education and everyday life (Olsson et al., 2016, 5). Although researchers describe ESD in slightly different terms, there is a consensus that ESD as an approach to education should address the complexity of a globalized world. In order to ensure that ESD becomes an ongoing process in young people's everyday lives, teaching needs to empower students to take action. Some key principles are relevant to all cultures and cover the scope, purpose and practice of ESD, which have been defined by UNESCO as follows, a transformative and reflective process that seeks to integrate values and perceptions of sustainability not only into education systems but also into everyday personal and professional life; a means of empowering people with new knowledge and skills to help solve common problems that challenge the collective life of global society now and in the future; a holistic approach to achieving economic justice and respect for all life; and a holistic approach to achieving economic and social justice and respect for all life; a means of improving the quality of basic education, reorienting existing educational programmes, and raising awareness (UNESCO, 2009, 26).

There are challenges to be overcome in order to implement ESD effectively. The diversity of contexts (social, cultural and institutional) and teachers' perspectives creates specific environments for good teaching, sometimes using very different strategies and methods (Leal Filho et al., 2021, 3). It is acknowledged that the concept of sustainable development may be perceived as an ideal end state and that historical and cultural factors may influence visions of this future. This could potentially lead to educational programs being perceived as indoctrination for this ambitious future. However, it is assumed that a sustainable society can only emerge due to complex interactions between system parameters and conditions, with education acting as a guiding force in transforming society towards a dynamic state (Kioupi and Voulvoulis, 2019, 5). In this regard, education systems should be improved to take into account the interdisciplinary nature of ESD, the involvement of civil society should be strengthened, and adequate institutional and material resources should be mobilized (UNESCO, 2009, 16). The education community needs to collectively define a sustainability vision for the future through participatory processes involving learners, educators, and local civil society. Broad stakeholder engagement, both internal (e.g., students, faculty) and external (e.g., communities, businesses), fosters collaboration, enhances the learning environment and drives sustainability transformation. Dialogue on institutional missions and goals is essential to aligning education with SDG goals (Kioupi and Voulvoulis, 2019, 6). The UNESCO, 2019 report states that partnerships are needed with other key actors, such as multilateral financial institutions, national development agencies, the private sector, civil society and community actors. The alliance with national mechanisms established to support the achievement of the SDGs through education will also require further attention. In particular, the use of innovative and creative financing mechanisms will be explored in the development of partnerships (UNESCO, 2019, Annex II, 10).

2.4 The effect of the political system on implementing ESD

Education for Sustainable Development aims to equip learners with the knowledge, skills, attitudes and values necessary to shape a sustainable future. It appears that a country's political system has a significant impact on the implementation of ESD. A number of scholars have highlighted the civic and political dimensions of place-based education, which they define as an approach that encourages students to critical thinking about their communities, their historical development, and potential avenues for positive change (Nusche et al., 2024, based on Gruenewald, 2005, 73 and Schild, 2015, 88). Verhelst et al. (2023) on the framework for the ESD effective school state that the organization of schools is situated within the largest external contexts, including political, cultural and economic contexts (Verhelst et al., 2023, 2). Furthermore, according to UNESCO, "ESD must explore the economic, political and social implications of sustainability by encouraging learners to think critically about their own parts of the world, to identify unsustainable elements in their own lives, and to explore the tensions between conflicting goals" (UNESCO, 2002, 12).

In the field of Global Development and ESD, where the comparison of political developments in industrial, emerging and

developing countries is of particular significance, the ability to shift perspectives is of paramount importance (KMK and BMZ, 2007, 105). Since the mid-1990s, ESD has increasingly received attention in politics (De Haan, 2010, 318). ESD in the context of political education is associated with the capacity for more expansive modes of thinking that inform the specific manner of making political judgments. As Juchler (2005) defines it, "The political judgment is characterized by a consensus-oriented balancing of individual self-interest with the actual or assumed interests of others, following political values" (Schreiber and Siege, 2016, 218). Sinako et al. confirm that the political perspective is one of the factors influencing the perception of SD and ESD, resulting in the terms being interpreted in different ways (Sinako et al., 2018, 20).

It seems that political intervention in ESD has created challenges in its implementation. In many countries, ESD is still shaped by those outside the education community. In these cases, the concepts and content of ESD are developed by ministries, such as environment or health, and then provided to educators for implementation. The issue of conceptual development independent of educator input is a challenge recognized by both international bodies and educators (McKeown, 2002, 10). Hofman (2012) highlights the concern that sustainable development in teacher education is largely rhetorical, rather than a tangible reality. This has led to a situation where student teachers are only partially equipped with the necessary knowledge of sustainable development and its multiple dimensions during their teacher education (Hofman, 2012, 303). A further challenge is that political models, which are often overly simplistic in their approach, attempt to provide a predefined version of sustainability (Kioupi and Voulvoulis, 2019, 5).

The United Nations Economic Commission for Europe (UNECE) strategy for ESD identifies the necessity of robust political backing at all levels of governance to ensure the incorporation of sustainable development (SD) perspectives throughout the educational sector (UNECE, 2022). To this end, educational systems must undergo comprehensive reform to address the interdisciplinary nature of ESD. Furthermore, the involvement of civil society must be strengthened, and adequate institutional and material provisions must be mobilized (United Nations Economic Commission for Europe, 2009, 16).

2.5 Comparing case studies in implementing ESD

Sustainable development, on the one hand, emphasizes the importance of having a long-term perspective on the results of today's activities and global cooperation among countries to achieve effective solutions, and on the other hand, it is one of the principles and requirements for sustainable development of international cooperation in areas such as the exchange of scientific knowledge (Kouhestani Kouhestani Nezhad, 2020, 29,). Germany and Iran, with different economic-social and political statuses, are among the developed and developing countries that have considered sustainable development education through the geography curriculum. Accordingly, it is clear that Germany and Iran have two completely different educational systems. In "top-down, inflexible" education systems (highly centralized, like Iran), despite the differences between teachers, students, and areas, they try to design uniform curricula for all of them (Shirazi, 2006, 50). Aminkhandaghi and Goudarzi quoted from (Assetto, et al., 2003) and Florestal and Cooper, (1997) argue that political will, legal framework, social will and economic resources are necessary conditions for decentralization of curriculum planning. And in the absence of such conditions, it will be impossible to succeed (Aminkhandaghi and Goodarzi, 2011, 91–93). Therefore, the complex bureaucracy and severe administrative centralization have reduced the effectiveness of the Iranian education system (ibid, 83).

In the decentralized "down-top, flexible" education systems (such as Germany), decision-making power is devolved to governments, communities, and local schools, and this devolution can range from textbook development to general policy development (ibid., 77). Thus, it can be said that the Iranian educational system and education in geography and sustainable development has the least flexibility in contrast to the German educational system (Glaesser, 2008, 206). In an educational system, if students' expectations, needs, and perspectives are the source and axis of curriculum production and development, it is considered a decentralized educational system (Aminkhandaghi and Goudarzi, 2011, 79). In Iran, curricula in the form of textbooks are completely predetermined, which deprives teachers and students of the opportunity to have other options and comments on these sources (Mehr Mohammadi, 1993, 109–111). It is worth mentioning that education is the most powerful tool at hand to drive the transformations necessary for sustainable development. And to realize this potential, education systems must be flexible, culturally sensitive, relevant and capable of changing people's values and behaviors (UNESCO, 2018, 29, based on, The World We Want 2013: iv).

In terms of Education for Sustainable Development, the two countries are on two different paths. On the one hand, Germany is taking serious steps to prepare and regulate education documents for sustainable development, including the implementation of formal education in schools to educate future citizens towards sustainable development goals. In comparison, in Iran, despite the importance of sustainable development in upstream documents such as -Iran's five-year development plans-, the necessary and sufficient practical actions have not been taken to implement ESD and the content has remained at the textbook level (Parishani et al., 2018, 13). The presentation and quality of sustainability topics in textbooks can be analyzed as an indicator of the status of integration in education, norms, values and political orientations (Leder, 2015, 165). It seems that these topics are limited to reminders and reviews in textbooks and cannot be persuasive education that leads to changes and modifications in behavior and lifestyle in the future (Dehghan et al., 2017, 307). Sustainable development is a global issue and according to the 2009 Wals Mid-DESD report, most governments have begun efforts to educate about sustainable development (Wals, 2009, 7). In the transition to sustainable development, the actions of developed countries alone are not enough, but the cooperation of developing and underdeveloped countries is also very important because we know that four-fifths of the world's population, about 6.1 billion people, live in developing countries (UNCTAD, 2017, 63).

3 Methodology of the research

The present study is framed as qualitative research because it aims to understand the subjective world of human experiences (Cohen et

al., 2011, 21) and seeks answers to questions that stress how social experience is created and the meaning that it is given (Denzin and Lincoln, 2008, 14). This research aimed to analyze and compare EDS implementation in the geography classes of Iran and Germany (North-Rhine Westphalia) from the teachers' perspective. It is important to note that in contrast to the German education system, the curriculum in Iran does not have the same importance as in Germany. The most recent national curriculum developed by the Ministry of Education for implementation in 2013 does not make any specific reference to geography. In the aforementioned document, geography is referenced within the subfield of education and learning of humanities and social studies, albeit in indirect terms, with an emphasis on the study of the natural and human environment and place. It is noteworthy that the document in question, which comprises 64 pages for all subjects, does not adhere to the conventional characteristics of a curriculum (Ministry of Education of Iran, 2013).

3.1 Participants and the setting

30 geography teachers from secondary schools (15 Geography teachers from Germany and 15 Geography teachers from Iran) participated in this research. We applied theoretical sampling to interview people with as many different perceptions as possible (Conlon et al., 2020, 947). The participants were selected to represent a broad spectrum of perspectives. The criteria encompassed a range of factors, including age, teaching experience, educational background, academic major, type of school, and, to a certain extent, geographic distribution. This approach was adopted to ensure a diversity of experiences that were pertinent to the subject of study. Therefore, care was taken to cover teaching experience in different types of schools and the gender of teachers in both countries. The teaching experience of the sample of teachers ranges from 2 to 30 years. The participants obtained bachelor's and master's degrees in different subjects, but they are common in teaching geography lessons in secondary schools. For ethical considerations, the teachers and schools were given pseudonyms (see Table 1).

4 Data collection and analysis

To answer the research questions of the study, semi-structured interviews with open questions have been used. The choice of methods has been influenced by the research aims and questions. While semi-structured interviews generally follow a guide or protocol that is developed before the interview and are structured around a core topic in order to provide a general framework, they also allow for discovery, with the freedom to follow topical trajectories as the conversation

TABLE 1 Teachers' profile (Germany).

Overview of the profile of teacher participants from Germany	School type	Teacher (Pseudo)	Gender	Qualification	Subjects	Teaching experiences (Years)
1	Gesamtschule	Ger1		Master	Geography	1
2	Grammar School	Ger2	Female	Master	Spanish, German	20
3	Grammar School	Ger3	Male	Master	German and Geography	1
4	Gesamtschule	Ger4		Master	English and Geography	13
5	Grammar School	Ger5	Male	Master	Geography and History	1
6	Grammar School	Ger6	Male	Master	Chemistry, Physics and Geography	1
7	Hauptschule	Ger7	Female	Master	German and Math	21
8	Gymnasium and Grammar	Ger8	Male	Master	French and Geography	21
9	Grammar	Ger9	Female	Master	biology and geography	22
10	Gesamtschule	Ger10	Female	Master	Geography and	1
11	Gymnasium	Ger11	Female	Master	Geography and	3
12	Gymnasium	Ger12	Male	Master	German and Geography	3
13	Grammar school	Ger13	Male	Master	French and Geography	10
14	Gymnasium	Ger14	Male	Master	mathematics, sports and geography	10
15	Gymnasium	Ger15	Male	Master	Geography and	4

Reference: data collected from interviews by the authors.

unfolds (Magaldi and Berler, 2020, 4,904). Besides, they offer richer and more extensive data than data from surveys or even the open-ended portions of survey instruments (Yin, 2018, 129).

Our interview questionnaire included 17 main questions that consisted the following topics: Perception of the concept of Sustainable Development, Perception of the concept of ESD and its importance, Importance of ESD in Geography, extension of integrating education for sustainable development in geography lessons, other activities in geography class related to ESD, topics concerning sustainable development which are addressed in the geography curriculum and textbooks, topics in sustainable development, used and suggested methods for teaching ESD, challenges and solutions to overcome the problems of ESD implementation, evaluation of implementation ESD, strengths, weaknesses, opportunities, and threats of implementing ESD in Geography lessons.

4.1 Data analysis

Mayring's methodology was followed, so the responses from interviews were transcribed and then coded by making use of the MAXQDA program. The codes were grouped into different categories and subsequently interpreted (Mayring, 2000, 1–8).

Among the results obtained from the above 17 main questions, our focus in this article is on two categories including (1) the challenges of implementing sustainable development education and (2) the proposed solutions to overcome these challenges from the teachers' perspective. The main two categories can be categorized into three subcategories based on the German and Iran teachers' statements including teaching practice (media, methods, content, teachers' qualification, students related), School and Educational Organization (curriculum, time), and Political and Social Framework Conditions; Educational policy, social framework). Table 2 shows the categorization of interview answers provided by teachers). It is important to note that in the written codes, "GER" denotes that the teacher interviewed is from Germany, while "IR" signifies Iran. The first number indicates the order of the interviewees in the final English-language interview file. To ensure the reliability of the qualitative coding, we assessed intercoder agreement using Cohen's kappa (κ) and the percentage of agreement across all 30 interviews (15 from Iran and 15 from Germany). Two groups of independent coders from the university of Cologne applied a unified coding framework comprising six analytical categories—three subdimensions (Teaching Practice, School and Educational Organization, and Political and Social Framework) nested within two main dimensions (Challenges and Solutions). The overall kappa (κ) ranged from 0.82 to 0.88, indicating strong agreement according to established benchmarks (McHugh, 2012, 279; Table 3).

To adapt the challenges and solutions we categorized the second main category "Solutions regarding challenges of implementation of ESD" into the same six subcategories based on the previous main category "Challenges of implementation of ESD "which includes education system, society, methods, complexity of the concept of sustainable development, and school system (Table 4).

5 Results

In the following lines, we present the findings from the teachers' interviews based on the research questions in this article. First, we present results on what challenges teachers encounter in implementing ESD through geography lessons and compare their attitudes in both countries. The next step is to see what solutions they offer to overcome the challenges mentioned.

TABLE 2 Teachers' profile (Iran).

Overview of the profile of teacher participants from Germany	School type	Teacher (Pseudo)	Gender	Qualification	Subjects	Teaching experiences (Years)
1	Secondary school 2	IR1	Female	Master	Geography	5
2	Secondary school 1	IR2	Female	Bachelor	Social Sciences	23
3	Secondary school 2	IR3	Male	Master	Sociology	18
4	Secondary school 2	IR4	Male	Master	Geography	12
5	Secondary school 1	IR5	Male	Master	Geography	2
6	Secondary school 2	IR6	Female	Master	Geography	19
7	Secondary school 2	IR7	Male	Master	Geography	18
8	Secondary school 1	IR8	Male	Bachelor	Social Sciences	30
9	Secondary school 1	IR9	Female	Bachelor	Social Sciences	22
10	Secondary school 2	IR10	Female	Bachelor	Social Sciences	1
11	Secondary school 2	IR11	Female	Master	Sociology	4
12	Secondary school 2	IR12	Female	Bachelor	Mathematics	29
13	Secondary school 2	IR13	Male	Master	Literature	22
14	Secondary school 1	IR14	Male	Bachelor	Social Sciences	22
15	Secondary school 2	IR15	Male	Master	History	29

Reference: data collected from interviews by the authors.

TABLE 3 Challenges in the way implementation ESD, categorizing teachers' attitudes.

Main categories	Sub categories	Sub-sub categories	Sub-sub-sub categories/ focus	Examples from interviews
Challenges of the implementation of ESD	Teaching Practice	Media	Textbooks	*"Contents related to sustainable development are presented only theoretically and without a proper structure in textbooks, and it is not easy to integrate them into the learning process" (IR11).*
			Other Media	*"Dealing with modern media is an absolutely important challenging task." (Ger2)*
		Methods		*"I know there are some games and puzzles, but mostly I cannot use them for grades 8 and 9. Most of them are better to apply for the grades 11 and 12" (Ger10).*
		Content, Goals, Competences		*"Sustainability is an extremely big point" (Ger15).*
		Teachers Qualification		*"It would be important for me as a teacher to know where I get my information and how I structure my lessons based on modern technology in order to stay up to date, also with regard to ESD" (Ger14).*
		Students related		*"Students are not motivated enough to bring up such topics" (IR9).*
	School and Educational Organisation	Curriculum		*"The perspective in the curriculum is often spatially too far away for us" (Ger15).*
		Time		*"It is always time-consuming to integrate SD in lessons" (Ger11).*
		Equipment		*"In general, we do not have enough facilities and equipment, we do not have the same minimums for ESD" (IR9).*
	Political and Social Framework Conditions	Educational policy		*"Overall, educational policies in Iran are not in the same direction for implementing ESD" (IR5).*
		Social Framework		*"We face a lot of complications in the classrooms because of the society atmosphere" (IR7).*

5.1 Challenges of implementation of ESD

The main category "challenges of implementation of ESD in geography classes" can be categorized into three subcategories including teaching practice, school and educational organization, and political and social framework conditions.

5.1.1 Teaching practice

All 15 interviewed teachers from Germany and all 15 teachers from Iran had statements that could be assigned to this category. Overall, this category has five subcategories including media, methods, content, teachers' qualifications, and students-related challenges. Among these subcategories, media involve another subcategory which is textbooks and other media. Textbooks are the most mentioned topic in both countries.

5.1.2 Media

5.1.2.1 Textbooks

One of the most important challenges to the implementation of ESD, as identified by teachers, was the textbooks. Teachers from Germany describe a very extensive implementation of ESD, which is even partly described as an overdose (see below). They also noted the repetition of some content, presentation of the topics on a global scale and rarely on a local scale, an overemphasis on environmental aspects at the expense of social and economic aspects, and a lack of practical terms. These issues significantly impacted the implementation of ESD in textbooks.

> *"One challenge in ESD is that maybe there is an overdose because there are so many topics or it feels like everything from fifth to 13th grade is the same" (Ger13).*

Interviews with Iranian teachers suggest that textbooks are a major obstacle to the implementation of ESD. In Iran's highly centralised education system, textbooks serve as the primary instructional medium, which explains why teachers rely on them so heavily and are so critical of them. Teachers reported several persistent issues: textbooks are often pedagogically misaligned with students' developmental stages, resulting in limited comprehension and diminished engagement with sustainability-related content. The extensive volume of required material restricts opportunities for practical ESD activities, and the predominantly theoretical and decontextualised presentation of concepts hinders students from making meaningful connections to their everyday lives. Teachers also noted repetitive content and the absence of updated sustainability themes across educational levels.

TABLE 4 Solutions for overcoming challenges in the way of implementation ESD, categorizing teachers' attitudes.

Main categories	Sub categories	Sub-sub categories	Sub-sub-sub categories/ focus	Examples from interviews
Solutions to challenges in the implementation of ESD	Teaching Practice	Media	Textbooks	*It is necessary to update the textbooks annually based on the content related to ESD. (Ger1)*
			Other education media	
		Methods		*Educational methods, games and puzzles should be designed according to the age of the students and the class. (IR3)*
		Content, Goals, Competences		*ESD should start at elementary school and even kindergarten and be continuous in all relevant subjects. (Ger5)*
		Teachers Qualification		*It is important to hold in-service training courses related to ESD for teachers (Ger11).*
		Students related		*The student should be motivated to see how ESD changes his/her living environment. (IR2)*
	School and Educational Organisation	Curriculum		*In Iran, it is necessary to write a curriculum for geography textbooks and send it to all schools. In this document, the contents of ESD and its implementation should be clarified for teachers. (IR12)*
		Time		*If we want to move towards sustainable development and this development starts through education, we need a reprogramming of subjects and teaching hours. (IR15)*
		Equipment		*In all schools, the necessary facilities for the implementation of new teaching methods that are suitable for the implementation of ESD should be provided. (IR9)*
	Political and Social Framework Conditions	Educational policy		*The centralized education system is not suitable for a vast country like Iran and should be adjusted and changed. (IR15)*
		Social Framework		*The parent-teacher council, which is held once every semester, should be held every month and the necessity of implementing ESD should be explained to the parents. (IR5)*

Participants also emphasised that sustainability topics often conflict with the political and religious orientations embedded in Iranian textbooks. The lack of localised examples — stemming from the centralisation of content production — further reduces students' ability to relate to sustainability concerns. Teachers observed that textbook authors typically lack expertise in geography pedagogy, resulting in material that merely transmits information without fostering transformative learning. Consequently, most sustainability content remains at the lower tiers of Bloom's revised taxonomy (knowledge and understanding), offering limited opportunities for higher-order cognitive engagement, such as application, analysis, creation or evaluation. These are all essential components of effective ESD.

> *"Some of the content in the textbooks for secondary school students is pretty trivial. For example, in the 7th-grade book, they talk about the water cycle and its importance, which is very simplistic, and the students do not pay much attention. There are other, more important aspects of water that should come in secondary books."* (IR10).

In this case, the teacher recognizes that educational content has to be appropriate to the student's age to enhance the student's understanding of sustainable development issues. Additionally, the aforementioned example illustrates that the content of education for sustainable development is insufficient and that important issues remain unaddressed. "*The volume of the textbook is very high, the book contains 24 lessons, each lesson requires two teaching sessions, finishing this volume of the book takes a lot of time and energy, which practically disrupts the implementation of sustainable development education.*" (IR4).

According to this teacher the amount of textbook content (inconsistency of teaching time and textbook content), the mandatories of teaching topics, and the rigidity of the teaching schedule as the reasons that hinder the implementation of sustainable development education.

> *"The contents presented in textbooks related to sustainable development are theoretical, dry and incomprehensible for students, for example, in the ninth book, types of weather and climate change are given, but none of its aspects are related to students' lives."* (IR11).

This teacher states that topics related to sustainable development are not presented in the textbooks with appropriate connections to the everyday lives of students. There seems to be a lack of concrete content in textbooks that engages the students in the learning process.

> *"The books contain a considerable amount of political and religious content. For instance, in the context of environmental issues, there is an inaccurate reference to the situation in other countries. Many students have expressed objections to the material, which has resulted in disruptions within the classroom."* (IR9).

This teacher considers politicized and ideologically oriented education to be an obstacle to the implementation of sustainable development education.

> *"The book is prepared for the whole of Iran, but Iran is a vast country with diverse geography and culture, the authors of the book have no knowledge of other provinces except the capital, for this reason, the contents in the book are not suitable for my students in the south of Iran. the examples given about the economy, society and environment are very different from the geography we live in."* (IR14).

Here, the teacher sees as a problem that the textbook content is not adapted to local and regional conditions.

5.1.2.2 Other media

A significant difference here can be seen in the extensive reference by German teachers to modern media such as games and puzzles. Most of the German teachers were satisfied with access to educational media and materials. The mentioned challenges related to other media were about the time-consuming nature of some media and then how to use them.

> *"I did mystery for the lessons in my traineeship, then of course you take the time for it, of course, incredibly time-consuming, but I think it's very, very effective."* (Ger5).

On the contrary, access to various educational media was considered a big challenge for Iranian teachers. In addition, due to the lack of familiarity and dominance of textbooks, Iranian teachers did not mention modern media such as games, puzzles, GIS, etc., except for the challenge of accessing the Internet.

> *"In Iran, we are faced with extensive filtering, so we cannot use the existing educational videos related to sustainable development topics on YouTube, for example, some textbook lessons have barcodes, which I heard can be used to see videos related to each lesson. But we do not have internet for classes at school and I have not even seen these movies myself."* (IR14).

5.1.3 Methods

German teachers reported that existing pedagogical practices hinder the implementation of ESD. They noted difficulties in integrating communicative, systemic and action-oriented methods into routine instruction, partly due to time constraints. For example, teachers said that organising excursions, which are essential for developing ESD competencies, is often not possible within the limited time available in the curriculum.

> *"As a geography teacher, I have to go out once a month with a study group, but I cannot do that because there's not enough time and the curriculum is often too tight."* (Ger15).

Iranian teachers specifically highlighted challenges related to methods in implementing ESD, such as the lack of facilities to implement the methods, the lack of familiarity among teachers with new teaching methods, and the lack of application of some methods in educational spaces.

> *"Our education is outdated. The subjects of the lessons have changed a little compared to the past, but many modern teaching methods are not possible to implement. For example, in a small classroom space that is very difficult to move, how can we make students sit in groups to discuss the benefits of environmental protection?"* (IR9).

5.1.4 Content, goals, competences

Some teachers identified the inherent complexity of sustainable development as a significant obstacle to ESD. German teachers emphasised its broad scope and its connection to all aspects of students' lives. They emphasised that ESD must cultivate students' capacity for multidimensional judgement and opinion formation — a challenging task, given the conceptual and moral complexity involved. Consequently, diverse assessments and classroom conflicts must be acknowledged and managed constructively.

> *"It's (Sustainable Development) so complex that we cannot do anything other than set priorities and say this is how I asses it and we can see that the other person assesses it differently."* (Ger9).

It is considered difficult to teach students system competence and the ability to act in order to create a sustainable future:

> *It depends a bit on how the individual teaches and tries it out, but yes, somehow you have to be able to approach it more systematically or maybe even more systematically. … Yes, and of course on the other hand, what I just said, you should actually be able to try a lot more to become really active, so really, it's always about developing competence to act and so on, (Ger2).*

Iranian teachers also believe that it is very difficult to explain sustainable development to students. This teacher addresses the fact that there are many unsustainable practices in Iran, such as the production of oil and deficits in achieving the Sustainable Development Goals, such as poverty, which are difficult to address critically in the classroom.

> *"You know that in our country, most of the government's income comes from oil, and on the other hand, poverty and social injustice*

> *are rampant in the villages, and in some areas, people make a living by selling smuggled fuel, talking about these indicators together. It is very difficult.*" (IR9).

5.1.5 Teachers' qualification

In a self-reflective manner, German teachers identified themselves and their colleagues as contributors to the challenges of implementing ESD. Six German educators specifically emphasised a lack of knowledge regarding SD and ESD, as well as limited collaboration with teachers from non-geography subjects. Similarly, Iranian teachers regarded teachers as a central barrier, citing inadequate knowledge of SD and ESD, weak inter-teacher cooperation, low professional motivation and insufficient pedagogical preparation in geography didactics as key impediments to effective ESD implementation.

> *One of our biggest problems in teaching geography is that we do not have specialist teachers and non-specialist teachers teach this subject, many of these teachers do not know the importance of the subjects. Or they do not know about sustainability at all and they are content with reading the contents of textbooks to the students in class.* (IR14).

5.1.6 Students related

Seven teachers from Germany mentioned challenges related to students, highlighting several key factors that affect the execution of ESD: fear of the future/disenchantment, difficulties convincing students to act, the effects of fake news and social media, and a lack of reading and writing skills.

> *We teachers can, we have to or every honest teacher has to say goodbye to the idea that we can somehow achieve sustainable development with every pupil because we cannot reach everyone, just a few pupils, and if it works with a few pupils, at least in our type of school, that they have more orientation, more knowledge, more interest and that it stays that way in the long term, then that's good. You can certainly achieve that with some of them. (Ger7).*

Similarly, Iranian teachers identified students as a major challenge when it came to implementing ESD. They highlighted a lack of motivation, inconsistencies between the content of lessons and students' lived realities, limited prior knowledge, weak literacy skills and tensions between the principles of sustainable development and students' everyday lifestyles. Most teachers emphasised that a lack of motivation, strongly shaped by prevailing socioeconomic conditions, is one of the most significant barriers to effective ESD in geography classes.

> *Unfortunately, the students have no interest in studying, and the problem is that if they are interested in studying, they are not interested in geography subjects, because my students are mostly in the fields of experimental sciences, mathematics and physics. And the geography and human and environment subjects are taught only in the 10th grade.* (IR5).

5.1.7 School and educational organization

German teachers identified two key challenges at school level for implementing ESD: insufficient cooperation among colleagues in related disciplines, and limited collaboration between schools and external institutions relevant to ESD. In Iran's highly centralised system, teachers reported broader structural issues, including large class sizes, inadequate facilities, low school budgets, the marginalisation of geography at high school level, limited professional cooperation, unequal distribution of resources among schools and the absence of ESD foundations in primary education.

5.1.8 Curriculum

German teachers consistently highlighted curriculum-related and temporal constraints. They highlighted the inflexibility of the curriculum, its insufficient alignment with ESD principles and the difficulties of integrating ESD across subjects. Other issues raised were the difficulty of developing ESD-related argumentation and the lack of clarity or guidance on the available ESD materials.

> *"I think that the topic of sustainable development … in the curriculum is too often too far away from the students' world"* (GER 3).

In contrast, the Iranian teachers did not make specific statements about the curriculum. Only four of them commented on it and identified it as one of the main challenges in implementing ESD in geography education. In addition, the Iranian teachers' comments on the curriculum were general and did not specifically address ESD.

5.1.9 Time

Like the curriculum, time constraints have been considered by all teachers as one of the most important challenges in implementing ESD. German teachers listed the final exam (Abitur), the time-consuming implementation of related methods, and the lack of class time as the most significant obstacles related to time.

When counting the challenges: "*The main issue is time. It's actually quite straightforward. You need to find a way to get the topics in the book covered in a little bit of time. (Ger10).*

Similarly, all Iranian teachers also consider the time factor an important challenge in the implementation of ESD. They cited preparing students for the final exam and university entrance exam, the lack of class time for geography, and the allocation of geography lesson time to other subjects as the most significant obstacles related to time.

> *Our biggest problem in sustainable development education is time to do any exercise that engages the student in the activity. We only have one geography session a week, and one hour and 15 min is really not enough time.* (IR3).

5.1.10 Equipment

It was mentioned by all Iranian teachers in some way that they did not have access to educational facilities and welfare. Even some teachers who are now teaching in well-equipped schools talked about their experiences in schools without facilities. In comparison,

> *We are in absolute lack of all the facilities in schools in the villages or in the eastern provinces, I can boldly say that we have nothing else at our disposal except a blackboard and a textbook. I have written several times for maps and globes, but have not received a reply.* (IR5).

The interviewed German teachers not only did not complain about the lack of facilities, we could say they were satisfied.

5.1.11 Political and social framework conditions

This category largely emerged from the emphasis placed by Iranian teachers on the influence of political and social conditions on education and, by extension, ESD. All Iranian participants identified these factors as the main barriers. They argued that the education system, which is highly politicised and religiously oriented, significantly hinders ESD implementation by shaping content, materials and funding. Furthermore, teachers emphasised that broader social and economic challenges in the country pose significant obstacles to the effective integration of ESD into classroom practice.

5.1.11.1 Educational policy

The top-to-bottom education system in Iran was repeated as one of the major obstacles to the way of implementation of ESD.

> *In our educational system, there are very few opportunities to move. For example, a few years ago, there was a plan called Bom plan*[1]*, and for a while, I thought that it would be possible to teach local sustainability issues to students, but it was so restrictive that I gave up on it. You know better that the whole system is not on a sustainable path and what we are doing is only to relieve our conscience.* (IR12).

5.1.11.2 Social framework

Many Iranian teachers emphasised that the persistent gap between theoretical instruction and practical application is a significant obstacle to the implementation of ESD. They also emphasised the crucial role of families and external educational stakeholders. According to the teachers, the most frequent and significant challenges within this category are limited family cooperation, low parental awareness of sustainability, and insufficient collaboration from relevant organisations.

> *"I was teaching in a very poor area on the outskirts of the city, there were so many side issues of the students that sometimes there was a disruption in the teaching hours. Usually, the exercises that I gave as homework related to sustainable development were incomplete. Or it was done incompletely."* (IR12).

Given the stark contrast between the economic and social conditions in Germany and Iran, it is unlikely that the statements of German teachers can be meaningfully aggregated in relation to this category.

5.2 Solutions regarding challenges of implementation of ESD

Here we categorized the main category "Solution to overcome the challenges of implementation of ESD" exactly like the category of challenges. Therefore, here, we also have three subcategories: teaching practices, schools and educational organizations, and political and social frameworks.

5.2.1 Teaching practice

As mentioned in the challenges section, the frequency of teachers' statements referring to this category shows the importance of this category. In the same way, the teachers had many references to this category when they talked about solutions.

5.2.2 Media

5.2.2.1 Textbooks

Teachers pointed to changes in textbooks and the addition of topics related to sustainable development in the textbook as a solution to better implement sustainable development. For example, the following statement from a German teacher shows the importance of change in the textbooks, *"The textbooks should also be developing in the way to sustainable development. They should include more and more sustainable development goals and also the sustainability triangle (Ger1).*

He wants theoretical models of ESD such as the sustainability triangle, which takes social, economic and economic factors into account to be more strongly integrated into school textbooks.

Iranian teachers also wanted changes in textbooks to address sustainable development, although their statements were more general and less detailed than German teachers. *"I think the fastest action that can be taken to start education for sustainable development is to rewrite the textbooks, of course, this time by the hands of experts and adding topics of today's world to them, changing the maps and pictures and adding interesting content. Even in my opinion, we can imitate the books of other countries. Why not* (IR13)."

5.2.2.2 Other media

Regarding using other media for the implementation of ESD, the German teachers mainly found the solution in the combination of different educational media in the geography classroom and the use of digital media. *"Yes, so all sorts of exploration, of course, there are the methodological skills in evaluating maps, statistics and so on, but then also all sorts of digital tools that we now use, for example, which is also great, for example, satellite images and so on used to be a task, now with Google Maps, for example, Google Street View or partly that is always a bit difficult, but. WebGIS applications or so that you also try to use such media to approach such issues so that you can look at places in a slightly different way, that used to be the case"* (Ger2). However, the Iranian teachers considered the desired solution in providing financial resources for the provision of additional media besides the textbook for the implementation of ESD. *"In my opinion, a special section of the education budget should be devoted to equipping schools to prepare maps and atlases. Maps should be other than book maps and related to topics such as climate change and the importance of green space."* (IR6).

1 The BOM plan is a special program for schools, according to the pedagogical-cultural approach, considering skill-oriented teaching and the development of educational activities in schools nationwide. This program is also essential for education, taking into account the requirements of the students' living environment (Khosravi et al., 2021, 13).

5.2.3 Methods

For German teachers using different types of methods was considered a solution to involving the pupils in SD topics, *"If it is possible then I always try to incorporate SDGs with a wide variety of methods that can be used to make students aware of them."*

Iranian teachers considered in-service courses to familiarize teachers with new educational methods as a solution. *"In our educational system, the teacher is the only speaker and the student is the listener, but this method is not useful for involving students in new discussions and topics such as sustainable development and climate change. In my opinion, in-service courses for new teaching methods and techniques should be held for regular teachers."* (IR6).

This teacher sees a particular need for action- and student-orientated teaching methods that actively involve the students in the lesson.

5.2.4 Content, goals, competences

Some German teachers found a solution to overcome the conceptual complexity of sustainable development by integrating this concept into a subject such as geography. *"The fact that geography has always focused on the networked complex thinking anyway, that you try to look at issues from different perspectives with different effects, naturally also transfers this to the concept of sustainability and so on."* (Ger2).

This teacher finds the didactic change of perspective in the teaching of ESD topics and the systematic analysis processes relevant.

However, some other teachers believed that other subjects should also be involved in sustainable development education to facilitate the transfer of this concept.

> *"I think we have to deal with sustainable development. In whatever form in all subjects -whether in biology chemistry or physics, or geography, in all other subjects too. Even the so-called general education subjects such as German have to deal with it because sustainable development is simply necessary to maintain our existence."* (Ger6).

Iranian teachers have given the most emphasis to connect the concept of sustainable development with the daily life of students.

> *"In order for the student to really engage in these issues related to sustainable development, we must teach the material concerning the student's environment and lifestyle."* (IR3).

This teacher suggests using teaching material from the pupils' immediate environment in addition to the textbook in order to make reference to their living environment.

5.2.5 Teachers' qualification

German teachers have found the solution in teaching teachers and holding educational conferences with various institutions involved. *"We should continue with the conferences at the national level in which the Ministers of Education and Cultural Affairs are involved."*

Iranian teachers considered the Ministry of Education to be obliged to launch in-service courses and train student teachers. *"In-service courses for teacher guides should be held regularly in this regard."* (IR7).

5.2.6 Students related

German teachers have seen students' general awareness of sustainable development and their motivation as an opportunity and solution. *"I believe that our generation of students in particular is very receptive to these topics (SD)."* (Ger13).

Iranian teachers have usually seen the potential solution in the cooperation of families with the schools. They believe that with the cooperation of students' families, issues related to sustainable development can be more easily integrated into students' lives. *"The council of parents and teachers and the school should be held regularly and families should receive the necessary regarding training at the same time as the students."* (IR1).

5.2.7 School and educational organization

German teachers recommended tackling school-level environmental, social and economic (ESD) challenges by providing interdisciplinary sustainability education, incorporating sustainability topics into other subjects, revising the curriculum and allocating more time to geography lessons.

> *Developing interdisciplinary project days for the middle school, where we say, for example, we have the challenge of taking on the topic of the century at some point, whether it's nutrition or I do not know, climate change, all kinds of things* (Ger2).

This teacher also suggests organizing special teaching days in which ESD topics are taught across subjects.

Although they acknowledged the improbability of such structural change, Iranian teachers proposed broad reforms, including transitioning from a centralised to a decentralised education system. They also recommended the following practical measures: equipping all public schools with modern educational resources; reducing inequalities in facilities; and providing comprehensive ESD training for all pre-service and in-service teachers, as well as all school staff.

> *If we have a decentralized system, we will be on the way to sustainable development more easily.* (IR9).

5.2.8 Curriculum

Since the curriculum is one of the most important foundations of the educational system in German schools, some teachers asked to involve other subjects than geography in ESD and some others asked for more ESD-content in the curriculum.

> *"That's why I think it's very important that it's not just geography that pursues these goals, but that other subjects also incorporate these goals into their lessons, which yes. In social sciences, also in German and actually none. I think the problem is and I think that's what it takes to make these goals more present and interdisciplinary (Ger1)."*

On the other hand, in the absence of a clear curriculum, Iranian teachers wanted to prepare a curriculum that would help to integrate sustainable development into geography education.

> *In the annual meeting with the authors of textbooks, I will definitely request that a curriculum for geography books be written and sent, what is this situation that we do not have a geography curriculum*

> *for such an important course in the humanities and even other education majors?* (IR11).

5.2.9 Time

Many teachers in both countries are aware that it is very difficult to devote more time to geography in the weekly school curriculum. However, Iranian teachers have insisted that the weekly schedule of schools should be changed in such a way that they have enough time for activities related to sustainable development.

> *I have been working in private schools for two years now, and we have two full 90-min geography lessons a week. And I'm starting to think that maybe in public schools the weekly schedule can be arranged so that teachers have enough time for practical activities on these sustainable topics. You know, Thursdays used to be part of the school timetable and it was easier to plan. Now, if the school does not have an opposite shift, an extra hour can be added to the school day.* (IR15).

This teacher discusses the differences between different types of schools that affect the implementation of ESD, in particular the difference in time available for practicing ESD in private and public schools.

5.2.10 Equipment

Many Iranian teachers wished to increase the school budget in order to provide facilities and equipment suitable for teaching geography and, therefore, implementing sustainable development education.

> *The school budget should be increased to equip the schools. This year, the school principal told us that the school's bank account had reached zero. Well, in such a situation, I, the teacher, cannot expect the technical equipment of the school to be complete. I have to go to several institutions. We wrote a charity letter and we hope to receive a positive answer. But none of them is a solution, the budget of schools must increase by 100%.* (IR2).

German teachers consistently reported that inadequate school facilities did not pose a significant obstacle to the implementation of ESD. Most educators indicated that they had not experienced any shortages of resources and expressed general satisfaction with the physical infrastructure and equipment available in their schools. They viewed these conditions as adequate for supporting ESD-related activities.

5.2.11 Political and social framework conditions

5.2.11.1 Educational policy

When examining the political aspects of ESD, German and Iranian teachers expressed fundamentally opposing perspectives. German teachers view politics as an integral part of sustainable development and advocate stronger political engagement in geography education. They argue that ESD should prepare students for democratic negotiation processes, making critical assessment and forming opinions central learning goals. Furthermore, they emphasise the need to transcend traditional subject boundaries in order to address interdisciplinary ESD topics comprehensively, and to integrate political dimensions more systematically across the curriculum.

On the other hand, Iranian teachers want to remove geopolitical content from the teaching of geography.

> *"If we want to step on the path of education towards sustainable development and have effective education, the first condition is to separate politics from education. …. The most important document for the implementation of education for sustainable development (2030) in our country was abandoned due to political reasons"* (IR9).

Likewise, German teachers want the participation of politicians for ESD purposes, but Iranian teachers want their non-interference in education in general, and consider their involvement as an obstacle to the implementation of education for sustainable development.

5.2.11.2 Social framework

As mentioned previously, Iranian teachers highlighted a number of social issues affecting ESD, although German teachers also raised concerns in this area. Recognising the difficult socioeconomic conditions in their country, Iranian teachers emphasised the need for active family involvement and family-oriented education. They argued that the economic hardships faced by disadvantaged households must be recognised, and that free educational opportunities should be made available. Furthermore, several teachers contended that the social dimension of sustainability is foundational and requires the establishment of supportive social structures through broad public education before the other pillars of sustainability can be effectively addressed.

> *We are in a difficult economic situation, families are really having financial problems, it is really cruel to impose education costs on them. In my lesson, I try to choose solutions that are not expensive, for example, instead of taking students to the central museum where students have to pay for transportation and museum entrance, I took them to the park in my own time. Near the school, there was a lesson about planting low-water plants in dry geographical areas in parks.* (IR5).

This teacher sees the solution in doing ESD education projects in the neighborhood.

6 Discussion

6.1 ESD challenges and responses in Germany

Implementing Education for Sustainable Development (ESD) in geography classes presents distinctive challenges in Germany and Iran, shaped by their respective socio-political and educational contexts. In line with existing ESD research, this study examines the main challenges and solutions as perceived by geography teachers in both countries, focusing particularly on educational practices, school organisation and political frameworks. The findings align with the broader academic discourse on ESD, which emphasises the need for context-specific methodologies to address the complexities of sustainability education (Leicht et al., 2018, p. 14).

The teaching of ESD emerges as a major challenge covering media, methods, content and the qualifications of teachers and students. The media category, with an emphasis on the inadequacy of textbooks, is a significant issue in both countries. German teachers criticise textbooks for their imbalanced presentation of sustainable development topics. According to them, this imbalance includes an

uneven inclusion of relevant global issues in relation to national, regional, and local aspects, as well as an uneven treatment of environmental, social, and economic aspects. This critique reflects the argument of Mochizuki and Bryan (2015) that ESD materials should adopt a more integrated approach to sustainability, balancing local relevance with global perspectives. An essential component of effective ESD is a systems-thinking approach that views sustainability as an interconnected triad of environmental, social and economic factors (Mochizuki and Bryan, 2015, p. 20). As ESD-related content is already strongly integrated into German textbooks, the criticism is more about the didactic approach to the material than the content itself. Teachers feel that there is a particular lack of support for forming opinions, argumentation, evaluation and action in the context of complex ESD topics.

Teachers in both countries have proposed solutions to these challenges that emphasise changes to educational materials. German teachers advocate textbooks integrating the Sustainable Development Goals (SDGs) and the sustainability triangle to reflect a systems-based approach (Rieckmann, 2017, p. 43). Iranian teachers, while also calling for updated textbooks, emphasise the importance of modernising content by incorporating global perspectives and contextually relevant material. This illustrates their demand for a curriculum that addresses contemporary global challenges (Salimiet al, 2024, p. 176–180). Germany's recognition of digital tools as a valuable medium for ESD reflects international trends, where the use of technology in sustainability education is becoming increasingly important (Leicht et al., 2018, p. 28). The call by Iranian teachers for increased financial resources to support such media underscores the need for greater resource allocation in developing countries to enable the effective use of these tools (UNESCO, 2018, p. 17).

From a methodological perspective, teachers in both Germany and Iran encounter challenges when it comes to implementing effective ESD teaching methods, primarily due to time constraints. German teachers report difficulties in adapting ESD methods to the weekly programme and express a desire for interdisciplinary and subject-linking school lessons. Iranian teachers cite a lack of familiarity with new pedagogical approaches and inadequate classroom facilities. This difference in familiarity with modern teaching methods highlights a wider gap in professional development and teacher training, particularly in Iran, where teacher training programmes have been found to inadequately prepare educators for the complexity of ESD (Ghoreyshi et al., 2023, 84).

German teachers have proposed active, collaborative learning approaches to engage students more deeply with sustainability issues. This reflects broader trends in ESD research advocating participatory learning methods (Barth et al., 2016, p. 104). In contrast, Iranian teachers emphasise the need for in-service training (Ghoreyshi et al., 2023, 90) to improve their ESD delivery skills. This disparity in teacher training is a prevalent challenge in countries where ESD policies are still in their infancy, and the necessity of thorough teacher training programmes is emphasised in literature as a pivotal factor for the successful implementation of ESD (Rieckmann, 2017, p. 92).

The interdisciplinary approach suggested by the German teachers, whereby ESD is integrated across multiple subjects beyond geography, is in line with recent findings that emphasise the importance of interdisciplinary learning in addressing the multifaceted nature of sustainability (Redman et al., 2018, p. 315). In Iran, however, the focus is on making ESD relevant to students' daily lives, reflecting a practical, localised approach to teaching sustainability. This contextualisation of ESD is important because research shows that when students can see the direct relevance of sustainability issues in their immediate environment, they are more likely to engage with and understand these concepts (Evans et al., 2017, p. 41).

The organisational structures of schools also present challenges for the implementation of ESD. In Germany, for example, teachers report a lack of collaboration between colleagues and institutions responsible for ESD, hindering the integration of sustainability across subjects. This mirrors the findings of Tilbury (2019), who emphasises the need for systemic changes/complementing in school organisationorganization (Seddighi et al., 2023, 2) to support ESD, including better interdepartmental coordination and collaboration (p. 64). Without institutional support and cooperative frameworks, teachers struggle to implement the interdisciplinary approaches necessary for comprehensive sustainability education (Wals, 2015, p. 141).

Political involvement in ESD is another area in which the two countries differ. As Leder (2015) observed, it is important to recognise that educational systems reflect and transmit political and cultural values, such as those associated with hierarchical or democratic principles, through pedagogical practice (Leder, 2015, p. 22). In Germany, teachers view policy support as essential for successfully implementing ESD, which aligns with research emphasising the importance of robust political frameworks in advancing sustainability education (Mochizuki and Bryan, 2015, p. 24). The desire of German teachers for more political involvement reflects the broader trend of integrating ESD into national education policies to ensure widespread adoption and support (Leicht et al., 2018, p. 36). Democratic decision-making is considered essential for addressing ESD topics in the classroom. Open expression of opinion, discussion, and evaluation methods play a significant role in teachers' thinking. German teachers' requests for political support to expand ESD initiatives suggest a more positive relationship between politics and education. This is consistent with Bernstein's theory of recontextualisation, whereby policy can enable or constrain the transmission of knowledge (Bernstein, 1996, p. 46). In Germany, there is greater alignment between the political system and the goals of ESD, enabling more effective implementation. Teachers here advocate for greater political support for ESD, viewing policy involvement as crucial for expanding the reach and effectiveness of sustainable education. This stance aligns with Bernstein's (2000) notion of inclusion rights, emphasising the role of institutional frameworks in ensuring that all students can participate in an education that equips them to engage with pressing global issues.

6.2 ESD challenges and responses in Iran

Iranian teachers highlight the mismatch between textbook content and students' level of understanding, compounded by the theoretical and non-practical nature of the content. Iran's centralised education system exacerbates this issue, as textbooks fail to address the country's diverse geographic and cultural contexts, distracting students from the importance of ESD. Textbooks tend to be overly theoretical and disconnected from practical applications. This aligns with the research of Hosseini et al. (2015), which shows the negative

impact of top-down curriculum design on localised education (p. 225). The lack of localised, culturally relevant content further disconnects Iranian students from ESD, impeding the development of meaningful learning experiences in sustainability education (Shakarbaghani and Yazdani, 2016, 38–39).

In Iran, the challenges are more structural in nature, including overcrowded classrooms and a lack of resources, both of which significantly hinder the implementation of ESD. These conditions reflect inequalities in distributional rights, with some schools lacking the basic resources necessary for effective ESD implementation (Bernstein, 2000, p. 29). Iranian teachers are calling for decentralisation and more equitable distribution of resources, reflecting the need for systemic educational reform to address inequalities and create an environment conducive to ESD (UNESCO, 2018, p. 21). Their call for the decentralisation of the education system and equal resources for all schools reflects the need to address these structural inequalities. However, without addressing the wider socio-economic inequalities that permeate the Iranian education system, the successful implementation of ESD will remain limited (Tilbury, 2011, p. 7).

Conversely, Iranian teachers view political interference as an obstacle and advocate depoliticising education to enable more effective ESD implementation. This reflects a broader concern about autonomy from political agendas, which is essential to ensuring the integrity and impartiality of sustainability education (Jickling and Wals, 2008, p. 3). Furthermore, the relationships within micro-level classroom interactions can be linked to underlying power structures and control mechanisms at the macro-level (Leder, 2015, p. 22). Furthermore, this article corroborates the findings of Movahedinia et al. (2021), as detailed in their research, 'Contextualisers of Policy Interference in the Kerman Province Education System'. This research indicates that teachers in the region perceive the education system to be inherently politicised. In the aforementioned study, the interviewed teachers posited that the 'politicised province' had an adverse impact on their social capital, resulting in the phenomenon of 'education as a political reserve army' (Movahedinia et al., 2021, pp. 46–50).

According to Bernstein's (2000) framework, the right to a voice is compromised when education becomes politicised. This is because students are denied the opportunity to engage with diverse perspectives and develop their own informed positions on sustainability issues. This reflects wider concerns about the influence of politics on education in centralised systems, where the content of the curriculum can be shaped by political agendas rather than educational goals (Salimi et al., 2024, 178). The political challenges in Iran also highlight the tension between government control and the need for educational autonomy when developing effective ESD programmes (Rieckmann, 2017, p. 110). Furthermore, Bourdieu's concepts of 'field' and 'habitus' are particularly relevant when examining the political challenges faced by Iranian teachers, who view political interference as an obstacle to effective ESD. The political field in Iran, shaped by its centralised education system, imposes a particular habitus on teachers and students alike, thereby limiting their ability to engage critically with sustainability issues (Bourdieu and Passeron, 1977, p. 203). This political interference can be viewed as a form of symbolic domination, whereby the state controls the content and delivery of education to maintain its ideological power.

The observed discrepancies between Germany and Iran are consistent with prior cross-national ESD research, which suggests that contextual factors—including governance structures, cultural values, and teacher autonomy—exert a significant mediating effect on the implementation of sustainability education (Rieckmann, 2017). Germany's decentralized and participatory education model fosters innovation among teachers and interdisciplinary collaboration. In contrast, Iran's centralized system impedes local adaptation and critical engagement. These findings contribute to the field of comparative ESD scholarship by illustrating how national policy environments influence the translation of global sustainability goals into classroom practice, echoing results from similar studies in Europe and Asia (Evans et al., 2017; Mochizuki and Bryan, 2015). This enhanced discussion lends further support to the argument that the implementation of ESD must be analyzed through a variety of lenses, including those of pedagogy, as well as those of socio-politics and culture, which shape educational agency.

7 Conclusion

Implementing Education for Sustainable Development (ESD) within geography education is heavily influenced by national educational structures, cultural values and political systems. A comparative analysis of Germany and Iran highlights the importance of being sensitive to context when designing and applying ESD strategies. In Germany, where ESD has already been formally embedded in policy and curricula, the challenge lies in moving beyond content integration to foster transformative competencies such as critical thinking, systems thinking and participatory engagement. To address this, educational stakeholders should develop interdisciplinary, project-based learning models; enhance collaboration between schools and civil society organisations; and promote ongoing teacher training that focuses on complex problem solving and democratic classroom practices.

In contrast, Iran's centralised educational system and constrained political environment have limited the practical application of ESD, despite policy-level recognition of its importance. Therefore, solutions must begin with structural reforms that decentralise educational decision-making and increase curricular flexibility. Simultaneously, targeted investments in teacher training, infrastructure, and localised textbook development are critical. Building pilot programmes that demonstrate successful ESD integration in diverse regions could generate models for national scale-up. Furthermore, international collaboration, emphasising the cultural adaptation of global frameworks, could support the gradual transformation of Iran's ESD landscape.

In both countries, ESD must be recognised as a broader societal project, requiring alignment across educational, political and community actors, rather than merely as an educational initiative. Closing the gap between policy rhetoric and classroom reality requires creating environments in which teachers are empowered to drive change and students are prepared to address and influence sustainability issues. Ultimately, a forward-looking vision for ESD requires long-term commitment, structural innovation and a willingness to reconsider the role of education in shaping sustainable futures.

While the findings are contingent on the specific context, the comparative insights derived from Germany and Iran may inform the implementation of ESD in other countries grappling with analogous structural or political challenges. The study's contribution lies in its illustration of how educational governance models and teacher agency interact to shape sustainability education in practice. While the research is qualitative in nature and limited to two national contexts, it offers transferable lessons for policymakers and educators seeking to localize global ESD frameworks within their own systems. Future studies could extend this comparative approach to include additional countries or longitudinal designs to examine how ESD policies evolve over time.

Data availability statement

The anonymized data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

Ethical approval was not required for the studies involving humans in accordance with the local legislation and institutional requirements. Written informed consent for participation was not required from the participants because consent was obtained verbally from all interviewees (adults over 18 years of age) and recorded as an audio file.

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The author(s) declared that Generative AI was not used in the creation of this manuscript.

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References

Aminkhandaghi, M., and Goodarzi, M. (2011). Designing a regional curriculum planning system for education in the Islamic Republic of Iran. *Curric. Stud.* 6, 76–109. Avialable online at: http://noo.rs/CVIjY

Bagoly-Simó, P. (2013). Education for sustainable development and school geography: theoretical considerations.

Bagoly-Simó, P. (2014). Tracing sustainability: education for sustainable development in the lower secondary geography curricula of Germany, Romania, and Mexico. *Int. Res. Geogr. Environ. Educ.* 23, 126–141. doi: 10.1080/10382046.2014.908525

Bagoly-Simó, P. (2022). Geography's unkept promises of education for sustainable development (ESD) on geography's wasted potential to educate for a more sustainable future. *Int. Res. Geogr. Environ. Educ.* 32, 53–68. doi: 10.1080/10382046.2023.2158631

Barth, M., Michelsen, G., Rieckmann, M. and Thomas, I. (Eds.) (2016). Routledge handbook of higher education for sustainable development. Abingdon: Routledge.

Bernstein, B. (1996). Pedagogy, symbolic control and identity: Theory, research, critique. London: Taylor & Francis.

Bernstein, B. (2000). Pedagogy, symbolic control and identity: Theory, research, critique. Rev. Edn. Lanham, MD: Rowman & Littlefield.

Biasutti, M. (2015). An intensive program on education for sustainable development: the participants' experience. *Environ. Educ. Res.* 21, 734–752. doi: 10.1080/13504622.2014.921805

Bourdieu, P., and Passeron, J. C. (1977). Reproduction in education, society and culture. London: Sage Publications.

Cohen, L., Manion, L., and Morrison, K. (2011). Research methods in education. 7th Edn. London: Routledge.

Conlon, C., Timonen, V., Elliott-O'Dare, C., O'Keeffe, S., and Foley, G. (2020). Confused about theoretical sampling? Engaging theoretical sampling in diverse grounded theory studies. *Qual. Health Res.* 30, 947–959. doi: 10.1177/1049732319899139

De Haan, G. (2010). The development of ESD-related competencies in supportive institutional frameworks. *Int. Rev. Educ.* 56, 315–328. doi: 10.1007/s11159-010-9157-9

Dehghan, H., Karimsara, P., and Nasser (2017). The sociability of water consumption in the mirror of water content analysis textbooks in social science textbooks 24, 285–312. doi: 10.22054/qjss.2017.7923

Denzin, N. K., and Lincoln, Y. S. (2008). The landscape of qualitative research. 3rd Edn. California: Sage Publications, Inc.

Dube, C. (2012). Implementing education for sustainable development: The role of geography in South African secondary schools (Doctoral dissertation, Stellenbosch University). Stellenbosch University. https://www.researchgate.net/publication/304781305_IMPLEMENTING_EDUCATION_FOR_SUSTAINABLE_DEVELOPMENT_THE_ROLE_OF_GEOGRAPHY_IN_SOUTH_AFRICAN_SECONDARY_SCHOOLS/citations

Emas, R. (2015). The concept of sustainable development: Definition and defining principles.

Evans, N., Stevenson, R. B., Lasen, M., Ferreira, J.-A., and Davis, J. (2017). Approaches to embedding sustainability in teacher education: a synthesis of the literature. *Teach. Teach. Educ.* 63, 405–417. doi: 10.1016/j.tate.2017.01.013

Finco, A., and Nijkamp, P. (2001). Pathway to urban sustainability. *J. Environ. Policy Plan.* 3, 289–302. doi: 10.1002/jepp.94

Ghoreyshi, S. A., Ahmadi, M., and Parhizkari, M. (2023). The effect of in-service training on the dimensions of empowerment and professional development of primary teachers according to paragraph 3 of the general policies "transformation in the basic education system". *J. Res. Educ. Sci.* 16, 81–94. doi: 10.1001.1.23831324.1401.16.59.5.8

Glaesser, J. (2008). Just how flexible is the German selective secondary school system? A configurational analysis. *Int. J. Res. Method Educ.* 31, 193–209. doi: 10.1080/17437270802212254

Gruenewald, D. (2005). Accountability and collaboration: institutional barriers and strategic pathways for place-based education. *Ethics Place Environ.* 8, 261–283. doi: 10.1080/13668790500348208

Guo, F., Lane, J., Duan, Y., Stoltman, J. P., Khlebosolova, O., Lei, H., et al. (2018). Sustainable development in geography education for middle School in China. *Sustainability* 10:3896. doi: 10.3390/su10113896

Hofman, M. (2012). Sustainable development in the Finnish teacher education – political rhetoric or reality. *Nordic Stud. Sci. Educ.* 8:303. doi: 10.5617/nordina.536

Hosseini, S., Hossein, M., Mehrmohammadi, M., Hajhosseinnejad, G., and Salsbili, N. (2015). Critical analysis of curriculum change patterns. *J. Crit. Res. Human. Texts Prog.* 15, 199–235. Available at: https://criticalstudy.ihcs.ac.ir/article_2181.html

Izzet, A., and Ramazan, S. (2017). Differentiation of developed and developing countries for the Paris agreement. *Energ. Strat. Rev.* 18, 175–182. doi: 10.1016/j.esr.2017.09.016

Javanmardi, E., Liu, S., and Xie, N. (2023). Exploring the challenges to sustainable development from the perspective of Grey systems theory. *System* 11:70. doi: 10.3390/systems11020070

Jeffrey, D. Sachs, Lafortune, Guillaume, Fuller, Grayson, and Drumm, Eamon (2023), Sustainable Development report, 2023, https://sdgtransformationcenter.org/reports/sustainable-development-report-2023

Jickling, B., and Wals, A. E. J. (2008). Globalization and environmental education: looking beyond sustainable development. *J. Curric. Stud.* 40, 1–21. doi: 10.1080/00220270701684667

Juchler, I. (2005). Democracy and political judgment: Reflections on a normative foundation of political didactics. Schwalbach/Ts: Wochenschau Verlag.

Kazuaki, O., Jeongsoo, Y., Osanai, S., and Serrona, K. R. B. (2021). Present issues and efforts to integrate sustainable development goals in a local senior high school in Japan: a case study. *J. Urban Manag.* 10, 57–68. doi: 10.1016/j.jum.2021.02.002

Khosravi, Fatemeh, Taghizadeh, Fawad, and Zahra, Zain al-Dini Meymand, (2021), Studying the role of the special school program (BOM) in Iranian curricula, sixth National Conference on innovation and research in humanities and education, Tehran, Available online at: https://civilica.com/doc/1444245

Kioupi, V., and Voulvoulis, N. (2019). Education for sustainable development: a systemic framework for connecting the SDGs to educational outcomes. *Sustainability* 11:6104. doi: 10.3390/su11216104

Kitamura, Y. (2014). The possibility of holistic safety education in Japan: from the perspective of education for sustainable development (ESD). *IATSS Res.* 38, 40–47. doi: 10.1016/j.iatssr.2014.05.004

KMK and BMZ (2007) in Global development education: A cross-curricular framework in the context of education for sustainable development. eds. D. Appelt and H. Siege (Munich, Germany: Capacity Building International (InWEnt) & State Institute for School Quality and Educational Research (ISB)).

Kouhestani Nezhad, M. (2020). He educational effect of geography textbooks on environmentally sustainable development, Master Thesis,. Tehran, Iran: University of Shahid Beheshti.

Leal Filho, W., Frankenberger, F., Salvia, A. L., Azeiteiro, U., Alves, F., Castro, P., et al. (2021). A framework for the implementation of the sustainable development goals in university programmes. *J. Clean. Prod.* 299:126915. doi: 10.1016/j.jclepro.2021.126915

Leder, S. (2015). "Education for sustainable development through argumentation in geography lessons" in Learning to argue professionally. Didactic research on argumentation in school subjects. eds. A. Budke, M. Kuckuck, M. Meyer, F. Schäbitz, K. Schlüter and G. Weiss (Münster: Waxmann), 138–150.

Leicht, A., Heiss, J. and Byun, W. J. (Eds.) (2018). Issues and trends in education for sustainable development: UNESCO Publishing.

Magaldi, D., and Berler, M. (2020). "Semi-structured interviews" in Encyclopedia of personality and individual differences. eds. V. Zeigler-Hill and T. K. Shackelford (Cham: Springer).

Mayring, P. (2000). Qualitative content analysis. Forum qualitative Sozialforschung forum: qualitative. *Soc. Res.* 1. doi: 10.17169/fqs-1.2.1089

McHugh, M. (2012). Interrater reliability: The kappa statistic. Biochemia medica: časopis Hrvatskoga društva medicinskih biokemičara. *HDMB* 22, 276–282. doi: 10.11613/BM.2012.031

McKeown, R. (2002). Education for sustainable development toolkit (version 2). Energy, Environment and Resources Center, University of Tennessee. Available online at: http://www.esdtoolkit.org (Accessed December, 12 2025).

Mehr Mohammadi, M. (1993). Comparative study of the curriculum planning system in the Islamic Republic of Iran and the Federal Republic of Germany. *Quart. J. Educ. Nos.* 35 and 36, 95–122. Available at: https://sid.ir/paper/426226/fa

Ministry of Education of Iran; (2013). National Curriculum of the Islamic Republic of Iran.

Mochizuki, Y., and Bryan, A. (2015). Climate change education in the context of education for sustainable development: rationale and principles. *J. Educ. Sustain. Dev.* 9, 4–26. doi: 10.1177/0973408215569109

Movahedinia, H., Bostani, D., and Yousef, M. M. (2021). The foundations of policy interference in education in Kerman province. *Soc. Issues Iran (Khwarazmi Univ.)* 12, 239–258. SID. Available at: https://sid.ir/paper/1001742/fa

Müller, U., Hancock, D. R., Stricker, T., and Wang, C. (2021). Implementing ESD in schools: perspectives of principals in Germany, Macau, and the USA. *Sustainability.* 13:9823. doi: 10.3390/su13179823

Nguyen, T. P. (2017). Education for sustainable development in Vietnam: exploring the geography teachers' perspectives. *Int. Res. Geogr. Environ. Educ.* 27, 341–356. doi: 10.1080/10382046.2017.1366204

Nusche, D., Fuster Rabella, M., and Lauterbach, S. (2024). Rethinking education in the context of climate change: Leverage points for transformative change (OECD education working paper no. 307). Organisation for Economic Co-operation and Development.

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

Parishani, N., Mirshah Jafari, S., Sharifian, F., and Farhadian, M. (2018). A comparative study of environmental education objectives and related activities in selected countries and Iran in order to propose activities for Iran. *New Educ. Approach.* 12, 1–24. Available at: https://www.sid.ir/paper/201673/fa

Pasang, B. S., and Mohd Najib, S. A. (2022). Implementation of education for sustainable development in geography subjects among trainee teachers. *Int. J. Eval. Res. Educ.* doi: 10.11591/ijere.v11i3.22159

Redman, E., Wiek, A., and Barth, M. (2018). Current practice of assessing students' sustainability competencies: a review of tools. *Sustain. Sci.* 13, 101–112. doi: 10.1007/s11625-020-00855-1

Rezaei, Maryam, (2016), Design and accreditation a curriculum model Iran appropriate for education for sustainable development in the elementary school, Doctoral dissertation, Shahid Rajaee Teacher Training University, Tehran, Iran.

Rieckmann, M. (2017). Education for sustainable development goals: Learning objectives. Paris: UNESCO.

Roseland, M. (1997). Dimension of the eco-city. *Cities* 14, 197–202. doi: 10.1016/S0264-2751(97)00003-6

Salimi, J., Lalabadi, M., Mehdi, and Ali, A. B. (2024). Elementary teachers' experiences of research lessons: implications for curriculum leadership. *Qualit. Res. Curric.* 6, 157–183. doi: 10.22054/qric.2025.84276.402

Sánchez, J. G. (2011). Teaching geography for a sustainable world: a case study of a secondary School in Spain. *Rev. Int. Geograp. Educ. Online* 1, 158–182. Available online at: https://dergipark.org.tr/en/pub/rigeo/issue/11187/133645

Schild, R. (2015). Environmental citizenship: what can political theory contribute to environmental education practice? *J. Environ. Educ.* 47, 19–34. doi: 10.1080/00958964.2015.1092417

Schreiber, J. R., and Siege, H. (2016). Curriculum framework: Education for sustainable development. Bundesministerium für Bildung und Forschung. Available online at: https://www.globaleslernen.de/sites/default/files/files/link-elements/curriculum_framework_education_for_sustainable_development_barrierefrei.pdf (Accessed December, 12 2025).

Seddighi, H., Lopez Lopez, M., Zwitter, A., Muldoon, M. L., Sajjadi, H., and Yousefzadeh, S. (2023). Non-formal disaster education programs for school students in Iran: a qualitative study of the challenges experienced by stakeholders. *Int. J. Disaster Risk Reduct.* 86:103531. doi: 10.1016/j.ijdrr.2023.103531

Shakarbaghani, A. A.-S., and Yazdani, H. (2016). Investigating how to implement sustainable development education in the technical and vocational curriculum (case study: mechatronics field). *Educ. Innov.* 15, 37–56. Available online at: https://noavaryedu.oerp.ir/article_79095_b5c076336b2609e53b768df891d63265.pdf

Shi, L., Han, L., Yang, F., and Gao, L. (2019). The evolution of sustainable development theory: types, goals, and research prospects. *Sustainability.* 11:7158. doi: 10.3390/su11247158

Shirazi, A. (2006). Introduction to educational management. Tehran, Iran: Ain Tarbiat Publications.

Sinakou, E., Boeve-de Pauw, J., Goossens, M., Van Petegem, P. (2018). Academics in the field of Education for Sustainable Development: Their conceptions of sustainable development, *Journal of Cleaner Production*. doi: 10.1016/j.jclepro.2018.02.279

The World We Want. (2013). Breaking down the Silos: Integrating Environmental Sustainability in the Post-2015 Agenda. Available at: http://www. worldwewant2015.org/sustainability

Tilbury, D. (2011). Education for sustainable development: An expert review of processes and learning.: Paris: UNESCO.

Tilbury, D. (2019). Education for sustainable development: A roadmap for systemic change: UNESCO.

UNCED (1992). Agenda 21: Programme of action for sustainable development. Rio de Janeiro, Brazil: United Nations.

UNCTAD, (2017), Handbook of statistics- Population, Available online at: https://unctad.org/webflyer/handbook-statistics-2017 (Accessed December, 12 2025).

UNDRR. (2023). Sendai Framework for Disaster Risk Reduction: A progress report. Available online at: https://www.undrr.org (Accessed December, 12 2025).

UNECE (2022). Framework for the implementation of the UNECE strategy for education for sustainable development (2021–2030). Geneva: UNECE.

UNESCO, 2002, Teaching and learning for a sustainable future, https://unesdoc.unesco.org/ark:/48223/pf0000125238

UNESCO, (2009). Review of contexts and structures for education for sustainable development, Key Findings & Ways Forward. Available online at: https://unesdoc.unesco.org/ark:/48223/pf0000184944 (Accessed December, 12 2025).

UNESCO (2018), Issues and trends in Education for Sustainable Development, by Leicht, A, Heiss, J. and Byun, W. J. Available online at: https://unesdoc.unesco.org/ark:/48223/pf0000261445 (Accessed December, 12 2025).

UNESCO (2019). Global education monitoring report 2019: Migration, displacement and education – Building bridges. Not Walls. Geneva: UNESCO.

UNESCO (2020). Education for sustainable development, a roadmap. Paris. doi: 10.54675/YFRE1448

United Nations. (1992). Convention on Biological Diversity: Status of Signatories and Parties. United Nations Treaty Collection. Avaialble online at https://treaties.un.org/pages/ViewDetails.aspx?chapter=27&mtdsg_no=XXVII-8&src=TREATY

United Nations (2015). Transforming our world: the 2030 Agenda for Sustainable Development. Available online at: https://sdgs.un.org/2030agenda (Accessed December, 12 2025).

United Nations Economic Commission for Europe (2009). Learning from each other: The UNECE strategy for education for sustainable development. Geneva: United Nations Publications.

Verhelst, D., Vanhoof, J., and Van Petegem, P. (2023). School effectiveness for education for sustainable development (ESD): what characterizes an ESD-effective school organization? *Educ. Manag. Admin. Leadership* 51, 502–525. doi: 10.1177/1741143220985196

Wals, A. E. J. (2009). Review of contexts and structures for education for sustainable development. Paris: UNESCO.

Wals, A. E. J. (2015). Beyond unreasonable doubt: Education and learning for socio-ecological sustainability in the Anthropocene: UNESCO.

WCED (1987); Our Common Future. Available online at: https://sustainabledevelopment.un.org/content/documents/5987our-common-future.pdf (Accessed December 12, 2025).

Yin, R. K. (2018). Case study research and applications: Design and methods. 6th Edn. Thousand Oaks, CA: Sage.