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School and Classroom Readiness for Education for Sustainable Development (ESD): Evidence from a Curriculum Pilot in Lebanon

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ABSTRACT

Purpose: This study investigates school and classroom readiness to implement Education for Sustainable Development (ESD). Given Lebanon's outdated curriculum and urgent need to align with the 2030 Agenda, the research explores how schools, teachers, and students respond to ESD integration.

Methodology: A qualitative case study design was adopted, combining classroom observations, semi-structured interviews with academic and administrative coordinators, and records from teacher training sessions. Ten Grade 10 classroom observations, five per school, were conducted across subjects to document teacher facilitation and student engagement using structured observation guides with quantitative scoring and qualitative notes. Also, four interviews were administered with school coordinators to collect institutional perspectives.

Findings: Classroom observations showed high engagement in science, mathematics, and geography, while sociology posed greater challenges due to task complexity and resource limitations. Language activities effectively introduced students to the SDGs, with differences noted between schools in group dynamics and pacing. Also, coordinators confirmed strong student enthusiasm and generally positive teacher adaptation, though initial resistance and time constraints were recurring issues. Overall, the pilot demonstrated that with adequate training and support, ESD can be meaningfully integrated into existing teaching plans.

Unique Contribution to Theory, Practice, and Policy: The study contributes to ESD literature by offering empirical evidence from a Middle Eastern context where systemic curriculum reform is overdue. Findings emphasize the importance of teacher training, administrative support, and resource provision for ESD. For policy, the study underscores the need for national reforms that institutionalize ESD through a whole-school approach while considering linguistic and cultural differences that shape student engagement.

Keywords: *Education for Sustainable Development (ESD), Curriculum Pilot, Teacher Training, School Readiness, Lebanon*

JEL Codes: *I21, I28, Q56, O15, O53*



1. INTRODUCTION

Education for Sustainable Development (ESD) has been widely recognized as a transformative approach to equipping learners with the competencies needed to address complex global challenges and to advance the Sustainable Development Goals (SDGs). However, the successful integration of ESD into formal education systems depends not only on curriculum design but also on the readiness of schools and teachers to adopt new pedagogical approaches and content. In Lebanon, where the national curriculum remains largely unchanged since 1997 and sustainability is only marginally addressed, efforts to mainstream ESD face institutional and pedagogical challenges (Danageuzian et al., 2025). Hence, this study investigates school and classroom readiness to implement ESD within Lebanese secondary education. The analysis is situated in the context of an ESD curriculum pilot implementation, which provided an authentic opportunity to address teacher training, classroom practices, and coordinator reflections. By focusing on the conditions and capacities that shape implementation, the study highlights critical enablers and barriers to integrating ESD into existing school structures.

1.1 Integrating ESD in Curricula, Teacher Training, and Classrooms

ESD must be incorporated across all levels of formal education including early childhood, primary, secondary, technical and vocational, and higher education rather than treated as an optional add-on. Crucially, ESD should not be presented as an isolated subject; instead, sustainability principles ought to be integrated into core disciplines such as mathematics, science, social studies, and languages. To achieve this integration effectively, learning objectives, pedagogical approaches, and assessment mechanisms must be aligned, and competencies should be scaffolded through progressively sequenced objectives. This alignment and scaffolding are central recommendations in UNESCO's guidance on ESD curriculum development (UNESCO, 2017).

Moreover, a transformation in teacher training is a necessary condition for ESD to translate into effective classroom practices. Teachers are the vital change agents who will enact curricular intentions; consequently, teacher training programs must be reoriented to equip educators with both subject knowledge and pedagogical strategies required for ESD. Content, organization, and assessment within teacher training must be revised to create meaningful and sustained change (UNESCO, 2017). In short, without deliberate reforms in pre- and in-service teacher training, curricular commitments to ESD are unlikely to be realized in everyday classroom practices.

Ultimately, it is important to recognize that ESD goes beyond the inclusion of sustainability content in subjects; it implies a systemic transformation of educational institutions. A whole-institution approach mainstreams sustainability across curriculum, campus operations, student participation, leadership and management, school culture, and community engagement. Such an approach embeds sustainability in the routines and lived experience of schooling, enabling competency development, value education, and capacity building. Complementary to whole-institution, change is the need for innovative, learner-centered, action-oriented and transformative

pedagogies. Participatory methods that empower students to act on sustainability issues are central to ESD's goals (UNESCO, 2017).

1.2 Research on Translating ESD into Practice

Since early conceptualizations of ESD, many researchers have examined how its principles are interpreted and enacted in school contexts. Madsen (2013) explored teachers' translations of ESD in Denmark and Ireland and identified four recurrent themes: (1) the "dramatic encounter," where teachers express uncertainty about how best to implement ESD; (2) a "concretization" process, in which teachers use artifacts and visualization to make sustainability issues tangible; (3) an orientation toward hope and student-led action; and (4) the anchoring of ESD within the school either as a cross-disciplinary theme, a standalone subject, or a whole-school focus. Madsen's study highlights teachers' recognition of ESD's importance and their need for clearer guidance and structures that support implementation.

Building on this, Anyolo et al. (2018) conducted a qualitative study in Namibia with senior secondary teachers and reported mixed findings: although teachers generally understood the environmental dimension of sustainable development, many did not explicitly connect social and economic dimensions. Participants preferred infusing ESD into existing subjects rather than creating a separate subject and they used participatory methods such as fieldwork and discussion. Yet, teachers reported substantial barriers notably lack of training, insufficient materials, time constraints, and limited curricular content. The authors concluded that there is a pressing need for teachers who are both knowledge-competent and comfortable with multidisciplinary complexity, suggesting further research on advisory or specialist roles that could support subject teachers in integrating ESD.

Mogren and Gericke (2019) focused on school leadership and organizational structures that enable transformative ESD. Interviewing leaders from ESD-active upper secondary schools, they identified three institutional levers: embedding ESD within the school's holistic vision to generate routine practices; fostering collegial interdisciplinary work to support curriculum integration; and promoting proactive leadership and legitimization of ESD through political and municipal support. These findings point to the organizational and governance dimensions of successful ESD implementation, indicating that classroom change is tightly coupled to institutional routines and external legitimacy.

Okubo et al. (2021) present a case study of SDG/ESD education in a Japanese senior high school that began implementing SDG-related courses in 2018. Student projects clustered around certain goals (notably SDG 3 and SDG 11), while others (SDG 7 and SDG 14) received less attention. Teachers' incorporation of SDG topics correlated positively with years of experience, yet many of them reported insufficient knowledge of the 17 SDGs and limited instructional time. The school's response of forging partnerships with university experts and local government demonstrates how external stakeholder collaboration can augment teacher capacity and expand curriculum breadth.

While international studies highlight the challenges and opportunities of translating ESD into school practice, recent research in Lebanon adds important contextual insights. Shayya et al. (2020) designed, implemented, and evaluated a multidisciplinary ESD model for Grade 10 in one Lebanese public school. Their intervention included the development of a content analysis framework aligned with UNESCO's (2017) learning objectives, pre- and post-test questionnaires to measure knowledge, skills, and attitudes, a rubric for evaluating student projects, and stakeholder interviews. Implementation involved 20 students and a teacher-training component to orient educators toward ESD pedagogies. Findings showed that students demonstrated improved knowledge and competencies and increased their performance on ESD-related skills as assessed through projects. However, interviews revealed persistent barriers, including the overloaded curriculum, lack of resources and technical expertise, classroom management challenges during group work, and weak partnerships with local stakeholders such as NGOs and municipalities. The authors argue for a whole-school approach and emphasize the importance of teacher training, resource provision, and stakeholder engagement for effective ESD implementation.

Additionally, Ghosn-Chelala and Akar (2021) investigated environmental sustainability practices in 21 public schools across four Lebanese governorates through semi-structured interviews with 51 teachers. Although Lebanon's 1997 curriculum does not explicitly include environmental sustainability, teachers noted that related topics appear within civics, languages, geography, and science subjects. Teachers generally expressed a narrow, short-term view of sustainability, focusing on local environmental issues and immediate generational wellbeing, rather than global and intergenerational dimensions. Classroom activities often revolved around waste management and resource restoration but did not position students as active citizens capable of individual and collective agency. Teachers also highlighted systemic obstacles, including national conflicts and corruption, which they saw as necessary to address before genuine sustainability education could take root. This study underscores the tension between curricular intent, teacher interpretation, and broader socio-political realities.

Together, these studies form a cohesive narrative: curricular policy and guidance for ESD exist and increasingly emphasize integration and whole-institution approaches, yet barriers persist at multiple levels, mainly teacher knowledge and training, availability of materials, time, school leadership, and external support. Empirical work routinely highlights teachers' willingness and acknowledgement of ESD's importance, while noting uncertainty about practical implementation and insufficient systemic supports. Therefore, although the conceptual and policy groundwork for ESD is robust, there remains a clear empirical gap in understanding how these recommendations play out in specific local contexts and what mechanisms most effectively translate policy into sustained classroom practice. This gap justifies studies that examine implementation through classroom observations, stakeholder interviews, and comparative analyses across different language or school systems that can reveal where, and why implementation diverges from policy intentions. To this end, this study answers the following research questions:

1. How did teachers, and students, respond to the pilot implementation of the ESD curriculum in classroom practice?
2. What institutional factors influenced school readiness for integrating ESD?

2. METHODOLOGY

This study adopted a qualitative case study design to examine school and classroom readiness for implementing an ESD curriculum. A qualitative approach was chosen because it allows for an in-depth exploration of teacher practices, student engagement, and institutional support within their natural classroom and school contexts.

2.1 Grade Level Selection

Within the scope of this study, it was necessary to identify a feasible starting point for piloting the ESD curriculum. Grade 10 was selected as the focus level for several reasons. First, Lebanon is already significantly behind in implementing ESD, and beginning with younger classes would delay observable outcomes for too long. Grade 10, the first year of the secondary cycle, provided a practical entry point. Students in this class, typically 15 to 16 years old, are at a stage where they are more independent, curious, and socially aware. They are capable of engaging in discussions about sustainability and are on the verge of becoming adult citizens who can act as change agents in their communities. Second, from a demographic perspective, Grade 10 represents the largest share of Lebanon's secondary school population (CERD, 2021). Focusing on Grade 10 therefore allowed this research to impact the largest cohort of students at the secondary level, while also targeting a class that is pedagogically well-suited for cultivating sustainability competencies.

2.2 School Selection

A purposive sampling strategy was employed to identify schools that use either French or English as the primary language of instruction. Based on statistics, 49.4% of Lebanese students were enrolled in French-instruction schools and 50.6% in English-instruction schools (CERD, 2021). To reflect this distribution and ensure relevance, one school from each linguistic category was selected. Schools were approached through formal communication which were then followed by meetings with administrators to explain the pilot implementation program and to confirm their willingness and capacity to participate. In the selection, only private schools were considered since public schools in Lebanon were frequently affected by teacher strikes and lacked the resources and institutional capacity due to the economic crisis. The process of securing schools was challenging. Many schools were reluctant to commit to piloting a non-official curriculum, citing concerns about disruption to required teaching plans. After multiple rounds of communication and negotiation, two schools were confirmed based on their willingness, logistical feasibility, and similarity in Grade 10 classes and educational profiles (each contained around 25 students). This recruitment difficulty revealed broader institutional barriers to adopting ESD, as school-level participation depended heavily on administrative readiness and flexibility.

2.3 Curriculum Pilot Implementation Program

The pilot implementation program was designed to introduce a representative subset of the full ESD curriculum. While the complete ESD curriculum consists of one introductory problematic and nine interdisciplinary problems, the pilot focused on four problematics: the introductory problematic on sustainable development, and one problem each from the social (gender equality), economic (sustainable production and consumption), and environmental (global ecological balance) dimensions. Together, these four problematics correspond to 25 learning objectives, each delivered through a specific learning experience. To ensure multidisciplinary integration, learning experiences or activities were mapped across existing Grade 10 subjects, including languages, sciences, mathematics, social studies, and social sciences. Subjects with higher weekly teaching hours were assigned three activities while those with fewer hours were assigned two, enabling a balanced distribution. This curriculum mapping, presented in table 1, ensured that sustainability content was embedded into existing teaching plans without replacing required national curriculum content.

The program was intentionally limited to a three-month duration, rather than a full academic year, to accommodate school schedules and minimize disruption to preparation for national exams. This timeframe allowed sufficient scope to trial the integration of ESD across disciplines, while remaining acceptable to school administrators. Ultimately, a curriculum enactment approach was employed whereby subject teachers implemented the pilot program activities. Teachers revised the supporting guides which provided instructions on the delivery of each activity, including the learning approach and assessment method.

Table 1: ESD Curriculum Pilot Implementation Program

Subject	ESD Problematic	Topic	Learning Approach
Math (3 activities)	Gender Equality Sustainable Production and Consumption Global Ecological Balance	Gender equality in the local community Consumption patterns and footprints Virtual water footprints	Self-directed Self-directed Technology-driven
Arabic (3 activities)	Intro. to Sustainable Development Gender Equality Global Ecological Balance	Role of education Traditional perception of gender roles Water and energy resources	Problem-based research Discussions Inquiry-based
1 st Language Eng. / Fr. (3 activities)	Intro. to Sustainable Development Gender Equality Global Ecological Balance	2030 Agenda and 17 SDG Role of education, technology and legislation Impacts of pollution and climate change	Interactive lecturing Problem-based research Self-directed
2 nd Language Fr. / Eng. (2 activities)	Intro. to Sustainable Development Global Ecological Balance	Origin and roots of sustainability Energy use and carbon emissions	Case study Self-directed
Geography (2 activities)	Sustainable Production and Consumption Global Ecological Balance	Population growth and consumer behavior Water pollution, access, and saving	Problem-situation Case study
Civics (2 activities)	Intro. to Sustainable Development Gender Equality	Importance and impact of the SDGs Gender equality and gender parity	Case study Debate-based
Physics (2 activities)	Intro. to Sustainable Development Global Ecological Balance	Social, economic, and environmental pillars Sustainable energy production	Discussion and video Interactive lecturing
Chemistry (2 activities)	Sustainable Production and Consumption Global Ecological Balance	Environmental impact of waste generation Water, Energy, Food nexus	Problem-based research Technology-driven
Biology (2 activities)	Sustainable Production and Consumption Global Ecological Balance	Green products Plastic products	Discussions and video Project-based
Sociology (2 activities)	Gender Equality Sustainable Production and Consumption	Gender equality and discrimination Impacts of a growing world population	Problem-situation Self-directed
Economics (2 activities)	Gender Equality Sustainable Production and Consumption	Gender disparity and gender roles Principles of a circular economy	Inquiry-based Self-directed

2.4 Teacher Training Program

To ensure effective implementation of the pilot curriculum, a blended professional development approach was adopted. Training and support were structured around three main components: (1) collaborative coordination with school coordinators, (2) teacher training sessions introducing the pilot program and the problem-based learning (PBL) approach, and (3) individualized support for subject teachers. Hence, this combination reflects aligning teacher development with intended student outcomes (Guskey, 2000) and it incorporates content focus, active learning, coherence, and collective participation (Desimone, 2009). Meetings with the academic coordinators facilitated communication, scheduling, and dissemination of program documents. General training sessions introduced teachers to the principles and stages of PBL, supported by summary guides and pre-recorded explanatory videos demonstrating sample activities. Subsequently, individual meetings were conducted with nearly all participating teachers to provide targeted guidance on the learning activities assigned to their subjects. This structure ensured alignment between training and the intended pedagogical approach of the ESD curriculum. In total, ten teachers participated in each school, alongside coordinators. In some cases, the same teacher covered two subjects (geography and civics in the French-instruction school, mathematics and economics in the English-instruction school). Training and follow-up sessions offered insight into teachers' interpretations of PBL, their readiness to apply it, and the challenges which they anticipated. While no formal evaluation was conducted, qualitative records and notes from meetings served as formative indicators of teacher preparedness. Ultimately, the discussions during individual meetings offered insights into teachers' interpretations, readiness, and potential challenges.

2.5 Classroom Observations

A mixed-methods observational approach was adopted to explore how the PBL approach was enacted in real classroom settings during the implementation of ESD learning activities. Therefore, structured non-participant classroom observations were selected to allow the researcher, physically present in the classroom in a passive role, to document classroom processes without engaging in the instructional process (Cohen et al., 2018). Accordingly, the tool for data collection was a structured classroom observation guide specifically developed for this study. The guide was informed by key characteristics of effective PBL environments as outlined in the literature (Hmelo-Silver, 2004) and adapted to this study. The guide consists of ten distinct categories, each reflecting critical elements of the PBL framework and classroom dynamics. Each of the categories was rated on a 5-point scale to allow for quantifiable comparisons using the following scale: poor = 1, needs improvement = 2, satisfactory = 3, good = 4, and exceptional = 5. Also, detailed observational notes were systematically documented to provide context, capture some examples, and offer qualitative insights into classroom dynamics and implementation of curriculum activities. This dual approach enabled a deeper understanding of how the ESD curriculum was enacted in real classroom settings.

Yet, data collection was constrained by logistical factors, including approval from school administration and teachers and time limitations. To navigate these constraints while ensuring consistency and comparability, a systematic observation method was adopted. A total of ten classroom observations were conducted, five at each school, representing a variety of disciplines to ensure a comprehensive assessment across different subject areas. Specifically, one observation was conducted in the sciences (biology, physics, or chemistry), one in languages (French in the French-instruction school and English in the English-instruction school), one in social studies (civics or geography), one in social sciences (sociology or economics), and one in mathematics. To ensure comparability in the process, each observation targeted the same activity within each subject, allowing for uniform analysis of the delivery of curriculum activities. A mixed-methods analysis was employed. The quantitative ratings from each category were summed to produce a total score over 100 for each observation. These scores, combined with the qualitative data from the observation logbooks, were analyzed to develop a comprehensive understanding of classroom practices.

2.6 School Coordinators' Interviews

A qualitative approach using semi-structured interviews was adopted to collect rich, focused data on key aspects of the pilot implementation (Creswell and Poth, 2018). For these interviews, a guide was developed consisting of five open-ended questions, addressing student engagement, teacher support and training, recommendations, feedback, and reflection. This format allowed participants to provide detailed and reflective answers, while ensuring coverage of consistent topics across all interviews.

The interviewees were the designated academic and administrative coordinators directly involved in the curriculum implementation at each school. Hence, a total of four interviews were conducted. Interviews lasted approximately 20 minutes each and the responses were transcribed verbatim. Given the small number of interviews and duration, a full thematic analysis with detailed coding was not applicable. Instead, a systematic content analysis was performed by thoroughly reading each transcript multiple times to capture core ideas. Key points were extracted and organized by question facilitating comparison across schools and interviewees.

2.7 Triangulation

To strengthen the credibility of the findings, a triangulation strategy was applied by combining multiple data sources. Classroom observations captured both teacher practices and student engagement in real-time, while semi-structured interviews with coordinators provided institutional perspectives on readiness and support. In addition, records from teacher training sessions and follow-up meetings offered insight into how teachers prepared for and interpreted the pilot curriculum. Together, these sources allowed cross-verification of evidence and a comprehensive understanding of school readiness for ESD implementation.

3. RESULTS AND DISCUSSION

The results are presented and discussed in the following two sections. The third section presents the challenges identified throughout the study.

3.1 Classroom Observations

Observation of Grade 10 classrooms during the pilot implementation provided insight into both teacher practices and student engagement across five subjects (science, mathematics, language, sociology, and geography). Table 2 summarizes the total observation scores, and the detailed scoring is presented in table 3 at the end of this section. Overall, results suggest that teachers in both schools demonstrated readiness to adopt PBL, while students engaged actively in most activities. However, levels of comprehension and participation varied by subject, depending on task complexity, teacher facilitation, and resource availability.

Table 2: Total Scores (out of 100) of Classroom Observations

Observation Subject	French-Instruction School	English-Instruction School
Science (Biology)	69	71
Mathematics	75	76
Language (French/English)	74	71
Social Science (Sociology)	64	66
Social Studies (Geography)	72	77

Science and Mathematics

Both schools demonstrated strong engagement with scientific and mathematical concepts of sustainability. Students developed an understanding of sustainable consumption, green products, and virtual water footprints through guided activities by teachers and multimedia resources. Teachers facilitated group work effectively, though discussions were occasionally limited by time. In fact, the English-instruction school benefited from stronger IT resources, which supported comprehension, particularly in mathematics.

Language

Language activities introduced the 2030 Agenda and the SDGs. While most students were initially unfamiliar with the SDGs, teacher-led discussions revealed meaningful connections across goals and links to school initiatives such as recycling. The French-instruction school demonstrated stronger group dynamics, whereas the English-instruction school emphasized written responses, which slowed pacing but still encouraged reflection.

Sociology

In both schools, activities on population growth and sustainable consumption presented challenges. Students struggled with complex figures and pacing constraints, and some groups deviated from the topic. Limited IT resources in the French-instruction school further constrained engagement. Scores were the lowest among all subjects, highlighting the need for better scaffolding of complex tasks.

Geography

Geography lessons showed strong potential for critical thinking and reflection. Students in both schools recognized that consumption patterns, rather than population size, drive sustainability challenges. In the English-instruction school, prior project work on population policies enriched the discussion, leading to deeper connections between sustainability, consumption, and policy.

Teacher facilitation was a key strength in both schools, with teachers effectively encouraging critical thinking and active participation. However, time management challenges occasionally limited the depth of exploration, particularly in activities that required extensive discussion or complex problem-solving. Teachers in the English-instruction school often adopted a more structured approach, which enhanced student understanding in challenging topics. The availability and use of IT resources also played a significant role in the success of certain activities. The school's better-equipped classrooms contributed to higher engagement and understanding, particularly in math and geography. Ultimately, the ESD curriculum pilot demonstrated its potential to foster relevant competencies including critical thinking, collaboration, and awareness of sustainable practices. However, logistical and resource-related challenges, including time constraints and IT limitations, need to be addressed for the curriculum to achieve its full impact. To enhance outcomes, teachers should focus on balancing pacing with opportunities for deeper discussions and structuring group activities to encourage meaningful collaboration.

Table 3: Detailed Scoring of Classroom Observations

Categories		Science (Biology)		Math		Language (Fr./Eng.)		Social Sc. (Sociology)		Social St. (Geography)	
Observation Criteria	Description	French	English	French	English	French	English	French	English	French	English
Problem in Context	- Meeting the Problem	4	3	3	4	5	4	4	4	4	4
	- Problem Summary	3	3	4	3	4	4	4	3	4	4
Problem in Action	- Problem Analysis	4	4	4	4	4	3	4	3	4	4
	- Objective Formulation	3	3	3	3	3	2	3	3	4	4
Results Obtained	- New knowledge and solution	3	4	5	4	5	3	4	4	3	4
	- Review and evaluation	3	3	4	4	4	2	3	3	3	3
Teacher's Facilitation	- Encouragement of critical thinking	4	4	4	4	4	4	4	4	4	4
	- Promotion of student engagement	4	4	4	3	4	4	4	3	4	4
Student Engagement	- Contribution to problem-solving	3	3	4	4	3	4	3	3	3	3
	- Interest and enthusiasm for activity concepts	3	4	3	4	3	3	2	3	3	4
Collaboration & Teamwork	- Interaction and peer support	4	3	4	4	3	5	3	4	3	3
	- Cooperation in problem-solving	3	3	4	3	4	4	3	3	4	4
Behavior & Curiosity	- Respectful communication and behavior	4	4	4	3	3	4	3	4	4	4
	- Expression of curiosity and interest	3	3	3	4	3	3	2	3	3	3
Time Management	- Effective use of time for learning	4	4	4	4	4	3	4	3	4	5
	- Adequate pacing of the activity	4	4	4	4	4	3	3	3	4	4
IT and Other Resources	- Availability of needed technology tools	2	4	4	5	4	5	2	4	4	5
	- Relevant utilization of IT and other resources	3	4	4	5	4	4	3	3	4	5
Overall Atmosphere	- Level of enthusiasm in the classroom	4	3	3	4	3	3	3	3	3	3
	- Classroom culture and community building	4	4	3	3	3	4	3	3	3	3
Total (out of 100)		69	71	75	76	74	71	64	66	72	77

The observations highlighted the effective implementation of PBL and collaborative activities by teachers. Students were observed working together to analyze sustainability challenges, brainstorm solutions, and develop ideas; guided by teachers. Regarding teacher facilitation, observations also indicated a shift from traditional lecturing to a more facilitative role. Teachers were observed guiding discussions, providing support, and encouraging student-led inquiry, rather than merely transmitting information. This aligns with the constructivist and humanistic views of the teacher as a facilitator who creates an enabling environment for learning, fostering autonomy and self-actualization (Sharp, 2012; Purswell, 2019). The initial teacher training and ongoing support provided during the pilot appear to have been crucial in enabling this pedagogical shift. Hence, teacher training and support are essential for effective ESD curriculum implementation.

While the observations largely pointed to successful implementation, some variations in the depth of engagement and the extent of teacher facilitation were noted between the two schools. Potentially, this was influenced by factors such as prior experience with active learning or specific school contexts. The overall pattern of observations indicates that teachers fostered a dynamic and interactive learning environment conducive to developing sustainability competencies. The consistent evidence of active student participation, effective collaborative work, and teacher facilitation provides robust qualitative validation for the teacher training program and curriculum's initial effectiveness.

3.2 School Coordinators' Interviews

Examining the responses of academic and administrative interviewees between the two schools, numerous differences and similarities emerge. For student engagement and learning, there was a general increase in interest in both schools. Students in the French-instruction school had a more uniform positive engagement, while there was variability in students at the English-instruction school as some students were influenced by their peers either positively or negatively. For teacher support and training, both schools reported a generally positive response from teachers, though teachers at the English-instruction school had an initial shock and there was a divide between those who embraced the curriculum and those who struggled due to other duties. Recommendations from both schools emphasized the importance of better planning. Coordinators in the French-instruction school suggested a broader integration of ESD projects across subjects and those from the English-instruction school recommended logistical support like a dedicated project space and more use of videos and field trips.

Regarding student and teacher feedback, both schools reported no significant negative feedback but mentioned time pressures, especially towards the end of the term. Finally, in their personal reflection, coordinators from both schools expressed strong support for integrating ESD into the mainstream curriculum. Particularly, coordinators at the French-instruction school focused on the developmental benefits for students while coordinators from the English-instruction school emphasized the essential nature of ESD in daily life and long-term sustainability education.

The interviews conducted with school coordinators provided a crucial administrative and pedagogical perspective on the pilot implementation of the curriculum. These insights are vital for assessing the curriculum's feasibility and reception as well as the role of teacher training and support. Overall, the school coordinators reported a positive experience with the ESD curriculum pilot, underscoring its potential for broader integration. The teacher support and training were consistently viewed as positive, reinforcing that teacher preparedness is essential for effective ESD implementation. Despite initial unfamiliarity, most teachers adapted effectively after reviewing materials and receiving support. This highlights the critical role of the initial teacher training and ongoing assistance in enabling a shift towards more facilitative, problem-based learning, departing from traditional methods (Anyolo et al. 2018). Also, the initial shock and divide among teachers of the English-instruction school resonates with challenges regarding resistance to change. This aligns with local literature (Ghosn-Chelala and Akar, 2021; Shayya et al., 2020) stressing comprehensive teacher preparedness for ESD. Feedback from both students and teachers was overwhelmingly positive regarding the curriculum's content and impact. However, a recurring challenge was time limitation, also reported by Anyolo et al. (2018), as students balanced ESD activities with tests and lessons. This points to a persistent implementation challenge within rigid exam-oriented systems. While challenges related to time management and teacher workload were noted, the overwhelming positive feedback on student engagement, teacher adaptation, and the curriculum's content strongly support the curriculum's potential for broader implementation.

3.3 Challenges

The execution of the pilot implementation presented challenges that are important to acknowledge. First, a significant obstacle was encountered in selecting and securing participation of schools willing to commit to the pilot implementation. The process of finding two schools that agreed to integrate the ESD curriculum and dedicate resources for its pilot was harder than anticipated. This difficulty underscores the broader systemic resistance to educational innovation in the Lebanese context. Second, after securing the approval of school administrators, there was an initial period of adjustment and resistance from both school coordinators and teachers. As the ESD curriculum introduced a novel approach it was perceived as an additional burden or unfamiliar territory at the beginning. Overcoming this initial hesitation required continuous communication, reassurance, and dedicated support, as well as the eventual demonstration of the curriculum's benefits. This experience further emphasizes the importance of robust teacher training and administrative support for any educational reform, aligning with findings from both local and global research on ESD implementation (Shayya et al., 2020; Mogren and Gericke, 2019).

4. CONCLUSION AND LESSONS LEARNED

This study examined the pilot implementation of an ESD curriculum in two Lebanese schools with different primary languages of instruction. The study's findings carry practical implications for administrators and teachers committed to advancing sustainability education in comparable contexts.

First, the adoption of PBL should be prioritized across classrooms. The pilot clearly demonstrated that PBL fosters engagement, deepens critical thinking, and cultivates collaborative problem-solving skills. Teachers adopting facilitative roles rather than relying on didactic lecturing can empower students to take ownership of their learning, engage in inquiry, and apply sustainability principles to authentic local challenges. Second, school leadership is essential for creating an enabling environment. Administrators and academic coordinators must ensure that teachers are adequately supported with time, resources, and space for collaborative and project-based work. Their visible commitment to sustainability also helps normalize ESD as a school-wide priority. This reflects UNESCO's call for a whole-institution approach, where leadership engagement is foundational to long-term success. Finally, the study highlights the reality of time and workload constraints that often hinder ESD implementation. Teachers should consider flexible strategies such as embedding short, sustainability-themed activities within existing lessons, and pooling efforts with colleagues to share responsibilities.

Attention should also be paid to the linguistic and cultural dimensions of instruction, as these shape how students engage with and communicate sustainability competencies. It is particularly noteworthy that students in the French-instruction school demonstrated stronger engagement. One plausible explanation lies in the dual demands of preparing for both the French and Lebanese baccalaureates. The French Baccalaureate curriculum emphasizes structured reasoning, analytical rigor, and argumentative clarity (Ministère de l'Éducation nationale, 2019). These academic traditions may have fostered students' ability to articulate complex ideas, situate problems within broader systemic frameworks, and propose collective policy-based solutions. This finding underscores an important consideration for ESD implementation: pedagogical practices and curricular designs cannot be assumed to have uniform effects across diverse cultural and linguistic contexts. Instead, they interact with existing traditions of teaching, assessment, and intellectual preparation. To maximize the transformative potential of ESD, practitioners must remain attentive to these mediating factors, adapting approaches to align with students' linguistic and cultural repertoires.

STATEMENTS AND DECLARATIONS

Competing Interests

The authors have no competing interests to declare that are relevant to the content of this article.

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Data Availability Statement

Data sharing is not applicable to this article as no datasets were generated or analyzed during the current study.

Declaration of Generative AI in Scientific Writing

During the preparation of this work, the authors used ChatGPT to support the drafting and refinement of text, as well as to check clarity and consistency. After using this tool, the authors reviewed and edited the content as needed and take full responsibility for the content of the published article.

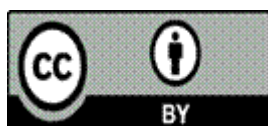
Author Contribution

Hrair Danageuzian, Liliane Buccianti Barakat, and Fadi El Hage contributed to the research conception and design. Material preparation, data collection, and analysis were performed by Hrair Danageuzian. The first draft of the article was written by Hrair Danageuzian. Liliane Buccianti Barakat and Fadi El Hage read and approved the final manuscript.

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