Designing and Piloting a Problem-Centered Education for Sustainable Development (ESD) Curriculum for Grade 10 in Lebanon

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Abstract

This study addresses the gap in Education for Sustainable Development (ESD) in Lebanon by designing and piloting a problem-centered competency-based ESD curriculum for Grade 10. The study investigates the following research questions: What are the limitations of the current Environmental Education (EE) curriculum in Lebanon? What are the national needs for ESD integration at the secondary level? And how effective is a newly designed ESD curriculum in enhancing students' sustainability competencies? The study first adopts a qualitative analysis of Lebanon's outdated EE curriculum of 1997, followed by a needs assessment involving 26 semi-structured interviews with education and sustainable development experts. Based on these insights and UNESCO guidelines, the ESD curriculum was developed, integrating social, environmental, and economic themes across academic subjects. The curriculum was piloted over four months in two schools—one English-instruction and one French-instruction school. To assess effectiveness, the study adopted mixed methods, including pre- and post-tests, classroom observations, focus groups, and interviews with school coordinators. Findings across both schools revealed significant improvements in students' ability to apply sustainable development concepts and demonstrate key sustainability competencies. These results underscore the curriculum's effectiveness in promoting ESD competencies such as systems thinking, critical reflection, and active engagement with real-world sustainability challenges. This research offers a replicable model for integrating ESD into national curricula, especially in contexts where education reform is needed.

Keywords

Education for Sustainable Development (ESD), curriculum design, competency-based education, problem-centered approach.

Résumé

Cette étude comble une lacune dans le domaine de l'Éducation au Développement Durable (EDD) au Liban en concevant et en testant un programme scolaire basé sur les compétences et centré sur les problèmes pour la classe de seconde. L'étude examine les questions de recherche suivantes: Quelles sont les limites du programme actuel d'Éducation à l'Environnement (EE) au Liban? Quels sont les besoins nationaux pour l'intégration de l'EDD au niveau secondaire? Et quelle est l'efficacité d'un nouveau programme d'EDD pour renforcer les compétences des élèves en matière de durabilité? L'étude adopte d'abord une analyse qualitative du programme obsolète d'EE datant de 1997 au

Liban, suivie d'une évaluation des besoins menée à travers 26 entretiens semi-structurés avec des experts en éducation et en développement durable. Sur la base de ces données et des directives de l'UNESCO, un programme d'EDD a été élaboré, intégrant les dimensions sociales, environnementales et économiques au sein des différentes disciplines scolaires. Le programme a été mis en œuvre pendant quatre mois dans deux établissements : l'un à enseignement en anglais, l'autre à enseignement en français. Pour évaluer son efficacité, l'étude a adopté une méthodologie mixtes combinant des tests pré- et post-intervention, des observations en classe, des groupes de discussion et des entretiens avec les coordinateurs scolaires. Les résultats obtenus dans les deux écoles ont montré des améliorations significatives dans la capacité des élèves à appliquer les concepts de développement durable et à démontrer des compétences clés en durabilité. Ces résultats soulignent l'efficacité du programme à promouvoir des compétences en EDD telles que la pensée systémique, la réflexion critique et l'engagement actif face aux défis concrets du développement durable. Cette recherche propose ainsi un modèle reproductible pour intégrer l'EDD dans les programmes nationaux, en particulier dans les contextes nécessitant une réforme éducative.

Mots clés

Education au développement durable (EDD), conception des programmes, approche par compétences, approche centrée sur les problèmes

مستخلص

تعالج هذه الدراسة الفجوة في مجال التعليم من أجل التنمية المستدامة في لبنان من خلال تصميم وتنفيذ منهاج دراسي قائم على الكفايات ومتمحور حول المشكلات للصف العاشر. تتناول الدراسة الأسئلة البحثية التالية: ما هي حدود منهاج التربية البيئية الحالي في لبنان؟ ما هي الاحتياجات الوطنية لإدماج التعليم من أجل التنمية المستدامة في المرحلة الثانوية؟ وما مدى فعالية المنهاج المصمم في تعزيز كفايات الطلاب في مجال الاستدامة؟ تعتمد الدراسة أولًا على تحليل نوعي للمنهاج اللبناني في التربية البيئية الصادر عام 1997، ثم تُجري تقييمًا للاحتياجات عبر 26 مقابلة شبه مهيكلة مع خبراء في التعليم والتنمية المستدامة. وبناءً على هذه الرؤى وإرشادات اليونسكو، تم تطوير المنهاج الجديد للتعليم من أجل التنمية المستدامة، مع دمج الأبعاد الاجتماعية والبيئية والاقتصادية في المواد الأكاديمية المختلفة .وقد تم تنفيذ المنهاج تجريبيًا على مدى أربعة أشهر في مدرستين: إحداهما تعتمد اللغة الإنكليزية، والأخرى تعتمد اللغة الفرنسية كلغة تعليم. ولتقييم الفعالية، اعتمدت الدراسة منهجية متعددة الأدوات شملت اختبارات قبلية وبعدية، ملاحظات صفية، مجموعات تركيز، ومقابلات مع منسقي المدارس .أظهرت النتائج في المدرستين تحسنًا ملحوظًا في قدرة الطلاب على تطبيق مفاهيم التنمية المستدامة وإظهار كفايات أساسية في الاستدامة. وتؤكد هذه النتائج فعالية المنهاج في تعزيز كفايات التعليم من أجل التنمية المستدامة مثل التفكير النظمي، والتفكير النقدي التأملي، والمشاركة الفاعلة في مواجهة تحديات الاستدامة الواقعية .تقدم هذه الدراسة نموذجًا قابلاً للتطبيق لإدماج التعليم من أجل التنمية المستدامة في المناهج الوطنية، لا سيما في السياقات التي تتطلب إصلاحًا تربويًا.

كلمات مفتاحية

التعليم من أجل التنمية المستدامة، تصميم المناهج، التعليم المبني على الكفايات، النهج المرتكز على المشكلات

1. Introduction

In response to the growing social, economic, and environmental problems worldwide, Education for Sustainable Development (ESD) is considered a critical means of equipping learners with the competencies and mindsets needed to address sustainability challenges. With the adoption of the 2030 Agenda and the 17 Sustainable Development Goals (SDGs), SDG 4: Quality Education, and precisely target 7, calls for all learners to acquire the knowledge and skills needed to promote sustainable development (UNESCO, 2017). Therefore, embedding sustainability competencies in education systems is essential not only to achieve the SDGs but to empower youth as agents of change in an increasingly uncertain world. While many countries have made significant strides in integrating sustainability into education systems, the global progress on ESD has been uneven.

The Lebanese education system continues to rely on the Environmental Education (EE) curriculum of 1997, which lacks a holistic and competency-based approach. Efforts to modernize education have emerged in recent years. In 2022, Lebanon's national curriculum development framework proposed a shift towards a competency-based and green curriculum that aligns with global trends and the 2030 Agenda (CERD, 2022). However, this has yet to materialize into a comprehensive curriculum applicable to learners nationwide. Also, Lebanon's complex social and political context characterized by prolonged governance issues, economic instability, and regional tensions has further hindered educational reform. Since October 2019, Lebanon has faced an unprecedented economic crisis, which worsened social issues and undermined the education system's capacity to innovate.

Given these conditions, this research presents an ESD curriculum for Grade 10 based on key sustainability competencies (UNESCO, 2017) and informed by local needs. This study also contributes to a clear understanding of how competency-based and problem-centered curricula can be developed in challenging contexts.

Literature on integrating ESD at the school level is very limited in Lebanon. Mekhael and Shayya, (2018) presented standardized measures of Lebanese tenth grade students' knowledge, attitudes, and behaviors regarding sustainable development. Twenty schools were selected from the administrative Beirut region with 437 grade 10 students from public and private schools. Results demonstrated that students' knowledge, attitudes, and skills regarding sustainable development were relatively high. The

social pillar scored the highest mean, followed by the environmental pillar, and the economic pillar recorded the lowest score. Furthermore, membership in an environment club influenced students' knowledge, skills, and attitudes concerning sustainable development. For the source of knowledge on sustainable development, the main source was the curriculum as 57% of students responded. The remaining sources included social media, school activities, parents, the environment club, NGOs, and friends. Accordingly, it is essential to reorient the curriculum to integrate ESD to advance knowledge, skills, and attitudes on sustainable development (Mekhael and Shayya, 2018).

Shayya et al., (2020) reinforced ESD in teaching practices by designing, implementing, and evaluating a multidisciplinary model for grade 10. A content analysis framework was developed. It adopted seven key characteristics of sustainability, and the ESD learning objectives of UNESCO (2017) were sorted over these characteristics and then supported with key ESD competencies as addressed in the literature. The model was implemented at the grade 10 level of a public school in Lebanon consisting of 20 students. For the implementation, workshops were conducted with teachers to introduce ESD and orient their teaching approaches to it. Also, the preparation and supervision of projects was addressed. The results analysis included a comparison of the pre- and post-test questionnaires which showed an increase in students' level of sustainable development knowledge, skills, and attitudes. Furthermore, the evaluation of the students' projects using the rubric indicated that 50 % of the students increased their ESD competencies. The interviews which were conducted after implementation highlighted many challenges including the integration of ESD topics in the already burdened curriculum, the lack of resources and technology experts, classroom management during collaboration activities, and lack of effective partnership with municipalities and NGOs. Ultimately, it remains essential to note the importance of the whole-school approach to sustainable development in Lebanon which would have a greater impact on students' skills and competencies. Furthermore, as teachers are the facilitators of ESD, proper training should address the pedagogies and resources needed. The authors conclude by addressing the importance of incorporating all stakeholders in the effective implementation of ESD including parents and the local community (Shayya et al., 2020).

Ghosn-Chelala and Akar, (2021) investigated education practices for environmental sustainability in Lebanon by conducting semi-structured interviews with teachers across 21 public schools. Like other conflict-affected areas, education reform in Lebanon has been mostly stationary with its 1997 national curriculum still in effect. Even though the Lebanese national curriculum does not explicitly address

environmental sustainability, it has incorporated themes related to caring for the natural environment in numerous subjects. Semi-structured interviews were conducted with 51 teachers from science, language studies, and social science disciplines. Findings showed that teachers demonstrated a short-sighted understanding of environmental sustainability when describing issues related mostly to Lebanon and for the wellbeing of the current generation. Teacher responses also showed that even though certain activities engaged young people in waste management practices and the restoration of natural resources, however, students are limited to the knowledge in the national curriculum and are not positioned as citizens who act individually. For solutions, teachers argued that sustainable practices should start at the household level and in society as a whole which begins with the termination of conflict and corruption (Ghosn-Chelala and Akar, 2021).

In light of the literature review, this study aims to design, implement, and evaluate a competency-based problem-centered ESD curriculum for Grade 10 students in Lebanon. This research promotes the development of students' key sustainability competencies, with a specific focus on integrating ESD into the Grade 10 curriculum in Lebanon. The study investigates the following research questions: What are the limitations of the current EE curriculum in Lebanon? What are the national needs for an ESD curriculum? And how effective is a newly designed ESD curriculum in enhancing students' sustainability competencies?

2. Methodology

The methodology is composed of four main steps or objectives.

2.1 Examining the national EE curriculum of 1997

The purpose of this step is to construct a comprehensive understanding of the current curriculum by examining its themes, topics, general behavioral goals, and the integration of EE in Grade 10 academic subjects. Qualitative content analysis (QCA) was used to examine the curriculum. It is a qualitative research method which is commonly used to analyze text data (Hsiu and Shannon, 2005). The qualitative data were the content of the EE curriculum of Lebanon (CERD, 1998). The curriculum document was reviewed comprehensively to extract the themes, topics, and behavioral goals.

2.2 Conducting a needs assessment to inform the design of an ESD curriculum

Since ESD must be tailored to country specific contexts and personalized to national and sociocultural levels in order to be effective (Hopkins, 2012); the purpose of this step is to identify the needs related to ESD in the Lebanese education context. A qualitative approach was adopted, and semi-structured interviews were conducted with two groups of participants: education and sustainable development (with its economic, environmental, and social dimensions). First, for the education group, the questions focused on the components of an ESD curriculum including educational objectives, skills and competencies, learning approaches, assessment methods, and obstacles to achieving ESD in Lebanon. For the sustainable development group, the questions focused more on the topic areas and problems to be integrated into the ESD curriculum, based on each interviewee's dimension of expertise.

For participant selection, university professors and researchers from high-ranking universities in Lebanon were targeted as academic experts. In addition, individuals with vast experience in relevant governmental and nongovernmental institutions were targeted as professional experts. These experts included personnel from UN agencies, MEHE, and CERD. The sample size was guided by the principle of purposeful sampling.

Regarding data collection, participants were contacted by email besides personal contacts. The interview durations ranged between 40 and 60 minutes. Consequently, the first step in the analysis involved transcribing the interviews and reading the transcripts multiple times to ensure proper comprehension. Coding was systematically conducted where responses to common questions across the two groups were coded together. A spreadsheet was used as a codebook in which the definition and criteria for each code were specified. In turn, emerging themes were extracted using a combination of thematic analysis and theoretical coding. Details regarding the methodology adopted can be found in Danageuzian et al., (2025).

2.3 Designing a competency-based problem-centered ESD curriculum

The purpose of this step is to design an ESD curriculum for Grade 10 that responds to national needs and aligns with global standards. The curriculum aims to empower students with key competencies for sustainable development while using real-world problems as entry points for learning. In line with literature and the needs assessment, the Competency-Based Curriculum Design (CBCD) was adopted (Lin et al., 2024). Figure 1 demonstrates the framework followed in this design.

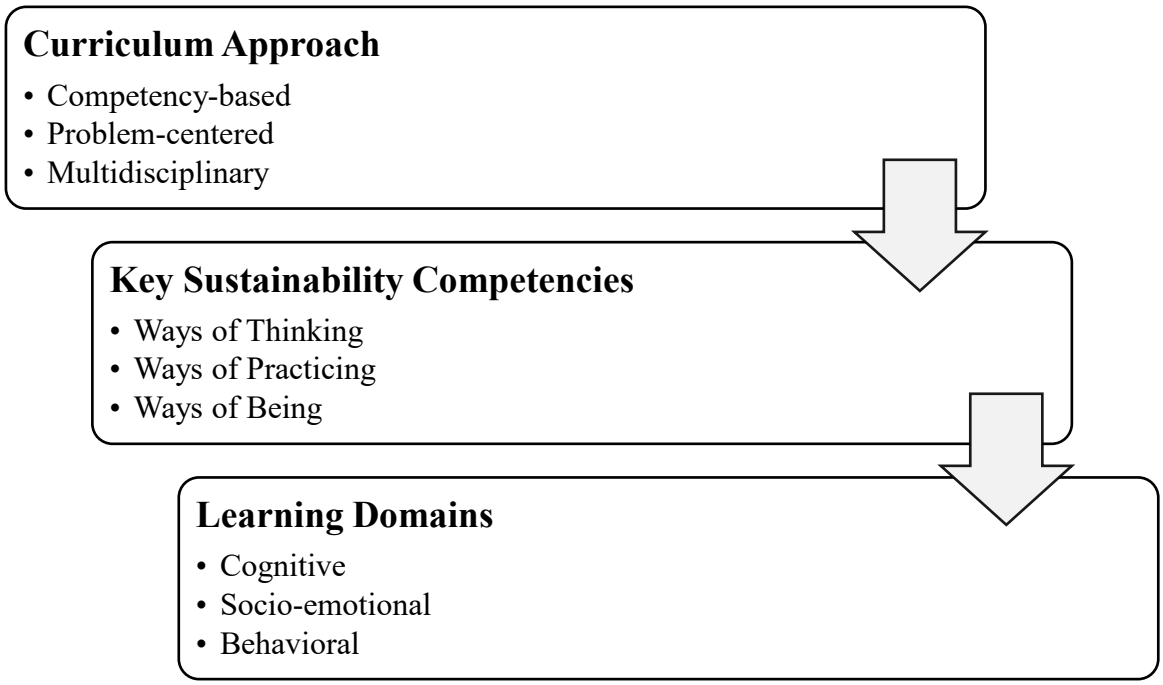

Figure 1: Framework of ESD Curriculum Design

The curriculum approach is competency-based since ESD is considered an education which allows learners to develop competencies for sustainability that are relevant to all SDGs (UNESCO, 2017). In addition, the curriculum is problem-centered since ESD involves teaching learners how to look at a problem and come up with a solution to it. Students are therefore exposed to real-life issues, which help them cultivate skills that are transferable to the real world. Problem-centered curriculum designs increase the relevance of the curriculum and allow students to be creative and innovate as they are learning (Dolmans and Schmidt, 1996). Also, the curriculum is multidisciplinary since sustainable development is not a standalone or independent topic. Rather, ESD is part of a holistic approach to solving everyday problems. Thus, the ESD curriculum has its independent framework, however it is integrated into all academic subjects of Grade 10 in a multidisciplinary manner.

2.4 Piloting the ESD curriculum

Based on CERD statistics, 49.4% of Lebanese students were enrolled in French-instruction schools and 50.6% in English-instruction schools in the academic year 2020 – 2021 (CERD, 2021). To reflect this distribution and ensure relevance, one school from each linguistic category was selected to enable a quasi-experimental research design. Therefore, the selection process aimed at securing two Grade 10

classrooms with similar student numbers and educational profiles that would support comparative analysis of outcomes. Before the pilot implementation, teacher training and support was conducted. In each school, a general orientation meeting was held with all the participating teachers to introduce the pilot and deliver a training session on the problem-based learning (PBL) approach. Also, individual meetings were conducted with nearly all teachers to provide targeted support and to ensure proper integration of the PBL methodology into classroom practice. The pilot implementation extended over around four months of the academic year.

2.4.1 Pre- and Post-test Student Questionnaires

A pre-post approach was used to assess the changes in students' sustainability competencies over the course of the pilot. A pre-post approach involves collecting data from the same participants before and after an intervention to measure change over time (Creswell, 2014). In fact, the questionnaire was first piloted with another group of Grade 10 students as a form of validation to ensure its clarity, relevance, and effectiveness. The sample size was based on the number of students in each of the two schools: 25 students from an English-instruction school and 27 from a French-instruction school. All statistical analyses were conducted using IBM SPSS Statistics (IBM Corp., 2020).

2.4.2 Classroom Observations

An observational approach was adopted to explore how PBL was enacted in real classroom settings during the implementation of ESD learning activities. 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. A total of five classroom observations were conducted at each school. To ensure comparability in the process, each observation targeted the same activity within each subject, allowing for uniform analysis of the PBL approach and the delivery of curriculum activities.

2.4.3 Student Focus Groups after ESD curriculum pilot

A qualitative focus group approach was adopted, which is particularly suited for assessing perceptions, attitudes, and shared understandings among participants (Krueger and Casey, 2014; Morgan, 1997). A discussion guide with open-ended questions was developed as a data collection tool. The discussion guide was structured on the key sustainability competencies embedded in the ESD curriculum. Two

focus groups were conducted, one in each participating school. Each group consisted of eight students (four males and four females), selected randomly by the academic coordinators to ensure gender balance and diverse perspectives. The findings from each focus group were then analyzed thematically, allowing for the identification of recurrent patterns and insights across participants' responses.

2.4.4 Interviews with schools' coordinators

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). A new interview guide was developed as a tool for data collection. It consisted of five open-ended questions, each addressing a major aspect relevant to curriculum implementation. The interviewees were not selected through any sampling process; rather, they were the designated academic and administrative coordinators directly involved in the curriculum implementation at each school. Hence, a total of four interviews were conducted. Given the small number of interviews, a full thematic analysis with detailed coding was not applicable. Instead, key points were extracted and organized by question facilitating comparison across schools and interviewees.

To ensure compliance with ethical research standards, all components of the methodology underwent formal review and approval by the Ethics Board of Saint Joseph University (USJ).

3. Results and Discussion

3.1 Evaluation of the national EE curriculum of Lebanon

Table 1 presents the six main themes and corresponding topics of each theme of the EE curriculum.

Table 1: Themes and Topics of the National EE Curriculum (Data from CERD, 1998)

Theme 1	Theme 4

The Natural Environment
Soil
Water
Plants and forests
Animals
Energy and natural resources
Agriculture
Industry

Problems of Pollution
Water and shore pollution
Air pollution
Physical pollution
Biological pollution
Chemical pollution
Soil pollution and erosion
Wastes

Theme 2 The Human Being and His Surroundings
The house
The school
The neighborhood
The village
The city
The relationship between countryside and city

Theme 5 Environment and Development
Concepts of human development
Public responsibility for development
Development and the environment
Problems of developing countries
Scientific and technological development

Theme 3 The Natural Balance
The water cycle
Oxygen, carbon dioxide, and the carbon cycle
Food chain
Natural balance

Theme 6 Heritage Preservation
Historical monuments
Natural landmarks
Culture
Arts
Artisanal production

The analysis of the curriculum revealed several shortcomings that largely hinder its effectiveness in preparing students for contemporary sustainability challenges. First, general behavioral goals are broadly phrased and not consistently aligned with specific grade levels or measurable outcomes. Phrases like “Practice proper behaviors…” are frequently used, making evaluation difficult and failing to encourage the development of higher-order cognitive skills. This fundamentally contrasts with principles of competency-based education (CBE), which highlight explicit, transparent, measurable, and transferable learning expectations (Levine and Patrick, 2019). Hence, the EE curriculum’s vague behavioral goals fall short of fostering action-oriented capacities.

Second, the EE curriculum exhibits a significant lack of coherence and progression across cycles and themes. Topics are often basic for higher cycles, and there is poor integration of content within and between themes. For instance, the theme “Natural Balance”, despite its importance, is in fact poorly

organized, moreover crucial topics like the oxygen or carbon cycle are minimally integrated into the secondary cycle. This fragmented structure fails to promote the cumulative and continuous learning essential for curriculum sequence (Ornstein and Hunkins, 2017). A truly effective ESD curriculum, as highlighted by UNESCO (2017), should not be an isolated, stand-alone subject but an integral part of core subjects. Learning objectives, teaching methods, and assessment measures should be aligned to reinforce each other through scaffolding of competencies.

Third, the curriculum's predominant focus on "proper behavior" or behavioral goals, while seemingly positive, oversimplifies the complex nature of learning and sustainable action. ESD demands a shift towards cognitivist and constructivist approaches, highlighting active knowledge construction and application in diverse settings (Yilmaz, 2011; Bada and Olusegun, 2015). The absence of suggested activities or delivery methods for many topics, and the lack of assessment methods further add to the curriculum's ineffectiveness. This contradicts the principles of a well-designed curriculum, which should provide a framework for planning, implementation, and evaluation (Ornstein and Hunkins, 2017).

Overall, the EE curriculum remains largely a collection of isolated themes and topics without proper structure or assessment methods to foster sustainability competencies. Its limitations in fostering an understanding of interconnected economic, environmental, and social dimensions underscore an urgent need for a transformative shift towards a progressive ESD approach.

3.2 Insights from the Needs Assessment towards an ESD curriculum

Interviewees of the education group addressed the EE curriculum and predominantly highlighted the need to update it. Some interviewees also discussed the inefficiency of the curriculum and the fact that it is not taught anymore due to many curricula reductions overs the years. Hence, the interviewees highlighted the need for an ESD curriculum and confirmed its role in setting clear learning objectives, providing structure and coherence, guiding instruction, and assessing student learning.

Next, interviewees of the sustainable development group contributed to the problems and topics, at the global and local levels, of the curriculum in light of the 17 SDGs, as presented in table 3. Regarding competency development, it was addressed in line with the three learning domains: cognitive, socio-emotional, and behavioral UNESCO (2017). Additionally, all interviewees contributed to the relevant

skills students should develop which constitute the key competencies. These include critical thinking, problem-solving, collaboration, empathy, environmental stewardship, leadership, teamwork … among others. Also, the learning approaches required for an ESD curriculum were also addressed, and the most commonly referred to included experiential learning, project-based learning, and problem-based research. Likewise, assessment methods were also examined in light of these learning approaches, which included peer assessment, reflective writing, concept mapping, and role-play simulations. The detailed results and analysis of the needs assessment with a deeper focus on each question can be found in Danageuzian et al., (2025).

3.3 The competency-based problem-centered ESD curriculum

As presented in the framework, the new curriculum adopts key competencies. Table 2 presents the ESD competencies (UNESCO, 2017) which are the transversal competencies of the curriculum.

Table 2: Key Competencies of the Curriculum (Data from UNESCO, 2017)

Key Sustainability Competencies	
KC.1	Systems Thinking Competency
KC.2	Anticipatory Competency (Future Thinking)
KC.3	Critical Thinking Competency
KC.4	Strategic Competency
KC.5	Collaboration Competency
KC.6	Integrated problem-solving Competency
KC.7	Self-awareness Competency
KC.8	Normative Competency

Figure 2 demonstrates the content of the curriculum. The first problem is an introductory problematic tackling the concept of sustainable development and ESD. The following nine problems are primarily

based on the 2030 Agenda and 17 SDGs. The topics include local issues, of primary importance to Lebanon, and global topics highlighted in the needs assessment.

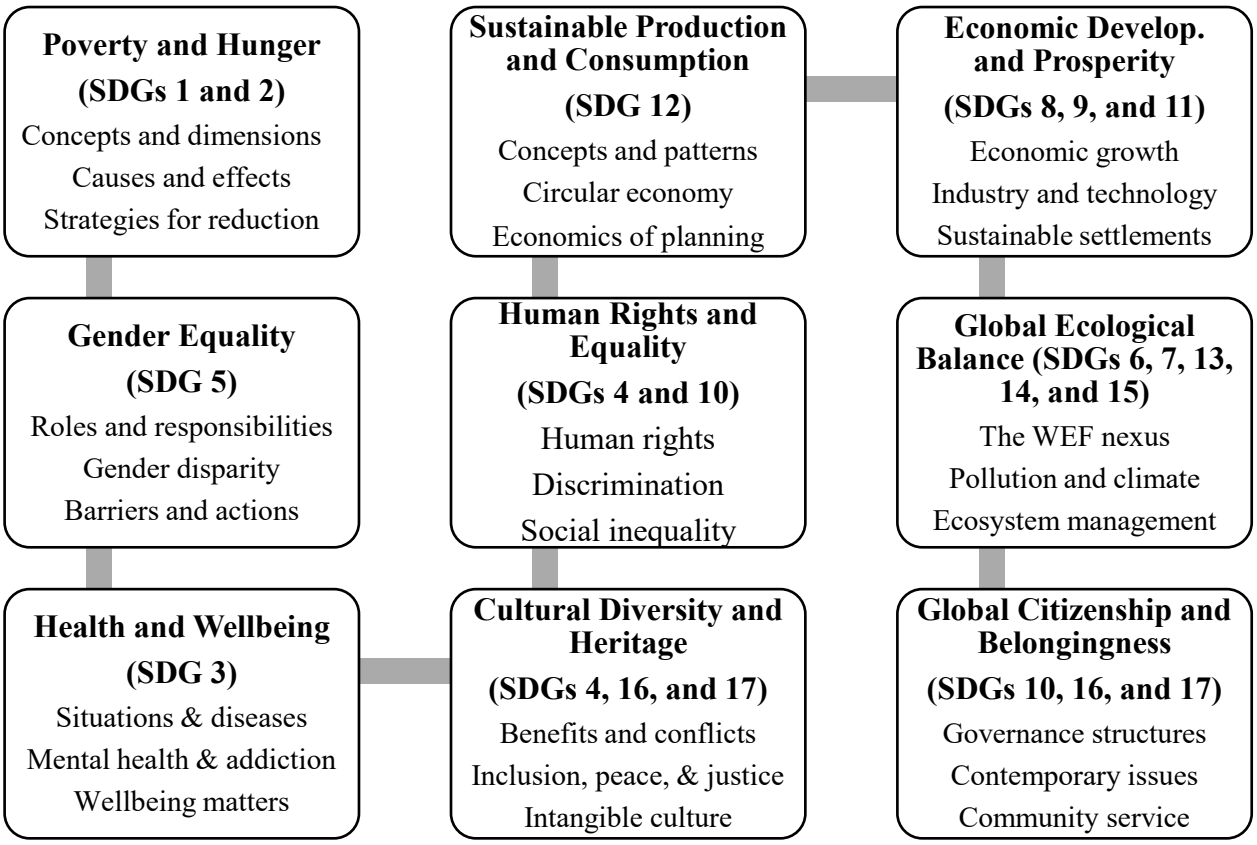

Figure 2: Curriculum Content: Problems and Topics

The curriculum with all its components elaborated in detail will be published in a separate article.

3.4 Pilot implementation of the ESD curriculum

Starting with the statistical analysis of the questionnaires, the total score's mean significantly increased from 12.62 in the pre-test to 21.17 in the post-test. Similar improvements were observed across all sub-scores. The most remarkable improvement was seen in the environmental score, nearly doubling its mean. These consistent increases suggest that the curriculum effectively enhanced participants'

understanding across the multi-faceted nature of sustainability. Moreover, table 3 presents the means of the total score, pre- and post-test, for each of the two groups.

Table 3: Means of the Total Scores

Group	Pre-test	Post-test
English-instruction School	11.80	18.76
French-instruction School	13.37	23.41

Based on the Mann-Whitney U test, the pre-test results did not show any significant difference between the two language groups ($U = 255.5$, $p = 0.130$). This means that both groups entered the study with similar baseline knowledge or understanding. However, the post-test results revealed a significant difference between the two language groups ($U = 123.5$, $p < 0.001$), indicating that the ESD curriculum pilot had a differential impact, possibly influenced by the language of instruction. Specifically, the French group recorded a better improvement in their post-test scores. The French-instruction school prepares Grade 10 students for a double baccalaureate, the French and the Lebanese. Hence, it is plausible that this could have contributed to the students' higher scores.

In turn, classroom observations provided valuable evidence regarding the implementation of the ESD curriculum and its impact on student engagement. An essential finding from the observations was the level of student engagement throughout the pilot. The majority of students were observed participating in discussions, collaborating in groups, and demonstrating enthusiasm for the tasks. 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 inquiry. 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. However, the overall pattern of observations indicates that the curriculum fostered a dynamic and interactive learning environment supportive to the development of key sustainability competencies. Ultimately, the consistent evidence of active student participation, effective collaborative work, and teacher facilitation provides robust qualitative validation for the curriculum's design and its initial effectiveness.

Additionally, the student focus groups provided rich qualitative data, offering deeper insights into the development of sustainability competencies and students' perceptions of the ESD curriculum pilot. A particularly insightful area of development was the anticipatory competency (UNESCO, 2017), or future thinking. While both focus groups acknowledged an increased awareness of long-term impacts, a distinct difference emerged in their application. In the French-instruction school, students expressed challenges in consistently considering future consequences in their daily actions, with examples leaning towards immediate interventions like clean-ups. In contrast, in the English-instruction school students exhibited a more pronounced and actionable awareness, citing specific behavioral changes such as reducing plastic use, donating clothes, and mindful water consumption. This distinction highlights a more advanced translation of understanding into concrete future-oriented behaviors within the latter group.

Finally, the interviews conducted with the school coordinators provided a crucial administrative and pedagogical perspective on the pilot implementation of the curriculum. In all, the school coordinators reported a largely positive experience with the ESD curriculum pilot, underscoring its potential for broader integration. Across both schools, a general increase in student engagement with sustainability topics was observed. Despite initial unfamiliarity, most teachers adapted effectively after reviewing materials and receiving support. The initial shock and divide among teachers of the English-instruction school resonates with challenges identified in the needs assessment regarding inadequate teacher training and resistance to change. This aligns with local literature (Ghosn- Chelala and Akar, 2021; Shayya et al., 2020) stressing comprehensive teacher preparedness for ESD. 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 supports the curriculum's potential for broader implementation.

Ultimately, the significant improvements in students' understanding and competency development, based on the ESD curriculum pilot as evidenced by the quantitative and qualitative results, relates to earlier findings by Mekhael and Shayya (2018). The authors noted that 57% of students in their sample considered the curriculum as their main source of knowledge on sustainable development. Hence, a well-designed ESD curriculum can indeed provide a more effective and transformative source of such knowledge and skills.

4. Conclusion

This study makes a significant contribution to the field of ESD within the Lebanese context. Its primary contribution lies in the design, pilot, and evaluation of a competency-based problem-centered ESD curriculum that effectively fosters key sustainability competencies. Ultimately, this research offers a concrete and adaptable model for curriculum reform in Lebanon, demonstrating a viable path to integrating ESD into the national education system. It highlights the gaps in the existing EE curriculum and provides a tested alternative that aligns with international best practices and the 2030 Agenda. By addressing local needs while also maintaining global relevance, the curriculum is a blueprint for contextualized ESD implementation.

The findings of this research in fact carry significant implications for educational policy in Lebanon, particularly concerning the integration of ESD into the national curriculum. The demonstrated effectiveness of the pilot in fostering key sustainability competencies among Grade 10 students provides compelling evidence for a policy shift away from the outdated EE curriculum. Hence, policies should encourage interdisciplinary collaboration and a whole-institution approach to ESD. The study's success in fostering key sustainability competencies was also due to the curriculum's design that transcended traditional subject boundaries. Thus, policy frameworks should promote cross-curricular integration of ESD themes. School administrations should embed sustainability principles across all aspects of school life, from operations to community engagement (UNESCO, 2017). This would help overcome the fragmentation observed in the 1997 EE curriculum and create a more cohesive learning environment.

Building upon the findings of this study, several paths for future research emerge that could advance the understanding and implementation of ESD in Lebanon and similar contexts. A focus on the long-term impact of ESD is warranted. The study assessed initial competency development; yet longitudinal research could track students' sustainability behaviors, attitudes, and engagement in community action over extended periods. Such studies would provide insights into the enduring effects of ESD and its contribution to fostering lifelong learners and active citizens committed to sustainable development.

References

United Nations Educational, Scientific and Cultural Organization. (2017). *Education for Sustainable Development goals: Learning objectives*. UNESCO. https://unesdoc.unesco.org/ark:/48223/pf0000247444

Center for Educational Research and Development. (2022). *Lebanese National Framework for General Education Curricula before University*. CERD. https://www.crdp.org/project-details/33493

Mekhael, E., & Shayya, J. K. (2018). Measuring grade 10 students' knowledge, skills and attitudes of sustainable development. *International Journal of Learning & Teaching*, *10*(3), 269–291. https://doi.org/10.18844/ijlt.v10i3.1032

Shayya, J. K., Mekhael, E., & Ayoubi, Z. (2020). *Education for sustainable development: Multidisciplinary model for grade 10 in Lebanese schools—Design, implementation, evaluation*. Academia.edu.

Ghosn-Chelala, M., & Akar, B. (2021). Citizenship education for environmental sustainability in Lebanon: public school teachers' understandings and approaches. *Environmental Education Research*, *27*(3), 366-381. https://doi.org/10.1080/13504622.2021.1879024

Hsiu, H.-F., & Shannon, S. E. (2005). Three Approaches to Qualitative Content Analysis. *Qualitative Health Research, 15*(9), 1277-1288. https://doi.org/10.1177/1049732305276687

Center for Educational Research and Development. (1998). *Environmental Education Curricula and Goals*. CERD.

Hopkins, C. (2012). Reflections on 20+ Years of ESD. *Journal Of Education For Sustainable Development*, *6*(1), 21-35. https://doi.org/10.1177/097340821100600108

Danageuzian, H., Barakat, L. B., & El Hage, F. (2025). Designing an education for sustainable development (ESD) curriculum: insights from a semi-structured interview study in Lebanon. *Environmental Education Research*, 1–16. https://doi.org/10.1080/13504622.2025.2489783

Lin, H.-F., Lu, H.-L., & Lin, M.-J. (2024). The stability and acceptance of the "system of competency-based curriculum design" framework: Perspectives of teachers. *The Curriculum Journal*, *00*, 1–19. https://doi.org/10.1002/curj.265

Dolmans, D., & Schmidt, H. (1996). The advantages of problem-based curricula. *Postgraduate Medical Journal*, *72*(851), 535-538. https://doi.org/10.1136/pgmj.72.851.535

Center for Educational Research and Development. (2021). *Schools Guidebook for General Education*. CERD. https://www.crdp.org/download-guide

Creswell, J. W. (2014). *Research design: Qualitative, Quantitative, and Mixed Methods Approaches*. SAGE.

IBM Corp. (2020). *IBM SPSS Statistics for Windows (Version 27.0) [Computer software]*. IBM Corp.

Hmelo-Silver, C. E. (2004). Problem-Based learning: What and how do students learn? *Educational Psychology Review*, *16*(3), 235–266. https://doi.org/10.1023/b:edpr.0000034022.16470.f3

Krueger, R. A., & Casey, M. A. (2014). *Focus Groups: A Practical Guide for Applied Research* (5th ed.). SAGE Publications.

Morgan, D. L. (1997). *Focus Groups as Qualitative Research* (2nd ed.). SAGE Publications.

Creswell, J. W., & Poth, C. N. (2018). *Qualitative Inquiry and Research Design: Choosing Among Five Approaches* (4th ed.). SAGE Publications.

Levine, E. & Patrick, S. (2019). *What is competency-based education? An updated definition.* Vienna, VA: Aurora Institute. https://aurora-institute.org/wp-content/uploads/what-is-competency-based-education-an-updated-definition-web.pdf

Ornstein, A., & Hunkins, F. (2017). *Curriculum: Foundations, Principles, and Issues*. Pearson Education Limited.

Yilmaz, K. (2011). The Cognitive Perspective on Learning: Its Theoretical Underpinnings and Implications for Classroom Practices. *The Clearing House: A Journal Of Educational Strategies, Issues And Ideas*, *84*(5), 204-212. https://doi.org/10.1080/00098655.2011.568989

Bada, & Olusegun, S. O. (2015). Constructivism Learning Theory: A Paradigm for Teaching and Learning. *IOSR Journal of Research & Method in Education (IOSR-JRME)*, *5*(6), 66–70. https://doi.org/10.9790/7388-05616670