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BOOK OF PAPERS

S6. Sustainability Education and Training

CONTENTS

UNDERSTANDING STUDENT PERSPECTIVES AND TRAINING NEEDS FOR SUSTAINABLE URBAN MOBILITY: INSIGHTS FROM THE UNIVERSITY OF WEST ATTICA

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ABSTRACT

The specific research work was carried out within the framework of the European project NextGen Urban Mobility Academy (NUMA). The NUMA project aims to enhance urban mobility education and innovation in Athens and Istanbul through the delivery of specialized training modules, stakeholder engagement events, and initiatives promoting gender inclusivity. The project aligns with the strategic goals of EIT Urban Mobility (https://www.eiturbanmobility.eu/) by focusing on education, innovation, and sustainable urban mobility. This study aims to investigate the perceptions, challenges, and training needs of university students regarding urban mobility, with the ultimate goal of informing the design of targeted educational programs. Urban mobility systems in Greek metropolitan areas face chronic inefficiencies—traffic congestion, limited accessibility, and unreliable public transport. Despite being key stakeholders, students are often excluded from formal urban mobility planning and training, resulting in a knowledge gap that hinders informed participation and future professional engagement in the field. A structured questionnaire was administered to 141 students at the University of West Attica (UNIWA), Greece, across various disciplines. The survey gathered both quantitative and qualitative data on mobility habits, perceived challenges, topic familiarity, and preferred learning formats. Descriptive statistics were used for closed-ended responses, while thematic analysis was applied to open-ended feedback. The majority of students (73%) reported limited knowledge of urban mobility issues, yet identified major challenges such as congestion (96%), poor accessibility (89%), and degraded infrastructure (84%). Despite dissatisfaction with existing systems, over 90% expressed strong interest in structured training. Students prioritized topics such as traffic safety, environmental impact, and pedestrian infrastructure. Preferred formats included online self-paced modules, blended learning, and simulation-based training. This study uniquely captures the intersection of youth mobility experience and educational demand in an urban European context. It reveals both a gap and an opportunity: students are motivated to engage in mobility planning if given access to targeted, flexible, and practice-oriented learning. The findings directly support the development of student-centered curricula and pilot interventions in sustainable urban mobility.

Keywords: Sustainable Urban Mobility, Student Perceptions, Training Needs Assessment

1. INTRODUCTION

Urban mobility is undergoing a profound transformation driven by rapid urbanization, climate imperatives, and evolving societal demands. Over the last decade, scholarly research has emphasised the importance of sustainable mobility, smart and data-driven planning, and gender-inclusive transport systems to build resilient and equitable cities [1–3]. Bibliometric analysis of about 2,000 scientific articles published between 2018 and 2023 highlights sustainability, walkability, public health, and technological tools such as SUMO and GIS as emergent thematic clusters in urban mobility research [1]. This convergence of environmental, social, and computational perspectives aligns strongly with the holistic aims of the NextGen Urban Mobility Academy (NUMA), focusing on education, innovation, and civic engagement.

A growing body of literature underscores the unequal gender dimensions of urban mobility. Empirical studies in diverse metropolitan contexts—including South American cities and India—reveal that women frequently undertake complex trip chaining related to caregiving, shopping, and domestic responsibilities, while also facing safety concerns and limited autonomy [4–6]. In Santiago, Chile, for example, mobility trace data demonstrates that women not only move less frequently than men but also explore fewer unique destinations—especially among lower-income groups—resulting in reduced access to urban opportunities [4]. Similarly, in India, gender-stratified mobility models show stark disparities: over 50 % of women remain home-bound on typical weekdays, far exceeding the mobility limitations observed among men [5].

Additionally, the planning profession is increasingly advocating gender mainstreaming and feminist policy reform as levers for inclusive mobility. Comparative analyses of urban transport policies across European cities reveal that strong coordination between women-focused agencies and transport planners can institutionalise gender-responsive strategies within Sustainable Urban Mobility Plans (SUMPs) [6]. These strategies include safety-oriented design, altered scheduling to suit non-standard mobility patterns, and targeted capacity building for municipal actors [6]. The EIT Urban Mobility initiative also highlights the transformative effects of integrating gender considerations into transport interventions across different contexts [7].

Parallel to these gendered perspectives, methodological innovations are reshaping urban mobility studies. Reviews of sustainability assessments and policy evaluations emphasise the increasing use of big data—from mobile phone records to travel surveys—to inform evidence-based planning [2,3]. Innovations in modelling tools (e.g. AHP, GIS, simulation with SUMO/ns-3) have enhanced decision-making in multimodal systems, enabling cities to align theoretical planning with lived realities [1,2]. This methodological turn supports active learning environments, where participants engage with real data and situational exercises akin to NUMA's "hands-on" approach within modular education and stakeholder events.

Therefore, the NUMA initiative is situated at the intersection of three critical trends: (i) the shift towards sustainable and smart urban mobility, (ii) the need for gender-sensitive and equitable transport strategies, and (iii) the value of interactive, data-informed education and stakeholder involvement. By targeting municipal employees, university students, and city residents—while placing particular emphasis on women's participation and climate adaptation—the NUMA initiative has the potential to implement leading practices in urban mobility education and innovation. Its integrative approach supports the development of inclusive, sustainable, and future-ready mobility systems through a combination of stakeholder engagement, hands-on learning, and interdisciplinary training. By organising targeted modules, stakeholder workshops, and inclusive online outreach, NUMA strives to cultivate capacity for long-term innovation and sustainability in Athens and Istanbul's urban mobility ecosystems.

In this context, the present study was conducted as part of the European project NextGen Urban Mobility Academy (NUMA), which operationalizes the aforementioned educational and societal goals through a structured framework of training modules, stakeholder engagement, and gender-inclusive actions in the cities of Athens and Istanbul. Aligned with the strategic vision of the EIT Urban Mobility initiative [7], NUMA focuses on empowering diverse urban actors via education, innovation, and sustainability-driven interventions. Specifically, this research investigates the perceptions, challenges, and training needs of university students regarding urban mobility, with the aim of informing the development of tailored educational content. Urban mobility systems in Greek metropolitan areas—Athens in particular—continue to suffer from chronic inefficiencies, including traffic congestion,

unreliable public transport, and suboptimal accessibility. Although students are key future stakeholders, they are often absent from institutional mobility planning, resulting in knowledge gaps and missed opportunities for civic and professional participation.

2. METHODOLOGY

The participants of this study were primarily university students, complemented by a small number of municipal employees and other professionals. In total, 161 respondents completed the survey: 141 UNIWA students, 7 municipal employees, and 13 others. The majority of students were aged 18–24 years (n=103), with smaller groups aged 25–34 (n=23) and above. Gender distribution was balanced (85 male, 75 female, 1 undisclosed). Academic representation was dominated by Engineering (n=96), with additional contributions from Administrative, Economics and Social Sciences (n=26), Applied Arts and Culture (n=13), Health and Care Sciences (n=13), Public Health (n=6), and Food Sciences (n=3). This broad academic coverage is significant, since mobility challenges require technical, social, and cultural perspectives [8].

The main research tool was a structured questionnaire developed under the NUMA project, designed in English and translated into Greek. The survey followed the structure of earlier needs assessments in mobility education [9] and consisted of nine sections: (i) General Information, (ii) Urban Mobility Knowledge & Skills, (iii) Current Mobility Habits, (iv) Challenges and Pain Points, (v) Future Mobility Preferences, (vi) Preferred Training Format, (vii) Digital and Technological Readiness, (viii) Personal and Organizational Goals, and (ix) Additional Comments. It combined closed- and open-ended questions, allowing for both quantitative description and qualitative insights [10].

The survey was disseminated at UNIWA in early 2025 through academic channels such as faculty announcements, classroom invitations, and digital platforms. Hosted online, it required 15–20 minutes to complete. Participation was voluntary, and students were informed about the study's academic purpose. Following the questionnaire, students joined in-person academic sessions at UNIWA's Ancient Olive Grove Campus. These sessions introduced core concepts and promoted dialogue on topics such as Sustainable Urban Mobility, SUMPs, Low Emission Zones (LEZs), Electromobility, Sustainable Urban Logistics, Mobility-as-a-Service (MaaS), Innovation in Mobility, and Gender Perspectives in Transport. Such participatory activities ensured that students were not only survey respondents but also active contributors to the academic context of the study, an approach shown to strengthen engagement in sustainability education [11].

Data analysis followed a mixed-methods approach. Quantitative analysis of closed-ended questions relied on descriptive statistics (frequencies, means, cross-tabulations), identifying dominant patterns such as the overwhelming recognition of traffic congestion (reported by 135 students) and a strong preference for blended learning. Qualitative analysis applied thematic coding to open responses, which revealed recurring categories such as public transport dissatisfaction, lack of accessibility, environmental concerns, and desire for innovation. These insights captured students lived experiences, including overcrowded buses, unsafe cycling, and difficulties for people with disabilities. Triangulation was achieved by comparing survey findings with themes emerging from the in-person sessions, which reinforced the reliability and validity of results.

Finally, the research followed established ethical principles [12]. Participation was voluntary, anonymity was guaranteed, and no personal data were collected. Results were aggregated and used exclusively for academic and project purposes within NUMA and UNIWA.

3. RESULTS

As part of the needs analysis for the NextGen Urban Mobility Academy (NUMA), a comprehensive survey was conducted among students affiliated with the University of West Attica (UNIWA) in Greece. The objective of this survey was to assess participants' knowledge, skills, challenges, and expectations regarding urban mobility, while identifying key mobility issues faced in their daily lives. The collected insights provide valuable input for shaping targeted training programs to address urban mobility challenges in the region, ultimately contributing to more sustainable, accessible, and efficient transportation systems. In total, the questionnaire consisted of thirty (30) questions. As is easily understood, this section presents the main findings from all the responses.

Table 1 presents the academic discipline which enrolled in each one of the UNIWA students. It is evident that the majority share of participants—61.1%—comprised students from the School of Engineering. This predominance was expected, considering that the survey was both designed and implemented by the Department of Mechanical Engineering of the School of Engineering at UNIWA. Nevertheless, the participation of students from other Schools with distinctly different academic orientations was also significant (e.g., Applied Arts & Culture: 8.3%, Health and Care Sciences: 8.3%, etc.), highlighting the interdisciplinary interest in the topics addressed.

Table 1. Number of participants per academic discipline

Academic Discipline	Rate (%) of Participants
Engineering	61.1
Applied Arts & Culture	8.3
Health and Care Sciences	8.3
Public Health	3.8
Food Sciences	1.9
Administrative, Economics and Social Sciences	16.6

Figure 1 presents the distribution of responses to the key question regarding participants' prior experience with topics related to urban mobility. According to Figure 1, the overwhelming majority of students reported having no prior experience or only minimal knowledge related to urban mobility topics. Approximately one in two students indicated having some partial knowledge and experience, albeit without having participated in any practical application. Finally, only a very small proportion of students (3.1%) stated that they possess substantial knowledge and experience in matters related to urban mobility. Given the limited prior exposure of the majority of students to urban mobility topics, as highlighted by the survey results, the significance of the NUMA project becomes particularly evident. By providing structured educational interventions, experiential learning opportunities, and interdisciplinary engagement, NUMA addresses a critical knowledge gap among university students. It fosters awareness, competence, and active involvement in sustainable urban mobility planning and practice—areas that are increasingly vital in the context of global urbanization and climate resilience. As such, NUMA plays a pivotal role in equipping the next generation of professionals with the necessary tools and understanding to contribute meaningfully to the transformation of urban mobility systems.

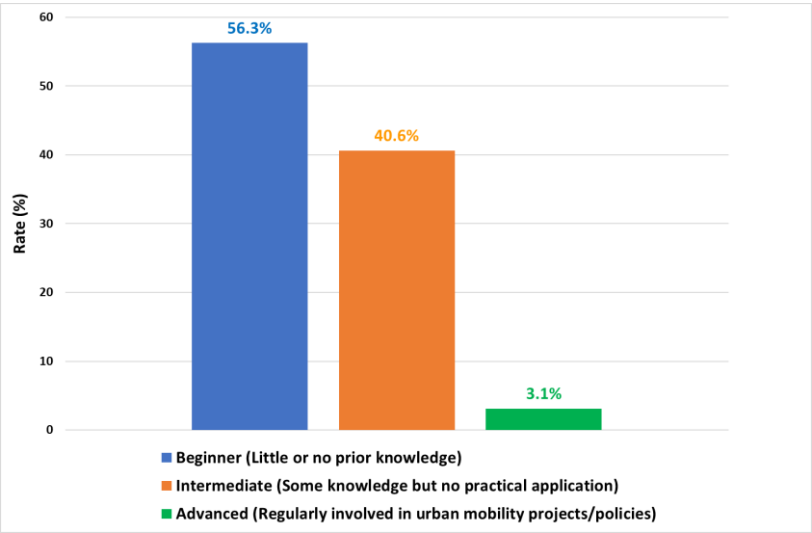

Figure 1: Rate of level of experience in urban mobility topics among participants

Figure 2 illustrates the distribution of student responses regarding the most pressing urban mobility challenges in the greater Athens area (GAA). The results reveal a multifaceted urban mobility landscape, characterized by several interlinked inefficiencies. Traffic congestion emerges as the most critical issue (20.4%), reflecting the chronic overreliance on private vehicles and insufficient regulation of peak-hour flows in the metropolitan area. Closely following, accessibility for people with disabilities

(19.2%) highlights significant gaps in inclusive infrastructure and barrier-free urban design, underlining the social dimension of mobility challenges. Lack of pedestrian and cycling infrastructure (17.8%) and air pollution (17.2%) further reinforce the environmental and health-related consequences of car-centric planning, indicating the urgent need to promote active modes of transport and low-emission alternatives. Inadequate public transportation (15.6%) reflects persistent dissatisfaction with the reliability, frequency, and coverage of mass transit systems—factors that directly influence mode choice and urban equity. Finally, lack of data-driven decision making (9.8%) was identified as a noteworthy, albeit less prioritized, concern. This finding points to a critical innovation gap in mobility governance, where evidence-based planning and digital tools remain underutilized, potentially undermining the effectiveness of strategic interventions. Collectively, the responses underscore the complexity of urban mobility in Athens, revealing an interplay of infrastructure limitations, environmental pressures, and governance deficits. These insights support the argument that future training and policy frameworks must adopt a holistic and interdisciplinary approach, integrating accessibility, sustainability, and technological innovation to reshape the city's mobility ecosystem.

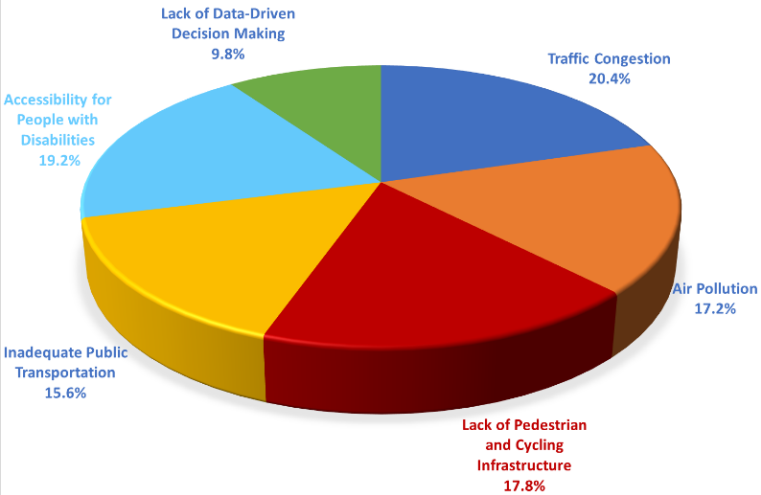

Figure 2: Rate (%) of students answers for the most pressing urban mobility challenges

Figure 3 presents the distribution of responses concerning the primary modes of urban transportation used by university students in Athens. The results underscore the dominance of conventional and individualised forms of mobility, with limited uptake of active and emerging transport options. Private car use ranks highest (30.7%), indicating a strong dependency on individual motorized transport despite its environmental and spatial inefficiencies. This finding is particularly notable in the context of student populations, who are generally expected to favour more economical and sustainable alternatives. The metro system follows closely (27.7%), reflecting its relative reliability, coverage, and convenience compared to other public transit options. Bus, trolleybus, and tram services account for 23.5% of responses, affirming their continued relevance in daily commuting. However, their share—lower than that of the metro—may suggest concerns regarding punctuality, crowding, or route limitations. Notably, walking represents only 8.4% of reported trips, and cycling or e-bike use is almost negligible (0.6%), revealing significant untapped potential for active mobility in a city with a favorable climate but lacking supportive infrastructure. Modes such as motorcycles/scooters (6.6%), suburban railway (0.6%), and general public transport (0.6%) remain marginal, while e-scooter rentals and taxi/ride-hailing services report no usage among the surveyed sample. These findings suggest that shared and micro-mobility services have yet to gain traction among younger demographics in Athens, possibly due to regulatory, infrastructural, or affordability barriers.

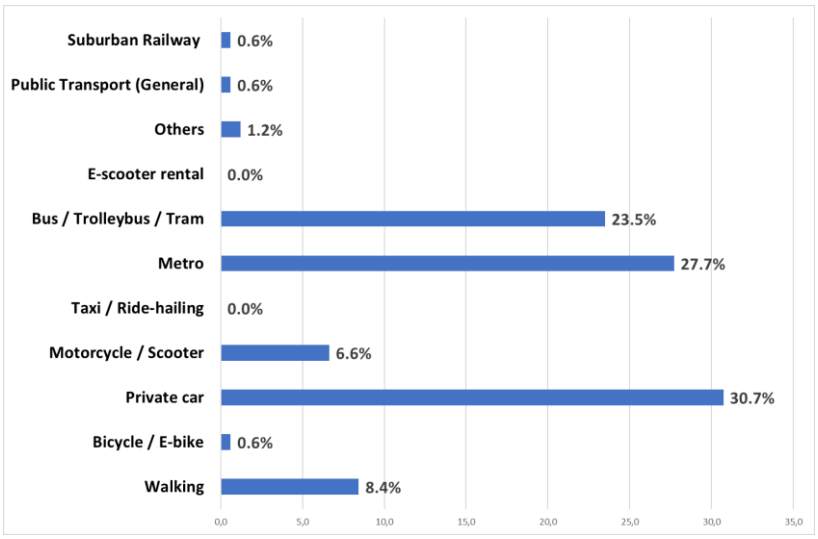

Figure 3: Primary modes of student transportation (%)

Overall, the data reflect a dual reliance on private vehicles and high-capacity public transport modes, with limited integration of soft or shared mobility options. These trends point to critical areas for policy and educational intervention, particularly in promoting modal shift toward sustainable and inclusive urban transport systems.

Figure 4 depicts the distribution of perceived barriers to effective and inclusive urban mobility in Athens, as reported by university students. The data reveal a complex network of interrelated challenges affecting the quality, accessibility, and reliability of the mobility system. Traffic congestion (14.7%) is identified as the most significant barrier, echoing previous findings and reflecting students' frustration with time delays, unpredictability, and reduced urban productivity. Closely following, overcrowding in public transport (13.2%) and unreliable public transport schedules (12.2%) highlight systemic weaknesses in mass transit operation—issues that reduce user confidence and push individuals toward less sustainable private transport options. Infrastructure-related issues are also prominent. Poor road infrastructure and pavement condition (11.2%), along with insufficient bike lanes and pedestrian infrastructure (10.3%), illustrate critical deficiencies in the physical environment, which affect both safety and inclusivity. Air and environmental pollution (10.3%) are another major concern, aligning with broader climate and health imperatives in urban sustainability agendas. Interestingly, lack of parking (10.0%) remains a notable issue despite the dominance of private vehicle use, suggesting a spatial mismatch between car ownership and urban design. Safety concerns (9.0%)—including accidents, crime, and harassment—underscore the importance of secure environments for all users, particularly vulnerable groups. Limited accessibility for disabled individuals (6.8%) indicates persistent inequality in physical access, while high transportation costs (2.2%) appear to be of relatively lower concern, possibly due to subsidized student fares or prioritization of other barriers.

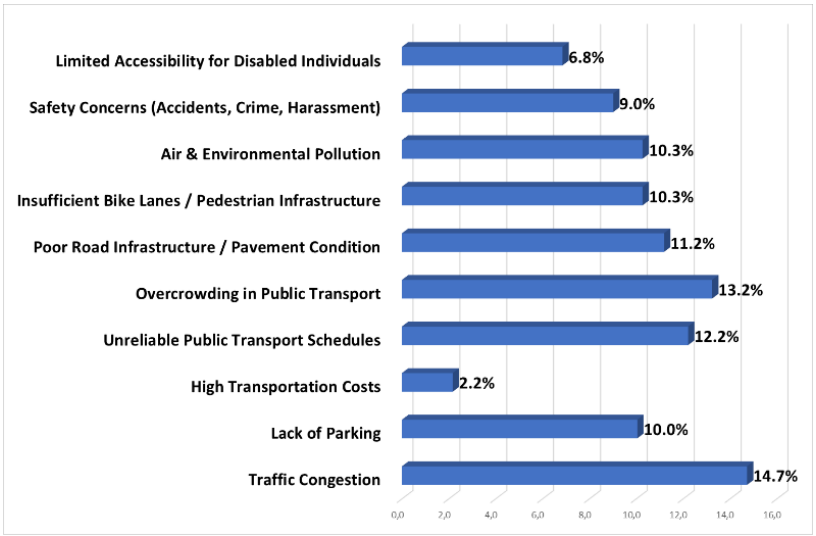

Figure 4: Rate (%) of answers concerning the biggest challenges students face when commuting in

the (GAA)

Overall, the findings portray urban mobility as a multidimensional issue in the Athens context, where operational inefficiencies, infrastructural gaps, and social inequalities intersect. These insights offer a strong empirical foundation for developing student-centered educational modules and policy interventions that address not only efficiency and environmental goals, but also safety, equity, and user experience.

Figure 5 presents students' preferences regarding priority improvements in urban public transportation services in Athens. The responses reflect a strong demand for enhancements in service frequency, infrastructure, and operational reliability—elements that directly influence the attractiveness and effectiveness of public transport. The most frequently cited improvement (20%) is the increase in service frequency, underscoring the centrality of wait times and availability in shaping user satisfaction. Real-time tracking and accurate schedules follow closely (18%), highlighting the importance of reliability and digital transparency in improving user experience—particularly among digitally literate younger populations. Similarly, expansion of metro lines and bus routes (17%) ranks high, revealing dissatisfaction with the current geographic coverage of the network and a desire for more accessible, multimodal connectivity. Better cleanliness and maintenance (15%) and better integration between metro, bus, tram, and other modes (14%) also appear as critical priorities, pointing to qualitative aspects of service and the need for a more unified mobility system. Interestingly, accessibility improvements for people with disabilities (10%) were selected at a moderate rate, reaffirming earlier findings on equity gaps in urban infrastructure. Lastly, only 6% of respondents prioritized lower fares or discounts, suggesting that for this particular student population, service quality and reliability outweigh cost concerns.

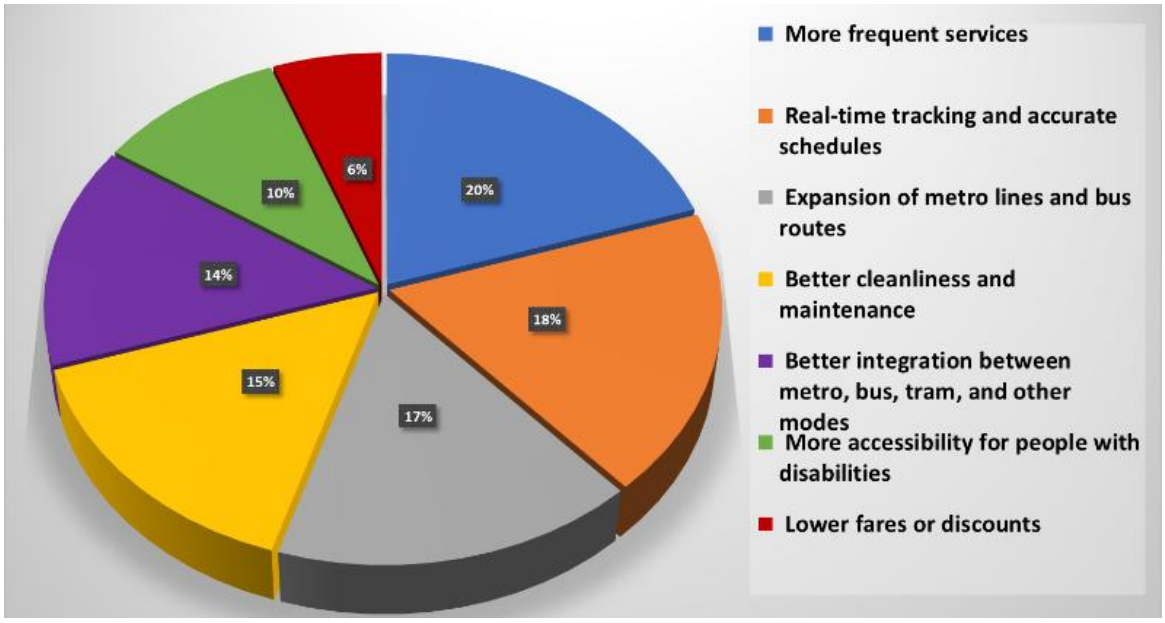

Figure 5: Rate (%) of answers concerning the improvements would encourage students in order to use public transport more often

These results confirm that students prioritize practical and operational improvements that make public transport more efficient, predictable, and accessible. Such insights provide a valuable basis for designing targeted interventions and education programs within initiatives like NUMA, aiming to align user expectations with sustainable mobility objectives.

4. CONCLUTIONS

The specific study provides critical insights into the perceptions, challenges, and educational needs of university students regarding sustainable urban mobility within the greater Athens area. The findings reveal a substantial knowledge gap among students, yet also a high level of interest in structured, practice-oriented training. The dominant reliance on private vehicles, combined with dissatisfaction toward existing public transport services and infrastructure, underscores the urgency for targeted

interventions. Students identified key urban mobility challenges—including congestion, limited accessibility, poor infrastructure, and inadequate public transport—and expressed strong preferences for solutions such as increased service frequency, real-time information systems, and expanded multimodal connectivity. Furthermore, their limited awareness of innovative mobility concepts such as MaaS, LEZs, and gender-inclusive planning highlights the need for interdisciplinary, student-centered curricula that foster both awareness and engagement. The NUMA project, by integrating education, stakeholder participation, and inclusive urban strategies, emerges as a timely and strategic response to these challenges. Its focus on flexible learning formats and participatory methods is well-aligned with the expectations of the student population and the broader objectives of sustainable mobility transformation in metropolitan regions. Overall, the study contributes empirical evidence that can inform policy design, curriculum development, and future research at the intersection of education, urban planning, and mobility innovation.

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FROM EDUCATION TO EMPLOYMENT: A BLUEPRINT FOR ADVANCING WOMEN IN STEM THROUGH SUSTAINABLE ENERGY SYSTEMS INITIATIVES

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ABSTRACT

This paper investigates the persistent underrepresentation of women in Greece's Science, Technology, Engineering, and Mathematics (STEM) sectors, a critical issue encapsulated by the "Greek Paradox." This paradox highlights a stark contradiction wherein Greece boasts one of the EU's highest shares of female STEM graduates, yet their presence in the corresponding labor market remains alarmingly low. Analyzing primary data from the "SHE CREATES" Summer Academies—an initiative within the Erasmus+ SECOVE project designed to foster female talent with a specific focus on sustainable energy systems—the study empirically confirms a strong positive correlation between participants' self-assessed confidence, their prior engagement in hands-on STEM activities, and the influential presence of parental role models with their stated interest in pursuing STEM careers. However, the findings also uncover a significant and concerning "optimism gap." While the young women surveyed overwhelmingly believe in the existence of equal opportunities, this hopeful perception starkly contrasts with the well-documented systemic barriers, persistent gender pay gaps, and significant leadership disparities that characterize the reality of the Greek STEM workforce, potentially leaving them unprepared for the professional challenges ahead.

To address this complex, multi-faceted challenge, this paper proposes a comprehensive, multi-stakeholder framework of actionable recommendations, recognizing that isolated efforts are insufficient to alter entrenched patterns. For targeted interventions like "SHE CREATES," it advocates for reinforcing experiential learning while strategically introducing resilience training and workplace navigation skills to bridge the aforementioned optimism gap, alongside broader outreach to engage a more socioeconomically diverse cohort. For educational institutions, it calls for the systemic embedding of gender-sensitive pedagogy and the implementation of transparent, merit-based policies to actively dismantle the academic "glass ceiling." For national and regional policymakers, the focus is on creating targeted initiatives that effectively bridge the education-to-employment gap, such as incentivizing companies that achieve measurable progress in gender diversity. Finally, for industry partners, the recommendations center on adopting fair and unbiased talent management practices and cultivating genuinely inclusive workplace cultures that support work-life integration. By moving beyond piecemeal interventions towards a holistic, systemic approach, Greece can dismantle the structural barriers preventing women from thriving in STEM, thereby unlocking the immense and currently underutilized economic and innovative potential crucial for its future.

Keywords: Women in STEM; Gender Equality; Labour Market; Optimism Gap; Greece; Role Models

EXPLORING MOODLE-BASED LEARNING IN SECOVE: A DUAL FOCUS ON ENTREPRENEURIAL AND SUSTAINABLE SMART BUILDING TECHNOLOGIES COURSES

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ABSTRACT

This study investigates the pedagogical design, technological infrastructure, and learning outcomes of Moodle-based courses developed under the SECOVE project. This European Union-funded initiative promotes vocational excellence in sustainable energy education. Focusing on two core learning tracks—"Entrepreneurial Competencies" and "Sustainable & Smart Building Technologies"— the research highlights how Moodle is leveraged as a learning management system to support blended, interactive, and skills-based training in the green transition. Methodologically, the platform's structure was analyzed through credentialed access, mapping course categories, dashboard design, and navigation pathways. The entrepreneurial module set (six courses) includes topics such as business modeling, digital marketing, and sustainable innovation. In comparison, the technical track (five courses) covers areas like energy efficiency, IoT integration, and smart materials in construction. Each course utilizes a range of resources, including video lectures, case studies, simulations, quizzes, and project-based assessments. The integration of interactive Matterport Augmented Reality virtual tours offers students immersive exposure to real-world sustainable building environments. A key finding is that the Moodle platform effectively supports pedagogical flexibility, cross-border collaboration, and learner engagement through tools such as forums, peer review assignments, and modular content. Moreover, the platform meets usability and security standards through SSL encryption and mobile accessibility. Sustainability is embedded not only in course content but also in the platform's design ethos, reinforcing EU Green Deal objectives. This research contributes a practice-based evaluation of how Vocational Education Training institutions can blend entrepreneurship education with technical environmental literacy using digital platforms. It also proposes enhancements in user experience, course interactivity, and cross-track integration, offering a replicable model for vocational training in the green-tech sector.

Keywords: Moodle-Based Learning, Entrepreneurial and Sustainable, Smart Technologies Courses

1. INTRODUCTION

The global challenge of the climate crisis and the need for a green transition have made the development of new skills in education and training a central issue **[1]**. The European Union, through a conceptual framework based on the theory of planned behavior **[2]**, and special strategies such as the European Green Deal and the Skills Agenda **[3]**, emphasizes the need to strengthen vocational education and training (VET) **[4]** to prepare citizens and workers for the demands of a sustainable and digital economy **[5]**. In this context, digital learning platforms emerge as key tools for providing flexible, innovative, and scalable training solutions **[6]**. The Moodle platform, as a Learning Management System (LMS), is an internationally recognized example of open-source software that supports the creation, organization, and delivery of distance and blended learning courses, especially for VET **[7]**. Its structure, integrating micro-learning content **[8]**, allows for the integration of multimedia, the use of collaborative tools, and the application of various assessment methods, contributing to the transition from a teacher-centered to a learner-centered approach **[9]**, and “built” digital competency of educators in the virtual learning environment **[10]**.

In this paper, we focus on the SECOVE (Sustainable Energy Centers of Vocational Excellence) project, a European initiative that promotes excellence in vocational education for sustainable energy. As part of the project, courses were developed with a dual focus: on the one hand, to cultivate entrepreneurial skills (Entrepreneurial Competencies), and on the other hand, to train in sustainable and smart building technologies (Sustainable & Smart Building Technologies). These two axes reflect the combination of theoretical and technical knowledge with innovation and entrepreneurial skills, which are crucial for the future labor market. This introduction aims to set the general context: to define the basic concepts, to present the importance of VET in the green and digital transition, to highlight the role of technology as an educational tool, and to rethink cognitive principles of VET in Greece and in Europe, at the beginning of the 21st Century **[11]**. In this way, the article links the theoretical discussion to a practical case study, proposing a training model that can be replicated in other European contexts. From a general perspective, this proposal fits into the context of the green transition and the climate crisis, highlighting the persistent skills gap in vocational education and the limited pedagogical infrastructure for addressing sustainability challenges. The study focuses on analyzing the design and implementation of innovative courses developed within the Moodle platform of the SECOVE project **[12]**, with an emphasis on two thematic pathways: "Business Skills" and "Sustainable & Smart Building Technologies". The aim is to critically evaluate how digital platforms can be leveraged to deliver scalable and replicable models of excellence in VET, in line with the European Green Deal and the Skills Agenda.

The methodology combines curriculum evaluation, comparative assessment with European and international frameworks, and in-depth case studies. Conceptual modeling is applied using the ICONIX method to map the structure of courses, resources, and their interactive functions. The pedagogical framework is enriched with digital innovations, including AR Matterport virtual tours, simulations, questionnaires, peer review assignments, and project-based assessments, which reinforce student-centered and skill-centered education. The results show that the balanced integration of business education and technical sustainability skills not only addresses skill gaps in emerging green sectors but also strengthens cross-border cooperation, strengthens local educational communities, and creates a benchmark for VET institutions across Europe. The study highlights the interdependence of education, digital innovation, and sustainability as key pillars of a just energy transition. Ultimately, the article is grounded in interdisciplinary principles, integrating pedagogy, educational technology, environmental studies, and labor market policies. This multidimensional perspective ensures that vocational education is not narrowly understood as technical training, but as a holistic and socially meaningful response to the socio-economic and ecological challenges of our time. The research questions concern:

(a) How were Moodle courses designed to meet social and employment needs?

(b) How were pedagogical and technological innovations integrated?

(c) How can this model be used by VET institutions, island communities, and European networks?

(c) How can it serve as a model for islands and European communities?

The first section (1) "Introduction," presents the context of the green transition and digital education, in conjunction with the lack of appropriate skills in VET, and the importance of the transition to

sustainable energy standards for Europe. Emphasis is placed on the dual focus of the courses "Business Skills" and "Sustainable & Smart Building Technologies." The second section (2) "Methodology" analyzes the educational program (mixed approach – curriculum evaluation, case study, comparative assessment with international standards), using conceptual modeling (ICONIX) to map the structure and functionality of the Moodle platform **[13]**. In the third section (3) "Results," the innovative versions of the program, applied in pedagogical practices in combination with skills mapping, are presented, along with their impact on both the labor market and VET educational communities. The article concludes with the fourth section (4) "Conclusions," which summarizes the contribution of the study and its theoretical and practical value, without overlooking its limitations. Equally important are the recommendations for future research and the prospect of applying the model in other European VET contexts with similar needs in the green transition.

2. METHODOLOGY

The ICONIX technique was used to provide a comprehensive conceptual clarification of the methodology. This approach strikes a balance between clarity and flexibility in design, enabling the visualization of key concepts, roles, and interactions within the educational ecosystem **[14]**. This facilitates the connection of pedagogical goals with the technological requirements of the Moodle platform, a critical element for hybrid adaptive educational eLearning projects **[15]** and VET programs in the context of the green transition. The ICONIX methodology is not limited to abstract theoretical representation. Still, it enables systematic development and the avoidance of ambiguities, resulting in practical adaptations that meet the needs of teachers and trainees. Its use in this context offers the opportunity to highlight both pedagogical functions (e.g., collaborative learning, project-based assessment, peer review) and technological solutions (AR tours, simulations, quizzes) through a common modeling scheme. ICONIX was chosen because it provides a methodological tool that bridges theoretical aspirations and practical applications, enhancing the validity and transparency of the analysis, while making the model applicable and reproducible in different VET environments **[16]**.

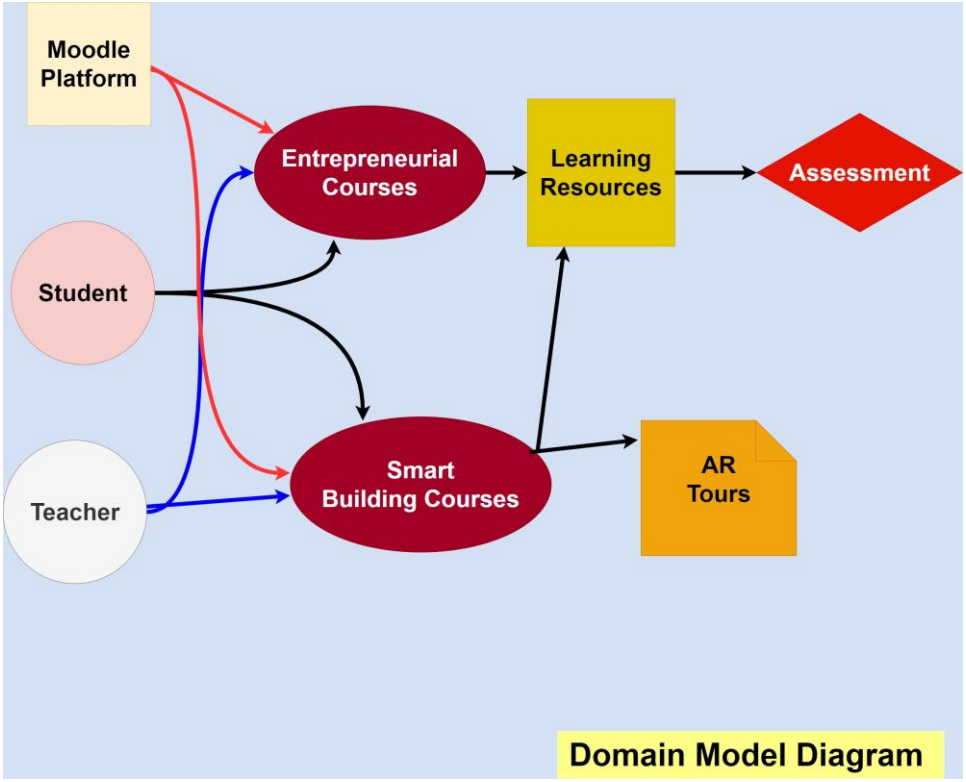

Figure 1: Domain Model Diagram

Figure 1 and Figure 2 present two characteristic types of diagrams: the Domain Model and the Use Case Diagram. Both belong to the ICONIX methodological framework and complement each other, as they provide different but interrelated views of the same educational ecosystem. The Domain Model focuses on the basic entities (courses, students, teachers, and learning resources). At the same time,

the Use Case Diagram depicts the functions and action relationships (e.g., accessing courses, participating in forums, and evaluating projects).
The Domain Model diagram (Figure 1) illustrates the fundamental entities and their relationships within the Moodle platform, as utilized in the SECOVE project for the courses "Business Skills" and "Sustainable & Smart Building Technologies". At the center is the Moodle Platform, which serves as the main learning infrastructure, hosting the two course modules. On the one hand, there are the “Entrepreneurial Courses”, which focus on skills such as business models, digital strategy, and innovation. On the other hand, the “Smart Building Courses” cover technological fields such as energy efficiency, IoT integration, and "smart" materials. Both modules are linked to “Learning Resources”, i.e., educational materials (videos, case studies, simulations). These resources lead to “Assessment”, which represents the evaluation processes (quizzes, assignments, projects). “Students” have access to both business and technical courses, utilizing the available resources and participating in the learning and evaluation processes. “Teachers” are also connected to both categories of courses, taking on the role of content design, guidance, and student assessment. An additional dimension that emerges is “AR Tours”, which are linked to “Smart Building Courses”, providing virtual tours of real sustainable building environments. This shows how technological innovation is integrated into VET, enriching the learning experience. Overall, the diagram illustrates the organizational logic of the ecosystem, where roles (students, teachers), thematic areas, resources, and assessments are interconnected in a coherent structure that combines pedagogical and technological dimensions.

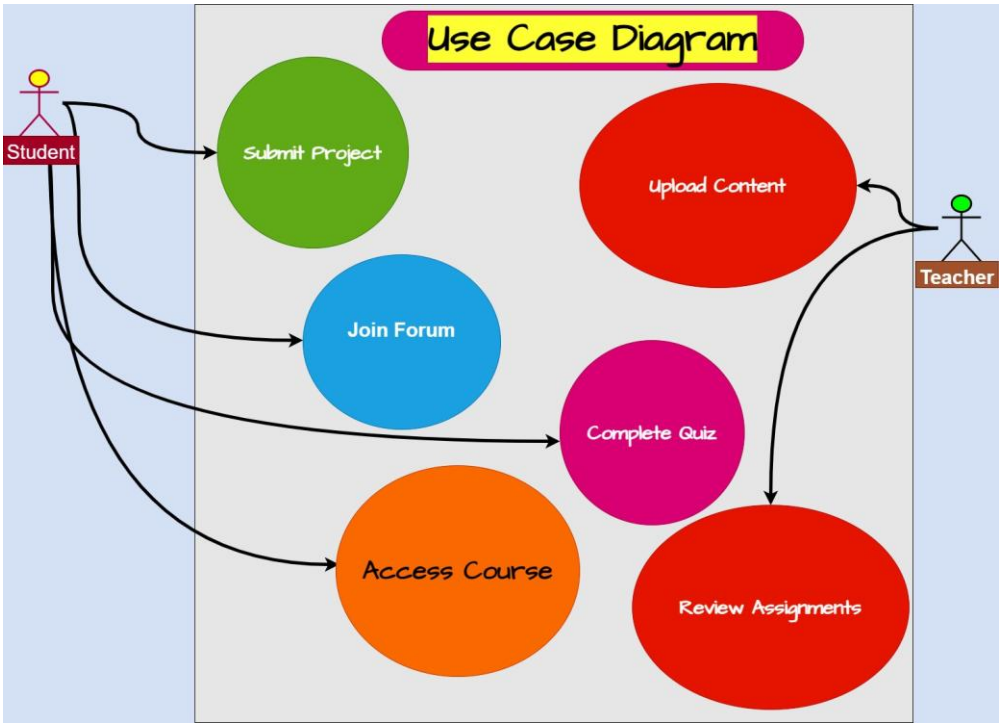

Figure 2: Use Case Diagram

The Use Case Diagram (Figure 2) presents the basic roles (actors) and main functions (use cases) supported within the Moodle platform, as utilized in the SECOVE project. The diagram aims to present in a simple and understandable way the actions that can be performed by users of the platform and to highlight how these roles interact with the various pedagogical and technological capabilities of the system. The diagram distinguishes between two basic roles: Student (Trainee) and Teacher (Instructor/Trainer). The first represents the learners who participate in the courses "Business Skills" and "Sustainable & Smart Building Technologies." The second describes the teaching staff responsible for designing, delivering, and evaluating the educational content. The role of the student is linked to four main functions:

- Access Course – Basic access and navigation of courses through the Moodle platform. Here, students gain access to educational materials, instructions, and activities.
- Complete Quiz – Students are assessed through quizzes designed to test their understanding of theoretical knowledge and basic skills.
- Join Forum – Reflects the collaborative and interactive dimension of Moodle, allowing students to exchange ideas, collaborate, and cultivate critical dialogue skills.

- Submit Project – This is project-based learning, where students submit projects or case studies that demonstrate their understanding and application of knowledge to real-world problems.

On the other hand, the role of the Teacher includes two basic functions:

- Upload Content – The instructor creates and provides learning content, which may include videos, notes, simulations, interactive tools, or virtual tours.
- Review Assignments – The instructor evaluates submitted assignments, provides feedback, and guides students in further developing their skills.

The Use Case diagram clearly shows that Moodle functions as an ecosystem that supports both the active participation of students and the guidance and assessment role of educators. The interactions depicted are critical elements of a pedagogical approach that combines learning through teaching, assessment, collaboration, and creation. The importance of the Use Case Diagram lies in its ability to provide a clear picture of the expectations and processes involved, making pedagogical design and technological implementation easier. It allows stakeholders to understand tangibly how the Moodle platform translates theoretical goals—such as developing business skills or understanding "smart" technologies—into specific learning activities and assessments.

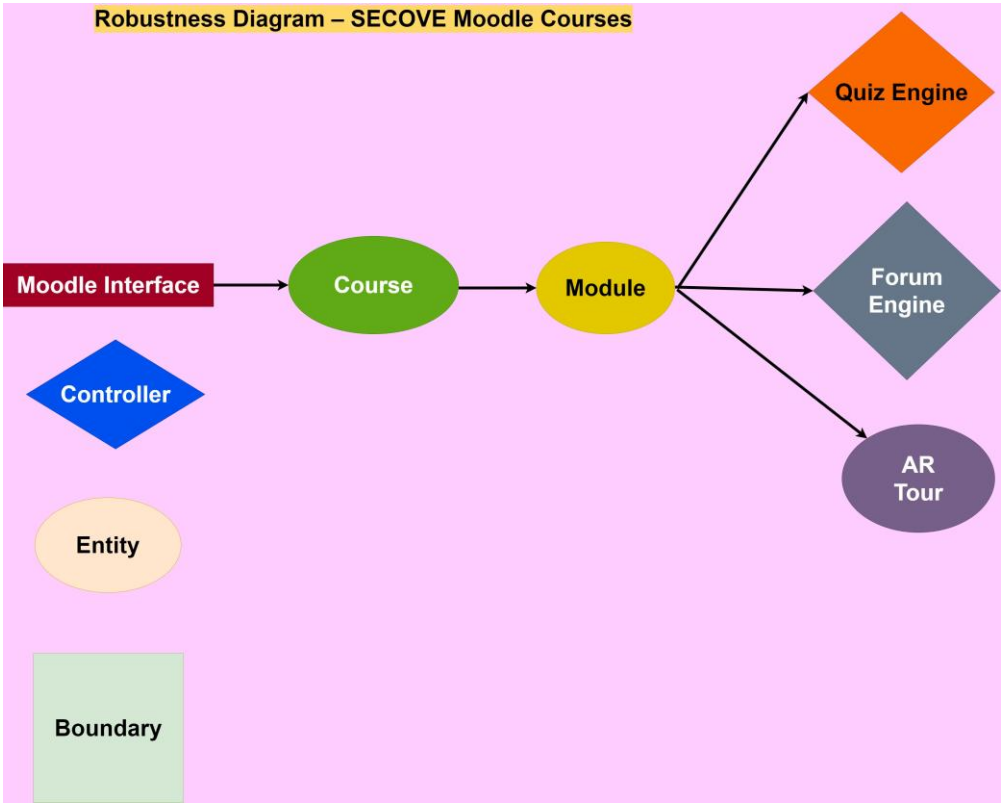

Figure 3: The Robustness Diagram

This conceptual representation of the Robustness Diagram (Figure 3) illustrates the structure and interactions of the Moodle system, with a focus on the dimension of robustness in terms of its architecture. In this diagram, we can distinguish three basic types of nodes: Boundary (boundaries/interfaces), Entity (data entities), and Controller (controllers/logic mechanisms). At the Boundary level, the "Moodle Interface" acts as the user's entry point into the system. It is the environment through which the learner or instructor interacts with the underlying functions. From there, the flow leads to the Course entity, which represents the structural unit of learning. The Course entity is linked to the Module entity, which is the subset of content or activities within a course. The concept of the Module is crucial, as it acts as an interface node with specialized control mechanisms (Controllers). Controllers include the Quiz Engine (a quiz-based assessment mechanism), the Forum Engine (an asynchronous communication and discussion mechanism), and the AR Module (an augmented reality subsystem for virtual tours). These controllers incorporate business logic, process data, and ensure the proper execution of functions. The system's resilience stems from its clear stratification and separation of roles: interfaces remain independent of business logic, entities maintain data integrity, and controllers can be upgraded or replaced without disrupting overall operation. This architecture promotes scalability, ease of maintenance, and adaptability to new technologies, while

reducing the likelihood of failure due to interdependence. Thus, the system can respond effectively to changing educational needs and technological developments, while maintaining a high level of reliability and operational consistency.

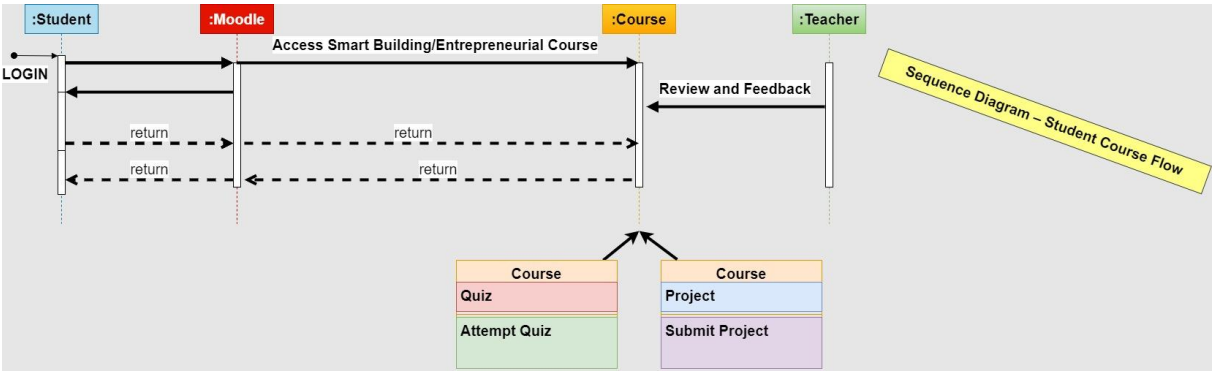

Figure 4: Sequence Diagram

The Sequence Diagram (Figure 4) depicts the temporal and logical flow of interactions between key actors and subsystems in the Moodle e-learning environment, focusing on a course that combines Smart Building and Entrepreneurship topics. This representation allows for an understanding of the sequence of actions, the flow of information, and the control points that ensure the smooth operation of the educational process. The sequence begins with the student, who, as the end user, performs the Login action to the Moodle system. This action is the point of authentication and entry, ensuring the identification and personalization of the learning experience. Moodle then provides access to the Course object, specifically the Smart Building/Entrepreneurial Course. This action marks the transition from the general platform environment to the specialized learning environment, where relevant activities and resources are concentrated. Within the course, students interact with two main activities: the Quiz and the Project. The Attempt Quiz action represents a knowledge assessment process, which can be formative or final, and provides immediate feedback to the learner. The Submit Project involves submitting an assignment or case study, which typically requires a synthetic and creative application of knowledge. The teacher enters the sequence at the assessment stage, with the Review & Feedback action for the Course. This intervention is critical to the pedagogical process, as feedback is not limited to grading, but includes qualitative comments, suggestions for improvement, and reinforcement of self-regulated learning.

This sequence highlights the interactive nature of educational communication: the student receives guidance and evaluation, while the instructor obtains information about the student's progress and needs. At the same time, this structure supports the resilience and scalability of the system, as each step is clearly defined and can be adapted or enriched with additional features (e.g., collaborative tools, multimedia material). Overall, the sequence diagram offers a clear, chronologically organized representation of the learning flow, facilitating the design, analysis, and optimization of processes in a modern digital educational environment.

3. RESULTS

The application of the ICONIX methodology within the SECOVE project for developing courses on Moodle yielded significant and multidimensional results. The analysis and design of the courses "Entrepreneurial Competencies" and "Sustainable & Smart Building Technologies" led to a coherent educational architecture that combines pedagogical and technological innovation. The Moodle platform served as a central learning hub, offering flexible access to multimedia material, interactive activities, and collaboration tools. Students participated in quizzes, forums, augmented reality virtual tours (Matterport AR), and project-based assignments, thereby enhancing both their theoretical understanding and practical application of knowledge. The methodology allowed for precise mapping of roles, functions, and information flows, ensuring a clear separation between interfaces, data entities, and control mechanisms. This enhanced the system's resilience, facilitating scalability and maintenance. Pedagogically, the approach enhanced active participation, interaction, and self-regulation of learning. Trainers utilized feedback and assessment tools to guide learners' progress, while cross-border collaboration between institutions enhanced the exchange of best practices. Overall, the results show that integrating entrepreneurial skills and technical knowledge for sustainable

technologies into a unified, well-structured digital environment can fill critical skills gaps, support the green transition, and set a standard for vocational education in Europe.

4. CONCLUSIONS

This research presents a replicable model for integrating vocational education and sustainable technical training through digital platforms, thereby enhancing the green transition. The results of the analysis provide practical evidence for incorporating innovative technologies into VET, thereby strengthening cross-border cooperation and addressing critical skills gaps in Greece and Europe. The design of courses on Moodle, as organized at the Thematic School of Advanced Vocational Training (Egaleo), responds to social and professional needs by combining business skills and technical training in sustainable building technologies. Pedagogical and technological innovations were integrated using AR tours, interactive quizzes, collaborative forums, and project-based assessment, reinforcing the learner-centered approach. The model can be used by VET institutions, island communities, and European networks, offering flexibility, scalability, and adaptability to different environments.

The main difficulties that continue to concern teachers in VET relate to the technical integration of advanced tools (AR, simulations) into Moodle, adapting content to different cultural and linguistic contexts, and synchronizing the numerous requirements of the labor market and companies. In addition, continuous training of trainers is required for the effective use of new tools. Future research could focus on the quantitative evaluation of the learning effectiveness of the model in VET, initially in Greece and then in Europe, comparing performance and skills before and after implementation. The integration of artificial intelligence for personalized learning paths and adaptive assessment would further enhance the experience. It is also recommended to develop interactive scenarios simulating real professional situations and to expand the range of topics to other areas of the green economy. Finally, the creation of an international community of practice in VET would support the continuous exchange of knowledge and the evolution of the model.

ACKNOWLEDGEMENTS

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OFFSHORE WIND TECHNICIAN TRAINING IN GREECE: A CASE STUDY OF THE THEMATIC SCHOOL OF ADVANCED VOCATIONAL TRAINING (EGALEO)

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ABSTRACT

This article presents a case study of the operation of a new vocational training program, "Offshore Wind Turbine Technician," which is being implemented at the Thematic School of Advanced Vocational Training (Egaleo), as part of the European SHOREWINNER project. The paper aims to address the growing shortage of skilled personnel in the offshore wind energy sector, which is critical to achieving the European Union's climate neutrality and reducing dependence on fossil fuels. The program, the first official Level five (5) program in Greece for this sector, combines theoretical, practical, and digital learning, using innovative tools such as virtual reality simulators and digital twins. The program covers electromechanical systems, automation, remote monitoring, and security. Gender equality and accessibility are also key principles. The program is a model for the development of green skills in Europe.

Keywords: Wind Technician Training, Vocational Education Training Institutions, Curriculum Evaluation

1. INTRODUCTION

The global energy transition represents one of the most profound social, technological, and economic transformations of the twenty-first century. At its heart lies the challenge of reducing humanity's dependence on fossil fuels, which are responsible for most greenhouse gas emissions, while also ensuring safe, affordable, and sustainable energy access **[1]**. The climate crisis, manifested through extreme weather events, biodiversity loss, water scarcity, and rising sea levels, underscores the urgency of this transformation **[2]**. Within the European Union (EU), the Green Deal and the 2050 climate neutrality target place **[3]** renewable energy development at the core of policy frameworks **[4]**. Offshore wind energy **[5]** is emerging as a cornerstone of this transition, combining high energy potential with scalability and technological maturity. It is increasingly recognized as a sector capable of advancing decarbonization, stimulating economic growth, and creating high-quality employment opportunities **[6]**. Yet the rapid expansion of offshore wind infrastructure has revealed a significant skills gap across Europe **[7]**. Companies and energy providers struggle to recruit adequately trained personnel to install, operate, and maintain offshore wind farms **[8]**. This mismatch between technological innovation and human resource development highlights the pressing need for coordinated investment in education, training, and certification **[9]**. Responding to this challenge, the European Skills Agenda and initiatives such as the Pact for Skills in the Renewable Energy Sector emphasize the role of Vocational Education and Training (VET) institutions in fostering flexible, responsive, and future-oriented learning pathways **[10]**.

Greece provides a particularly compelling case study. Although the motivation of vocational teachers in Greece is to create learning opportunities that develop sustainability competencies in students, using the European competence framework "GreenComp" **[11],** and despite its extensive coastline, high wind potential, and EU membership, the country has, until recently, lacked institutionalized and specialized training pathways for offshore wind technicians. This absence reflects a broader structural limitation within Greek vocational education: while traditional technical fields (e.g., electrical engineering, mechanical engineering, maritime studies) are well established, systematic adaptation to the emerging requirements of the green economy has been limited. The result is a widening skills shortage at the very moment when Greece is preparing to integrate offshore wind into its national energy mix. This gap threatens both the pace of the energy transition and the country's ability to participate fully in the European renewable energy value chain. The urgency of developing such skills is even greater in Greece's island regions. The Aegean and Ionian islands, historically dependent on costly and polluting fossil fuel imports, stand at the center of the national energy transition strategy. With their abundant wind resources, these islands are ideally positioned to host offshore wind farms and act as hubs for renewable energy generation. However, realizing this vision requires local communities to acquire technical and digital skills that enable them to participate meaningfully in the new energy economy. Without locally accessible educational opportunities, islands risk being reduced to one-sided energy production zones with limited benefits for residents and regional economies. By contrast, integrating specialized VET pathways into island development strategies can transform these areas into centers of sustainable innovation, ensuring that the energy transition enhances resilience, employment, and social inclusion. Against this backdrop, the role of VET acquires renewed importance. Traditionally regarded as a route into technical professions **[12]**, VET is today being redefined as a strategic tool for a just transition. It serves not only as a mechanism for technical specialization but also as a platform for cultivating transversal skills, digital competencies, and ecological awareness. In the renewable energy sector, VET operates as a bridge between technological innovation, labor market integration, and social inclusion. For offshore wind energy in particular, its role is decisive: the industry demands highly skilled technicians capable of working in challenging environments, operating advanced digital systems such as remote monitoring and digital twins, and complying with strict international safety standards. Establishing structured and recognized VET pathways for offshore wind technicians is therefore essential for aligning educational systems with sustainability imperatives.

The Thematic School of Advanced Vocational Training in Egaleo, within the framework of the EU-funded SHOREWINNER project, has directly addressed this challenge. It designed and implemented the first official Level 5 program in Greece, specifically dedicated to offshore wind energy technicians. The four-semester blended curriculum combines 1,200 hours of classroom-based learning with 960 hours of workplace-based training, aligning fully with the European Qualifications Framework and the international certification standard EN ISO/IEC 17024. Covering a broad range of areas—including electromechanical systems, automation, remote monitoring, safety operations, and environmental

awareness- the program also embeds principles of gender equality and universal accessibility. Its most innovative dimension, however, lies in its pedagogy: trainees engage with virtual reality simulators, digital twins, and collaborative digital tools, acquiring not only technical expertise but also the adaptability required to meet evolving industry standards. This case study demonstrates how a specialized VET structure can function as a model for sustainable island development. The program in the Advanced Vocational Training School in Egaleo illustrates that thematic specialization and digital enrichment of vocational education can directly address labor market shortages while strengthening community resilience. In the context of multiple global crises—climate, energy, and social inequalities—the integration of pedagogy, technology, and sustainability is not merely optional but essential. Offshore wind technician training, as this example shows, has the potential to serve as much more than narrow technical instruction: it is an educational innovation aligned with ecological justice and resilient community development.

From the general point of view, the context of this proposal concerns the energy transition and the climate crisis, with an emphasis on the skills gap in offshore wind energy and the absence of institutionalized educational structures in Greece. The aim is to analyze the design and implementation of an innovative curriculum for offshore wind technicians in Egaleo. The purpose of this study is to design and critically assess an educational model that can be replicated in the emerging green economy. The methodology integrates curriculum analysis, systematic comparison with international standards such as EN ISO/IEC 17024, and an in-depth case study approach. The pedagogical framework is enriched through advanced design tools, including ICONIX modeling, digital twins, Virtual Reality simulators, and competency-based skill mapping**.** The results highlight how the balanced integration of theoretical, practical, and digital learning not only responds to urgent skills shortages but also strengthens local labor markets, empowers communities, and creates a scalable reference model for other EU member states. The study contributes by connecting education, technological innovation, and sustainability as interdependent pillars of a just energy transition. Furthermore, the article is underpinned by strong principles of interdisciplinarity, combining insights from engineering, pedagogy, digital technologies, environmental sciences, and labor market policy. This multidimensional perspective ensures that vocational training is not treated narrowly as technical instruction but as a holistic response to the socio-economic and ecological challenges of our time. The research questions of the paper concern:

(a) How was the program designed to meet society's needs?

(b) How were pedagogical and technological innovations incorporated?

(c) How can it serve as a model for islands and European communities?

Beyond the present (1) Introduction, which focused on presenting the energy transition framework, combined with the shortage of engineers with relevant skills in Greece and the critical nature of Greece's geophysical (insular) dimension, the second section (2) “Methodology”, refers to the study program (mixed approach - curriculum evaluation, case study, benchmarking with international standards) using conceptual modeling (ICONIX) **[13]**. In the third section (3) for the “Results” issue is presented the innovative versions of the program for pedagogical practices applied in combination with skills mapping, and the impact on the labor market and educational communities of VET are presented. The article concludes with section four (4) “Conclusions” of the presentation, its contribution, and a summary assessment, highlighting its theoretical and practical value without glossing over its limitations. Also important are the suggestions for future research and the prospect of applying the program in other island regions of other countries.

2. METHODOLOGY

For a complete conceptual clarification of the methodology, we used the ICONIX methodology **[14]**. The ICONIX methodology offers a balance between clarity and flexibility in design. It allows for the visualization of concepts, roles, and interactions, facilitating the connection of pedagogical goals with technological requirements **[15]**. This ensures systematic development, avoids ambiguity, and allows for practical adaptation to VET needs. Figure 1 shows two types of diagrams. These diagrams (Domain Model and Use Case Diagram) belong to the ICONIX methodology and complement each other, providing two different but related views of the same educational ecosystem.
The Domain Model presents the basic concepts (entities) and their relationships within the context of the offshore wind technician training program. The basic entities of the Domain Model are:

- Curriculum: this is the backbone, i.e., the overall learning plan that shapes knowledge and skills.

- Modules: subsets of the program that convey specialized knowledge.
- Learners: the direct beneficiaries, who interact with the courses and acquire skills.
- Trainers: the learning providers who design, teach, and evaluate the courses.
- Industry/Labor Market: the external entity that influences the curriculum and determines skill requirements.

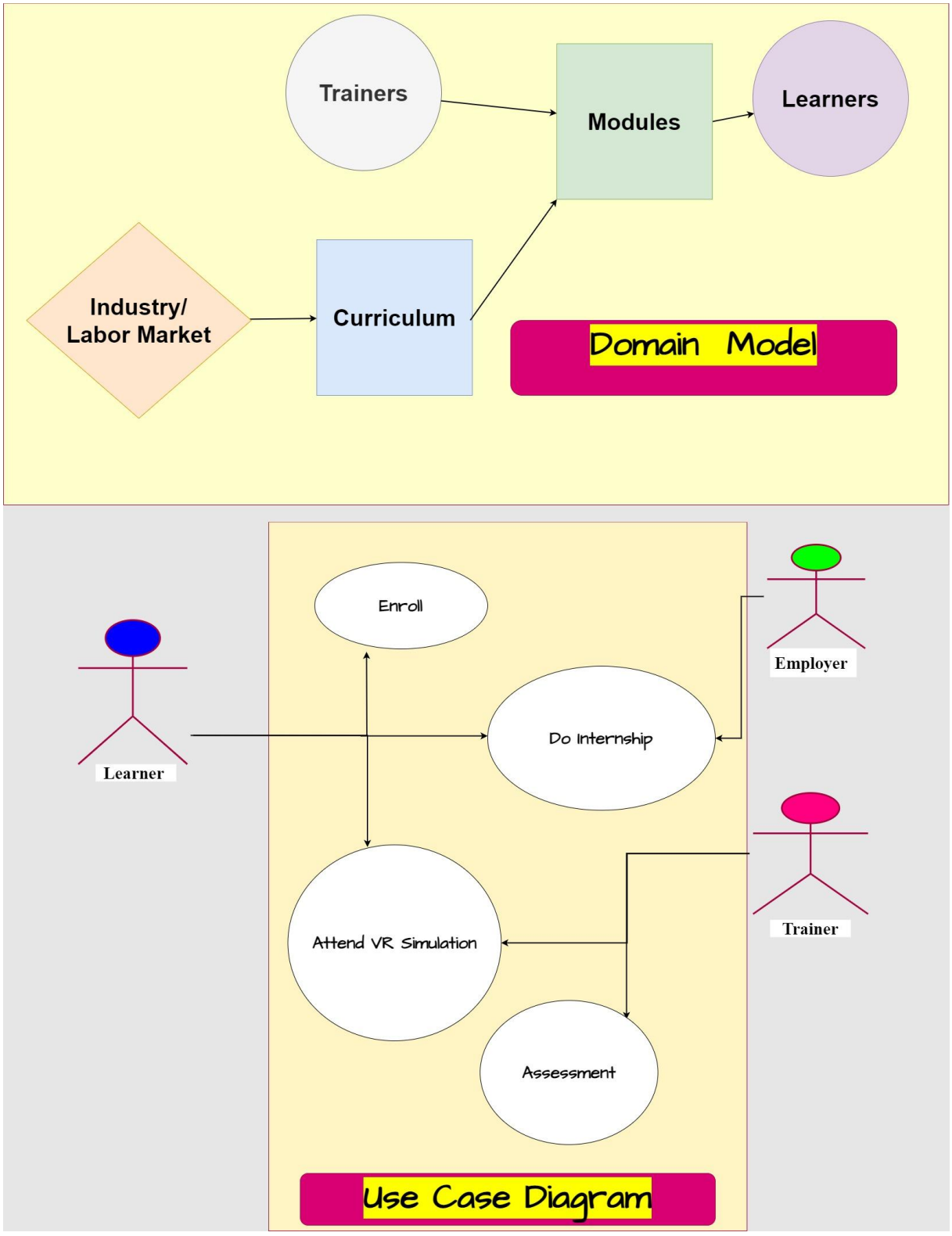

Figure 1: Use Case and Domain Model Diagram

The relationships show that the curriculum determines the modules, the modules feed the learners, while the trainers co-create and teach them. Industry acts as an external "guide" that determines the needs of the program. The Domain Model maps of Figure 1 present the learning ecosystem. The Use Case Diagram focuses on the actions and interactions of the key stakeholders. Here, the "actors" (Learner, Trainer, Employer) are associated with specific functions: the learner registers, participates in Virtual Reality simulations, does practical training, and is evaluated. The trainer is involved in simulations and evaluations. The employer provides the framework for the internship. The diagram depicts how the learning process is not only theoretical but also incorporates experiential, technological, and professional dimensions.
The two diagrams complement each other. The Domain Model shows "what exists" in the educational context, i.e., the structures, roles, and relationships, and the Use Case Diagram shows "what the stakeholders do," i.e., their interactions with the system. Their coexistence allows both the static dimension (entities, relationships, market requirements) and the dynamic dimension (specific learning, assessment, and practical training activities) to be captured. This ensures that the curriculum is both well-structured in terms of content and functional in its interactions. Together, the two diagrams provide a holistic picture: offshore wind energy is not only a technological subject but also an educational, social, and professional field, where the content of studies and learning processes come together in a unified, sustainable educational framework.

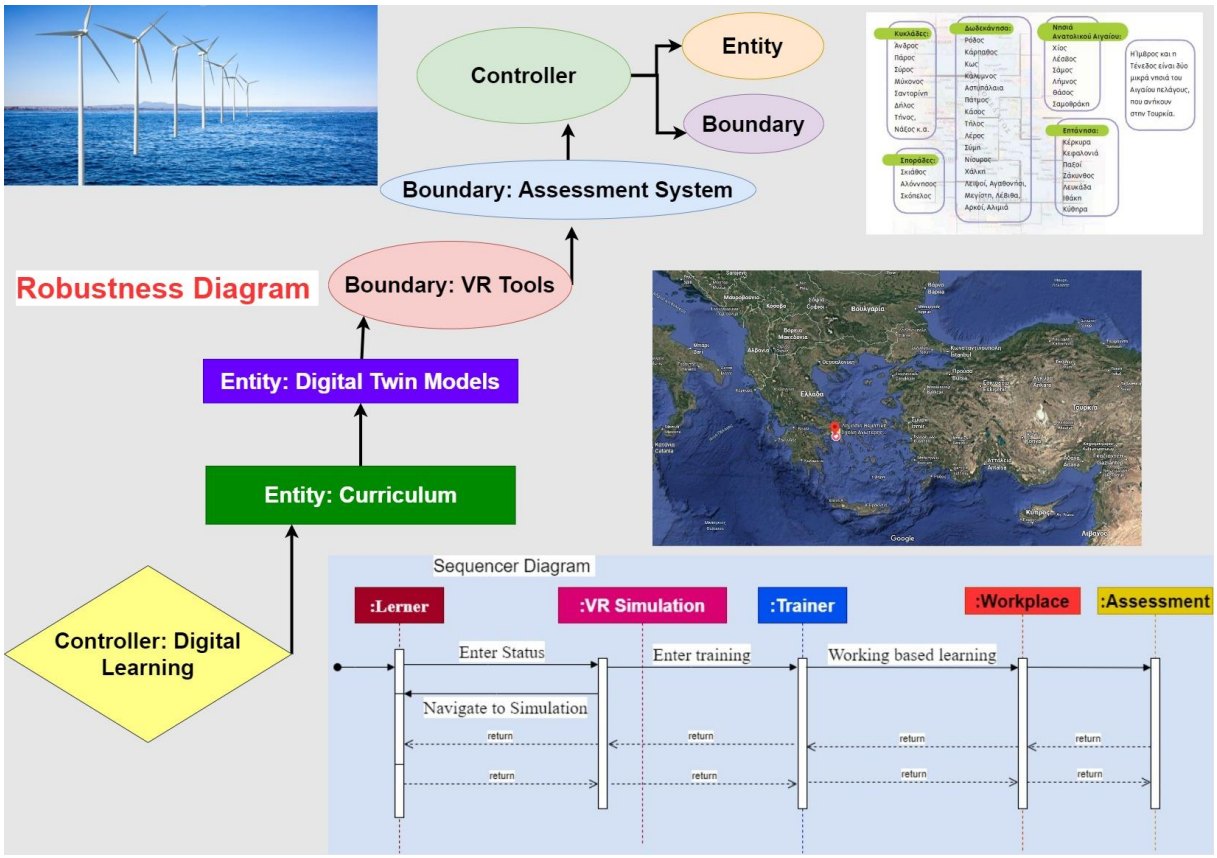

Figure 2: Sequencer Diagram and Robustness Diagram

The Robustness Diagram depicts the logical interaction between the key components of a learning system that incorporates Digital Twins and Virtual Reality tools. The ICONIX methodology uses robustness diagrams as a "bridge" between the Use Case and the Sequence Diagram, highlighting the roles, data entities, and boundaries/interfaces. At the center of the diagram is the Controller: Digital Learning, which represents the mechanism for controlling and organizing the learning process. The controller acts as the "brain" of the system, managing information, connecting theoretical and practical elements, and guiding the flow of knowledge. Next to the Controller are the Entities. The Curriculum is the institutional and pedagogical framework, which includes learning objects, target skills, and mapping to professional standards. Digital Twin Models are virtual representations of real wind turbine subsystems (e.g., electromechanical system, sensors, operational data). These provide learners with a “digital twin" experience in a safe environment, allowing them to familiarize themselves with maintenance and diagnostic procedures. The Boundary Objects category includes Virtual Reality

Tools, i.e., virtual reality tools that will enable trainees to immerse themselves in simulated scenarios. The Assessment System, which acts as the evaluation interface, collects data from trainees' exercises and the results of their practice. The lines in the diagram show that the Controller manages and coordinates the relationships between all these elements: it uses the Curriculum as a "knowledge base," connects Digital Twins with practical learning, activates VR tools as practice environments, and collects results through the Assessment System. In short, the diagram illustrates the coherence of the digital learning ecosystem and how theory, technology, and assessment are interconnected with a control node.

The Sequence Diagram depicts the temporal sequence of interactions between the key "actors" and systems in the learning process. The process begins with the Learner, who interacts with the VR Simulation. At this stage, the learner gains experience through simulation of real-life conditions, such as maintenance or control of wind turbines in a virtual environment. The VR Simulation is then linked to the Trainer. The trainer has a dual role: on the one hand, they monitor the learner's progress, and on the other, they intervene pedagogically by offering guidance and feedback. The Trainer is then connected to the Workplace. This transition reflects the shift from the virtual environment to real-life professional experience. The trainer acts as a "bridge" between simulation and workplace application. Finally, the Workplace leads to the Assessment (evaluation system). There, the results are recorded, both from behavior in VR and from performance in practice, to obtain an overall picture of the learning process. The Sequence Diagram, therefore, highlights the temporal logic of learning: from simulation (theoretical-technological) to collaboration with the trainer, from there to practical training, and finally to assessment.

The coexistence of the Robustness Diagram and the Sequence Diagram (Fig. 2) provides a complete picture of both the structure and dynamics of the learning process. The Robustness Diagram functions as a conceptual map: it shows the basic components of the system (curriculum, digital twins, VR, assessment) and how they are orchestrated by the Controller: Digital Learning. In other words, it answers the question "what are the critical nodes and how are they related to each other?" The Sequence Diagram, on the other hand, shows how these elements are activated in practice and in what time sequence. It explains how the learner moves from the virtual experience (VR) to pedagogical guidance (Trainer), from there to real practice (Workplace), and finally to assessment (Assessment). It answers the question "how does learning unfold step by step?" Together, the two diagrams form a coherent picture: Robustness shows the logical architecture of the system, while Sequence shows the educational flow over time. Their integration allows program designers to ensure that technological and pedagogical innovations (digital twins, VR, assessment) are smoothly and functionally linked to the learner's progress.

3. RESULTS

The research showed that the establishment of the new specialty "Offshore Wind Turbine Technician" in the Advanced Vocational Training School in Egaleo fills an important institutional and professional gap in the Greek Vocational Education and Training system. For the first time in Greece, an official level five (5) study program has been developed, fully harmonized with European standards and the emerging needs of the labor market in the offshore wind energy sector. The establishment of this specialization is a strategic intervention to link national training policy with the objectives of the Green Deal and reduce dependence on fossil fuels. In terms of training new technicians, the program adopts a four-semester structure that combines 1,200 hours of theoretical and laboratory teaching with 960 hours of practical training in real working conditions. The topics covered include electromechanical systems, automation, remote monitoring, and advanced security protocols. In addition, the integration of cutting-edge digital tools, such as VR simulators and digital twins, allows trainees to develop skills in highly realistic and safe conditions. The results show that the new specialization not only bridges the existing skills gap but also creates a replicable model for other EU countries. The training of young technicians combines technical expertise with the cultivation of green and digital skills, helping to build a resilient workforce capable of supporting the sustainable energy transition.

4. CONCLUSIONS

This study has demonstrated that the development and implementation of a specialized vocational training program for the offshore wind energy sector is feasible, effective, and socially necessary. The answer to the first question, whether it is possible to integrate theoretical, practical, and digital learning into a single program, is positive: this combination bridges skill gaps and adapts to social needs and market requirements. On the second question, whether the program can be aligned with international

standards, it has been shown that with the help of ICONIX modeling, teaching and learning in VET ensures standardization and comparability with European practices. On the third question, regarding its contribution to the green transition, the analysis shows that it boosts local employment, cultivates green skills, and links education to sustainable development. The research, therefore, demonstrates that professional excellence in thematic subjects can be a foundation for a fair and sustainable transition. The study adds value at both the theoretical and practical levels. Theoretically, it contributes to the debate on the role of vocational education in the transition to a green economy by proposing an innovative pedagogical model that combines technology, learning, and a social dimension. In practical terms, it presents a tangible example of a training program, the first in Greece at level 5 for the offshore wind energy sector, which can serve as a model and be replicated by other members of the EU. Systematic alignment with international standards, the use of cutting-edge digital tools, and the integration of principles of equality and accessibility give the program a universal character. The research, therefore, highlights the role of the Thematic School of Advanced Vocational Training (Egaleo) as a bridge between the social need and labor market, technological innovation, and social justice, contributing to the European agenda for sustainable development.

The implementation of the study encountered significant difficulties on multiple levels. First, the absence of a pre-existing institutional framework in Greece for specialized training in the field of offshore wind energy created administrative and organizational gaps. The development of the program required continuous consultation with relevant bodies and alignment with European standards, a time-consuming and often contradictory process. Secondly, the integration of advanced technological tools, such as VR simulators and digital twins, encountered technical and financial challenges, as infrastructure was limited and investments were demanding. Thirdly, ensuring equal participation and incorporating accessibility principles was particularly challenging given the technical nature of the subject matter. In addition, the lack of specialized trainers with experience in offshore wind energy made it necessary to provide training and utilize international collaborations. Overall, the research showed that developing innovative VET programs in cutting-edge fields requires not only pedagogical design but also strong institutional support, investment in technology, and the cultivation of human resources with interdisciplinary skills.

Despite the importance of this study, it is crucial to exercise harsh and sober criticism of the illusions that accompany new technologies in the field of green growth. Often, technocratic narratives promise that the integration of innovative tools, such as digital simulations, artificial intelligence platforms, or digital twins, will automatically lead to environmentally neutral and socially just solutions. These technologies are developed within a framework determined by profit and market needs, not by the needs of the environment or society. Experience shows that many so-called "alternative" technological solutions simply shift the problem: they consume enormous natural resources, produce new forms of dependency (energy, technological, economic), and reinforce inequalities. The promise of a neutral, "clean" technology often acts as an ideological veil that conceals the commodification of the environment and the reproduction of the same destructive logic of exploitation. Technocratic policies, which often overlap with development policies, present the narrative of the green transition as a technical issue, bypassing the social conflicts and political struggles that accompany them. Thus, instead of being a tool for liberation, new technologies risk functioning as mechanisms of control and integration. True environmental sustainability will not come from blind faith in technology, but from a radical change in production relations and a rethink of the relationship between society and nature. Future research should focus on ways in which advances in materials can be integrated into technologies that offer alternative responses to the environmental crisis. The development of durable, recyclable, and low-footprint materials, combined with technologies that reduce energy consumption and dependence on scarce resources, can transform vocational training into a real lever for ecological reconstruction. Instead of one-dimensional technocratic optimism, we propose an interdisciplinary exploration of the potential of material and technological innovation to contribute to a sustainable future with a strong social and environmental dimension.

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SOCIAL DEMAND AND GOVERNMENTAL POLICIES TOWARDS THE DESIGN OF SUSTAINABLE EDUCATIONAL ENVIRONMENTS: THE CASE OF SPECIAL SCHOOLS IN GREECE

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ABSTRACT

Nowadays, the rising social demand for more sustainable environments is expressed in various forms in everyday life. One area of need is the educational environment, where people spend most of their daily time, for a long period of their life, in the most critical years of human development, childhood. Numerous studies referred to the role that the School environment plays in children's education, behavior, socializing, health (physical, mental, psychological), and overall well-being. Especially for children with disabilities, this environment has a more significant role, as different conditions change the needs that should be fulfilled. The disabled child being on a sustainable school environment, has the opportunity to connect with nature and its natural elements (like plants and greenery, natural light and ventilation, natural materials like stones and wood) which could act not only as a source of knowledge, but also as a source of happiness and enjoyment.

But what happens with governmental policies and actions towards this need? Are they following this demand, in terms of legislation, organization and planning of actions, in order to create the appropriate sustainable educational environment for children, and especially those with disabilities?

Those areas of concern have being investigated, focused in Special Schools in Greece, and the related governmental policies and legislative framework around them. Research has conducted in all the Schools that host children with disabilities in Greece (295 Special Schools, 2517 special classes in General Schools), using as the main tools of investigation Questionnaires' survey, Interviews and Observation. Bibliographical sources, along with Interviews and Questionnaire survey in Governmental sources and relevant Organizations and Associations, covered the policies' and legislative framework's investigation.

Research's findings confirmed the gap between the need for a sustainable educational environment and the existing governmental policies, expressed by the people involved (parents, teachers and staff) as an urgent social demand. Action is required, in terms of organization of a central policy, to cover the need of creating a sustainable built School environment appropriate for the children with disabilities, involving in the process of design and construction a team of experts, like Architects & Designers, Psychologists, Educationalists, Health Experts, Occupational Therapists, Ergo-therapists, etc., in order the School's environment to fulfill its important role.

Keywords: Sustainable Architecture & Eco-Design, Greek Special Schools, Disability.

1. INTRODUCTION

The environment plays a fundamental role in children's development, and especially the School's environment. This is a fundamental principle of education and child psychology, expressed by numerous studies from scientists worldwide. The same occurs with the disabled child, and perhaps to a greater extent, as it spends most of its daily time in this environment trying to learn, socialize, and cope with everyday activities. The school environment functions as a pillar of knowledge, where the child absorbs the stimuli given to him like a sponge. If the environment is poor in stimuli, then the positive benefits to the child will also be inadequate. And especially to the child with disabilities, who has a greater need for environmental stimuli, as many types of disability are based on the sensory factor. We understand, therefore, how important it is for the child to be in such an environment, which offers him the maximum in his development. And since the sustainable environment, according to numerous studies, works for the benefit of humans, in terms of health, well-being, progress, knowledge, and development, we understand how important it is to apply it to the structured environment of educational spaces/schools.

But what is being done with government policies and actions towards this necessary implementation? Are they following the social demand for a sustainable environment? Is there related legislation in Greece, in European or in the global spectrum towards this direction? And what are the actions taken by governmental authorities on a national or local scale? Are the Greek Schools with sustainability under consideration? Are any natural elements, and on what scale, implemented in their design? And what could be done towards this direction? These questions were investigated through this research, which was focused on the Special Schools and the Special Classes of General Schools in Greece.

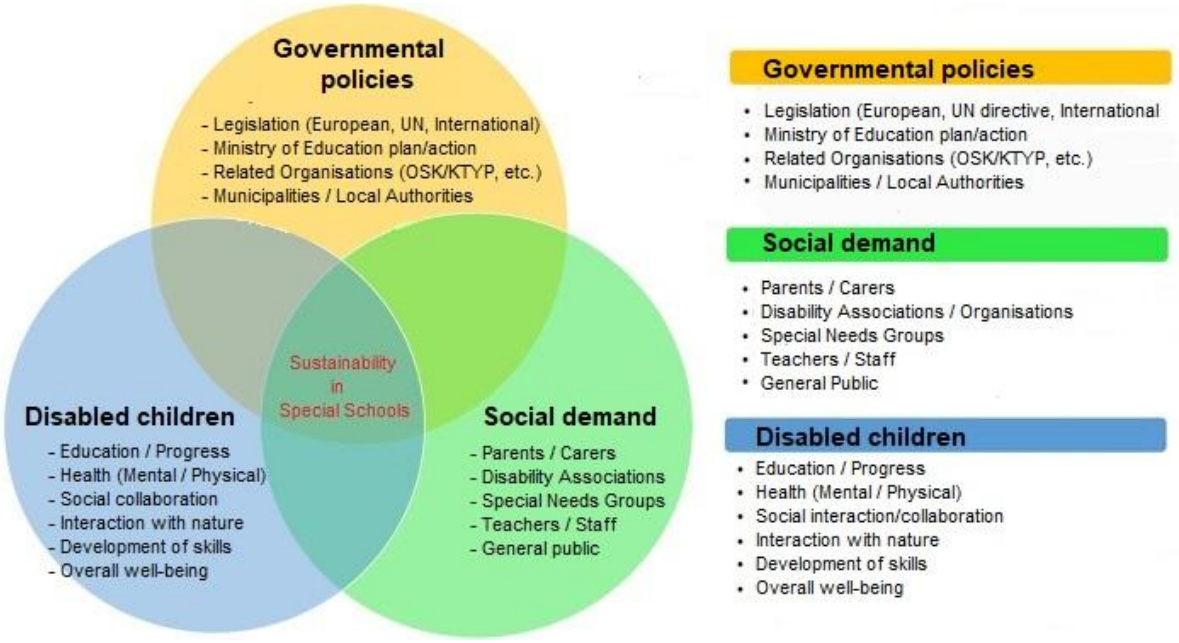

Figure 1: Sustainability in Special Schools, related to Governmental Policies and Social demand.

More specifically, according to studies, humans derive multiple benefits from interacting with nature in a sustainable environment. Benefits in health (Haider [1]), physical and mental, in stress levels (Ice [2]), and even in recovering from a health situation or accident (Samir [3]) have been recorded. Numerous studies have been conducted among students to explore the benefits of sustainable architectural environments. Benefits have been recorded in academic achievement, as well as in stress levels during exams or assignments (Abdullah [4]). Research at the Academy of Baltimore in the USA has compared the stress levels of students in sustainable and non-sustainable classrooms (Nair [5], et al.), yielding significant differences in findings. In another study (Basu [6], et al.), it has been found that the sustainable design in School buildings, which connects students to nature and greenery, reduced cortisol levels and thereby reduced stress in children. Another study (Grinde [7], et al.) has found that a visual connection to nature can relax the eye muscles and temper cognitive fatigue. A recent study

(Tyrovola [8]) on the positive implications of a sustainable school environment on disabled students demonstrated the need to create such spaces as soon as possible.

Since the benefits of a sustainable environment to children are clear, a few individual efforts to implement such an environment in school settings have begun at an international level (Heath [9]). These efforts are limited in number, as they are based on private initiative rather than organized, general governmental policies. This is because there is no central legislative framework related to sustainable architectural design at an international level, which ensures the proper design of educational spaces to meet scientific standards for sustainability. The recent European Sustainability Reporting Standards (ESRS), which came into force in June 2023, have a specialised framework that delves into Environmental, Social, and Governance (ESG) topics, but it is tailored to facilitate topic-specific disclosures related only to products and not going further, like to an architectural project, such as the creation of an educational environment.

2. METHODOLOGY

Various research methods, utilizing both primary and secondary sources, were employed in a cross-disciplinary approach to investigate this multi-layered subject. The scope of the research was to assess governmental policies and actions towards the need for a sustainable environment in Special Schools, in relation to social demand expressed by the opinions of the people involved, like teachers and staff, parents, and members of disability organizations and associations. After the assessment of the relevant legislation, governmental organization, and planning of actions from the Ministry of Education and related Organizations, like KTYP, through an extended literature review and interviews with governmental staff, an extended questionnaires' survey took place in Special Schools, and focused interviews were conducted to record the existing situation and measure the social demand for a sustainable school environment. As there is a lack of related previous research on the subject, regarding the relationship between governmental policies and social demand in terms of sustainability in Greek Special Schools, our research findings had to be compared to a wider framework of research and sustainability materialization.

The main plan was to first investigate the existing situation in Special Schools in terms of sustainability. To achieve this, a questionnaire survey, interviews, and observation were used as the tools of investigation. The research was structured around the principles of architectural design for sustainability, as outlined by Stephen Kellert [10], including environmental features, natural shapes and forms, natural patterns and processes, light and space, and place and human-nature interaction. Then, to assess the existing situation of governmental policies and actions, literature research, interviews, and a questionnaire survey were conducted at the Ministry of Education and related Organizations. For assessing the social demand, interviews and a questionnaire' survey took place at the Special Schools, and at related Disability Organizations and Associations. Research findings were organized to be compared with the wider sustainability framework.

2.1. Research tools and Sample population:

2.1.1. Literature review

on relevant legislation, existing governmental policies, relevant research and scientific databases, to collect information related to the Sustainable Design in Special Schools and social demand.

2.1.2. Questionnaire survey a. in Special Schools' Teachers and Staff:

A questionnaire was designed to collect opinions from users of educational environments, evaluate their need for a sustainable environment, record the sustainable elements within the Schools' built environment, and evaluate children's behavior within it. The questions were focused on the existence of general aspects of Schools' Interior and Exterior Design, like classrooms' design, furniture, lighting (natural/artificial), openings (windows, doors, skylights), corridors, open spaces (schoolyards, gardens), etc., and how these affect children's behavior, feelings, learning, and everyday activities. The questionnaire was sent to Teachers and Staff from the total of 295 Special Schools all over Greece, and from the total of 2517 special classes in General Schools. No exclusions were made. From Special Schools, 159 responded, and 426 responded from special classes.

b. in the Ministry of Education and related Organizations:

The questionnaire was designed to collect opinions from the members of staff who are related to the creation of governmental policies and decisions' making about Schools' built environment. The questionnaire was sent to fifty-four (154) members of staff at the Greek Ministry of Education and 23 members of staff at the related Organizations (KTYP/OSK). Thirty-two (32) in total were responded.

c. in Disability Organizations and Associations:

The questionnaire was designed to collect opinions from the members of Disability Organizations who have experienced the affect of School environment on their lives. It was sent to twenty-three (23) Organizations, and eighty-four (84) people responded.

2.1.3. Interviews' survey

provided experts' insights into the benefits of nature-integrated learning spaces and the practical challenges of implementing sustainable design in Special Schools:

a. in Special Schools they were chosen Teachers and Scientific Staff (Psychologists, Occupational Therapists, Nurses, etc.), from all sections of the Greek Educational system in Primary and Secondary Education. No exclusions were made. Nineteen (19) people participated.

b. at the Ministry of Education and related Organizations, with educational staff and Architects, Engineers, etc. were chosen to participate. No exclusions were made. Nine (9) people participated.

c. in Disability Organizations and Associations, with disabled people or relatives, related to Schools' sustainable design. No exclusions were made. Twenty-three (23) people participated.

2.1.4. Observation

in Special Schools and special classrooms in General Schools, to collect data that couldn't be assessed with previous tools, i.e., how the schools' environment was formulated in terms of sustainability (natural light, plants, ventilation, etc), the average time children spent in a sustainable environment, expressions of satisfaction or dissatisfaction with their surroundings (lighting, open space, windows, plants, gardens, etc.). Four (4) Schools and six (6) Special classrooms in General Schools were put under the prism of non-participant observation. The procedure lasted one (1) year.

2.2. Ethical considerations:

Particular attention was given to the design and application of the research tools, due to the fact that part of the research was undertaken in Special Schools, putting under the prism of investigation Children with Disabilities. The research plan was approved by the Hellenic Ministry of Education (dept. of Special Education) and the Schools' principals. The tools of investigation secure anonymity and the data collected, encrypted with access by encrypted methods (fingerprints/ biometric data).

3. RESULTS

Our research findings which was conducted in the Greek Special Schools and at the General Schools' Special Classes, confirmed the need for a sustainable Educational Environment for the disabled children, as this has a huge effect on their education, behavior, progress and overall development.
As no previous related studies exist on the subject, the research was based on the theoretical framework of sustainable architecture, on the disabled children's educational studies, and on the legislative framework from the international spectrum. For the sustainability part, the research was structured around the principles of architectural design for sustainability by Stephen Kellert[8], and for the disability education part from educational, psychological and related studies on the subject.

The research has record that the majority of Schools do not have environmental design elements in their built design. This negatively affects the students and staff, making them feeling stressed and unwilling to stay for long in the school's environment. This has a negative effect on the teaching procedures, on children's learning, on socializing, and in their general academic achievement.
The research on Governmental Authorities and relevant Organizations revealed the lack of a central plan for designing environmentally friendly educational environments and the lack of relevant legislation. The research on Disability Groups revealed the social demand for inclusive sustainable school environments.
Analytically:

3.1 Questionnaires' survey:

As described in the methodology section, three (3) different Questionnaires were distributed. One (1) to schools, one (1) at the Ministry of Education and related Organizations, and one (1) at the Disability Associations. Analytically:

a. The first one, revealed interesting findings in relation to Schools' sustainable design. There is a lack of natural elements like eco-materials/trees/greenery/, extensive use of artificial lighting instead of natural, and a massive use of petroleum as the basic method of heating instead of another alternative natural method, like geo-heating or sun. In terms of architectural design, there is a wrong positioning of the buildings facing north with small openings, and yards made of concrete, in most of the cases. Analytically:

In the majority of Schools, there are no natural surroundings or materials. Only 10% use natural materials (like wood, stones, etc.) in their construction or in furniture and schools surroundings, only one-third (34%) use plants and greenery in gardens or indoor spaces, one-quarter (25%) use the natural light as the basic source of lighting into classrooms, and one-fifth has natural ventilation as the medium of clean air into school, as they mainly use electric air-conditioning systems (Figure 2).

Figure 2: Percentages of natural elements in Special Schools.

Teachers and staff are disapointed by their surroundings, and pointed out that these effect in a negative way the teaching procedures, childrens mood, stress levels, distraction, cause lasyness, and other issues. They responded that they want a sustainable environment, as it is a good idea (68%), and will positivelly effect the children (42%) with their natural elements, like plants and natural light.

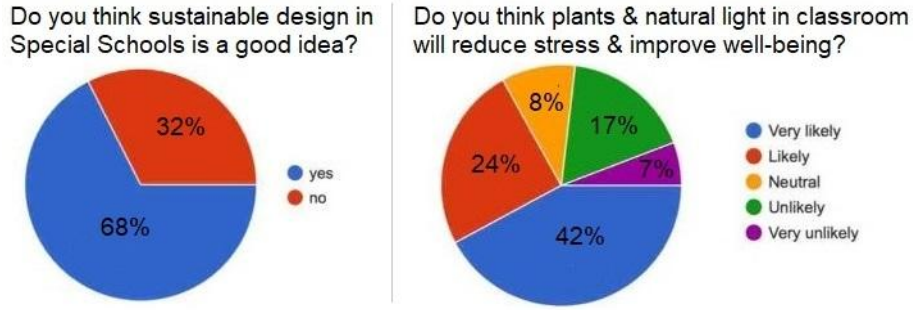

Figure 3: Teachers' opinions in Special Schools, related to sustainable design.

b. The second questionnaire, given at the Ministry of Education and its related Organizations (OSK/KTYP, etc.) revealed the lack of a central organizational mechanism about sustainability design of the School buildings, the lack of relevant legislation to support any decisions, together with the strong will of the people working on the field to make progress on the subject and support on the change of this situation. More specifically:

The majority of people (76%) responded that they don't have any central governmental plan to support any further action on sustainability design in Schools (Special or General). Many of them (13%) were unaware if there is any related plan or legislation on the subject, while some (11%) believe that there is such a plan at the Ministry of Education. Most of the people (83%) believe that it is a good idea to have Schools that will adopt sustainable elements, such as plants, trees and greenery in schoolyards and internal spaces, natural light and ventilation, while there are a bit skeptical about the use of natural materials on their construction, like wood or stone, as they consider concrete as a more stable material. The most interesting part of the questionnaire was that a great part of people (72%)

are unaware about what is sustainable design, especially in educational establishments, or they are misinformed about the subject, despite they work at the Ministry of Education (Figure 4). This raises an issue, on the need of organizing an information plan of educating people on the subject. The good part is that almost all of the responders are willing to participate at the creation of a sustainable environment in Schools, and they are positive of any further actions by the Ministry.
Another interesting fact on the research at the Ministry of Education is that people were unwilling to take part at the research, as this is presented from the low percentage of people responded (18%), despite the fact that the research was officially approved by the Ministry itself.

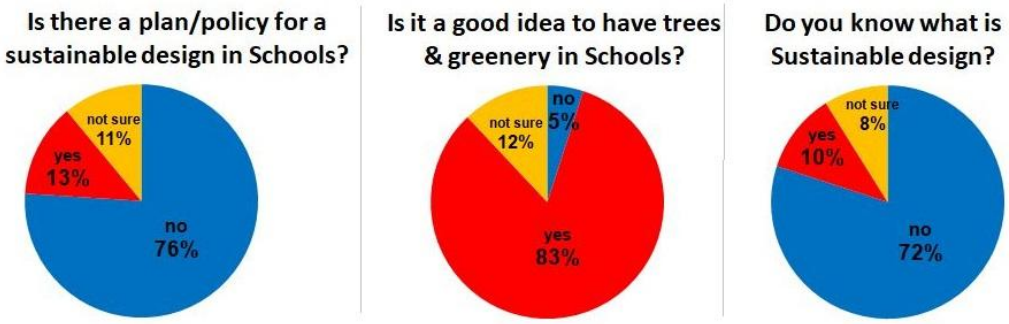

Figure 4: Member's of Ministry of Education opinions, related to sustainable design.

c. The third (3rd) questionnaire was distributed to Disability Associations and Organisations. The people there showed a great interest in the subject of sustainability at Special Schools. The majority were unaware of what sustainability is and how it may be connected with disability, particularly in how sustainability can help disabled children make progress in education and life skills, and on their overall health and well-being. After a brief explanation of what sustainability is and about the positive influence of the natural environment on the disabled child, people became enthusiastic about the idea of implementing sustainability in Schools, and expressed the willingness to push the authorities towards this direction. Analytically:

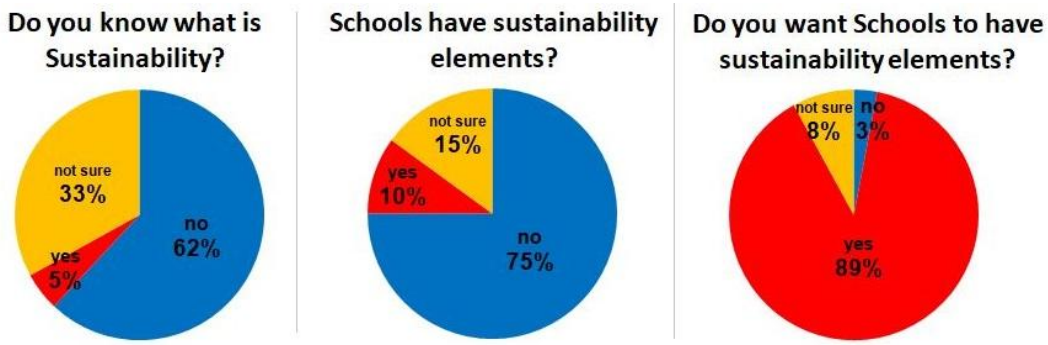

Figure 5: Member's of Disability Organizations' opinions, related to sustainable design.

On the question of "What is sustainability?" the majority (62%) had no idea, some think they knew but were no sure about it (33%) and only a few (5%) were informed on the subject. When they asked if they know if "at Schools are implemented sustainablity elements in their environment", they were positive (85%) that there is not such a thing in their knowledge. When they asked if they "want the Schools for the disabled to implement on their built environment sustainability elements", they were positive on the majority of their answers (89%). Only some were unsure (8%) and very few were negative (3%) on the idea. On the question of what they think is "the best policy as Disability Associations in order to push forward the authorities for the creation of a sustainable environment", they responded that the main thing to do is to inform them about it (65%) by sending letters and emails asking for that, to make an open call in terms of a protest as an Association (23%), or to involve the mass-media to address the issue to the public (22%).

3.2 Interviews' survey:

Three (3) different groups of individuals participated on interviews' investigation. One group was the Teachers and Staff from disability Schools, the other was the staff at the Ministry of Education and its related Organizations, and the last one was the members of the Disability Associations. Analytically:

a. The first one revealed the strong need of a sustainable environment in Schools in order this to employ all its positive effects to the disabled children. Teachers and staff, acting individually towards the creation of a more sustainable environment adding small elements, like plants and greenery, are asking for a central policy/action towards the creation of major architectural elements, like green roofs, open greenery spaces, skylights with natural light, bigger openings, natural heating and ventilation.

b. The second, revealed the strong will by Ministry members to participate and take action towards the formulation of a sustainable School environment across the country, implementing relevant legislation.

c. The third highlighted the strong social demand by the disabled people to a sustainable School environment, which will employ their disabilities, cover their special needs, and positively act towards children's development and overall well-being (Figure 6).

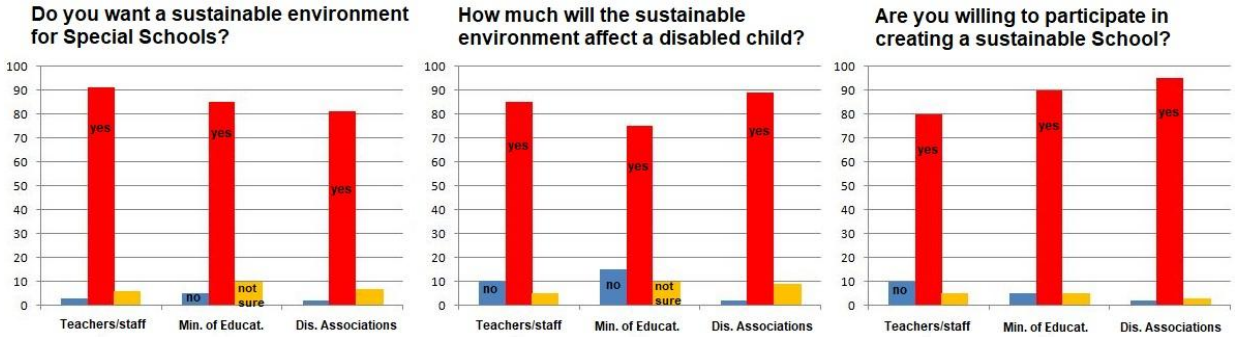

Figure 6: Interviews opinions' data, related to sustainable design in Special Schools.

3.3 Observations' survey:

Special Schools were put under investigation in the form of separate case studies, but with common research plan and analysis of the findings. Schools were investigated in two ways. The one was in terms of their built environment and how this was sustainable designed, adopting sustainability elements and in what quantity, and the other was the interaction of the people within the built environment and how they operate in it. The observation plan was based in the basic principles of "sustainability in Architecture" by Kellert[8], and organised in a method presenting details in people's interactions with space, like time taken for tasks (quantitative approach - Table 1) or recording expressions and feelings/reactions within the space (qualitative approach - Table 2). More specifically:

The majority of children (65%) like to spent most of their time (20 min) playing in the yards, or staying near openings (62%) during windy weather. Where is garden, they stay there (45%) most of the time (20 min) or at corrindors during winder months. At classroom, they not willing to stay long (4-10 min).

Table 1: Percentage of average time spent during tasks in Special School

Task	Average time			
	0-1 min	1-3 min	4-10 min	10-20 min
1. Staying into classroom	5%	15%	50%	30%
2. Playing in the yard	3%	7%	25%	65%
3. Staying in the garden area	8%	12%	35%	45%
4. Sitting in corridors/open area	5%	21%	40%	34%
5. Sitting near windows/openings	2%	6%	30%	62%

Table 2: Percentage of sustainability elements in Special Schools/Classrooms

Elements	Percentage											
	S.1	S.2	S.3	S.4	C.1	C.2	C.3	C.4	C.5	C.6	C.7	C.8
1.Natural light	25%	15%	30%	40%	32%	41%	25%	32%	30%	25%	20%	30%
2.Nat. ventilation	30%	17%	25%	50%	30%	20%	25%	30%	30%	20%	10%	65%
3.Materials(wood)	0%	0%	15%	0%	0%	30%	0%	0%	5%	0%	0%	45%
4.Plants/greenery	5%	21%	20%	30%	10%	20%	5%	10%	5%	5%	0%	34%
5.Large openings	25%	15%	30%	40%	30%	40%	30%	30%	30%	30%	20%	30%
6.Eco-heating	0%	0%	50%	60%	0%	50%	0%	0%	0%	0%	0%	20%
7.Green roofs	0%	0%	0%	10%	0%	0%	0%	0%	0%	0%	0%	0%

4. CONCLUTIONS

Greece has, as a general rule, to follow international developments in terms of social issues, legislation, education, disability issues, social benefits, and the establishment of governmental policy. In the case of sustainability, although there is a general discussion and mobilization on the subject, with the international community concerned about the importance of shifting to a green economy, there is not the same interest in applying sustainability in building infrastructure, especially in educational environments.

Despite numerous studies highlighting the importance of human interaction with the natural environment, especially for children, in their development, education, health, and overall well-being, only a few global attempts have implemented sustainable design in their built environment. Additionally, there is no international legislative regulation, and therefore not in Greece, on the design of sustainable educational spaces and their enforcement in schools. This is logical, from one point of view, if one considers that only recently was a similar legislative framework (N.) established in our country regarding accessibility and the design of spaces used by people with disabilities, following strong protests from disability movement, demands from society as a whole, and especially from the disability associations.

Therefore, in our case, the implementation of sustainable design is an urgent need, both due to the relevant scientific studies and the social demand, but its implementation is expected to be delayed, following the usual tactics in similar social issues, unless the benefit that sustainability has to the society, to the people and children with special needs, becomes more widely known, and the appropriate legislative framework is implemented. This is possible through modern technological capabilities and the wider use of mass media and social networking. However, this must be achieved through a collective and targeted effort by competent bodies, social services, associations, and scientists, who can inform the general public about their scientific studies.

In conclusion, the question that should concern us is whether a state, such as Greece, should wait for the international community to act through the implementation of collective legislation on the sustainable design of educational spaces, or take action autonomously, considering the proven benefits to children with disabilities, and comply with the social demand? Should scientists play a role in informing authorities and the general public about the benefits of sustainability in children’s progress, education, health, and overall well-being? Should governments take action and inform relevant policies? What is everyone's share of responsibility? It is clear that it is time for action.

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