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Theory and practice of environmental education in vocational training: the possibilities of project-based learning in vocational schools, with special regard to environmental awareness and sustainability

Doctoral (PhD) Dissertation

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1. Introduction and Rationale of the Study

The relevance and justification of this research stem from the increasing urgency of addressing escalating environmental challenges and the growing societal demand for sustainable development. These factors highlight the need to examine how environmental and sustainability education implemented within vocational education and training—through the application of project-based learning—can contribute to the development of environmentally conscious attitudes and responsible professional behaviour.

This dissertation analyses the theoretical and practical dimensions of environmental education in vocational education and training, and investigates the role that project-based learning may play in shaping students' knowledge and attitudes related to sustainability. The study focuses on the tourism and hospitality sector, where environmentally responsible operational practices are becoming increasingly significant in terms of both economic competitiveness and social responsibility.

2. Research Objectives and Hypotheses

The starting point of the research was the educational experience gained from the international ERASDG (Education Requires Application of Sustainable Development Goals) project, in which I participated as an external observer. In this dissertation, I

examine how the educational projects developed within the ERASDG framework can be adapted to the vocational education and training system of the tourism and hospitality sector in Hungary, as well as in Hungarian-language institutions beyond Hungary. The study builds on the experiences of pilot projects implemented at the Budapest Business Vocational Training Centre, Dobos C. József Hospitality Technology and Vocational School , and seeks to identify the conditions under which these developments may be extended to other institutions within the tourism and hospitality sector.

The aim of the research was to explore how the outcomes of international project developments may be adapted to tourism and hospitality training in Hungary and in Hungarian-language institutions beyond Hungary, and how such adaptations may contribute to the development of a sustainability-oriented mindset and to the effective implementation of project-based learning processes in vocational education and training.

The projects, methodological components, research instruments, and educational materials developed during the research are my original intellectual products. I independently carried out the adaptation of the projects to the tourism and hospitality sector, the design of the research, the collection and analysis of the data, and the interpretation of the findings.

Research Question:

Is the project-based learning approach more effective than traditional instructional methods in the field of environmental education and education for sustainability within vocational education and training (VET) institutions, with particular regard to the tourism and hospitality sector? Does it more effectively facilitate the development of sustainability-oriented thinking and better prepare students to meet labour market demands?

H1: I hypothesize that projects implemented in international and cross-sectoral training contexts can be successfully adapted to the Hungarian tourism and hospitality VET context with the involvement of domestic professionals.

H2: I hypothesize that adapting projects to the specific characteristics of the tourism and hospitality sector enhances their practical relevance.

H3: I hypothesize that educators require support to effectively implement project-based learning in environmental education and education for sustainability.

H4: I hypothesize that, in experimental project groups, both students' knowledge and attitudes show greater improvement compared to those of students taught through traditional instructional methods.

H5: I hypothesize that students perceive project-based learning as an instructional approach that supports the development of practical skills, creativity, and collaboration.

H6: I hypothesize that students evaluate the application of project-based learning as useful in the context of learning about sustainability.

H7: I hypothesize that students believe that acquiring a sustainability-oriented mindset enhances their competitiveness in the labour market.

3. Methods and Sample

The study employed a multi-phase, mixed-methods research design, integrating both qualitative and quantitative data collection and analysis procedures. The research was exploratory and analytical in nature, aiming to examine the applicability and impact of project-based learning (PBL) in the fields of environmental education and education for sustainability within vocational education and training (VET).

The research was implemented in three consecutive, interrelated phases.

In the first phase, the educational developments and operational processes of the international ERASDG project were examined. Data collection was conducted using qualitative methods, including observation, document analysis, and expert interviews. The

document analysis focused on project development materials and meeting minutes. The interviews were conducted with international project coordinators and Hungarian mentors involved in the project.

In the second phase, the national adaptation of the projects was carried out. Data collection was implemented at two levels. In the first part, a study was conducted among teachers in the vocational institutions of the Budapest Centre of Economic Vocational Training. Data were collected through semi-structured interviews and an online questionnaire survey. The questionnaire included closed- and open-ended questions, as well as Likert-scale items, focusing on the practice of implementing PBL, teachers' experiences, and the status of sustainability education. A total of 122 teachers from vocational institutions completed the questionnaire. In the second part, the projects were piloted at the Dobos C. József Hospitality Technology and Vocational School, part of the Budapest Centre of Economic Vocational Training. The study involved 9th- and 10th-grade students from the tourism and hospitality sector. During the research, experimental and control groups were established. Students in the experimental group participated in a project-based learning process, while the control group was taught using traditional instructional methods. Multiple measurement instruments were applied during data collection. To assess students' knowledge and attitudes, pre-test and post-test questionnaire measurements were conducted. Students participating in the project also completed additional evaluative and

comprehensive questionnaires focusing on their experiences with PBL, group work, and the development of sustainability-oriented thinking. Furthermore, students' project outputs—such as presentations, posters, and other artefacts—were also analyzed.

In the third phase of the research, the projects were implemented in additional Hungarian and cross-border VET institutions offering tourism and hospitality training. A total of 8 Hungarian and 6 cross-border vocational institutions participated in this phase. Experimental and control groups were also established in these institutions. Data analysis was conducted using both quantitative and qualitative methods. Questionnaire data were analyzed using repeated-measures group comparison techniques. The comparison of pre- and post-test results enabled the examination of changes in students' knowledge and attitudes between the experimental and control groups. Qualitative data—such as interviews, observations, and student outputs—were analyzed using thematic content analysis.

4. Research Findings and Interpretation of the Hypotheses

H1: Projects implemented in international, cross-sectoral training contexts can be successfully adapted to the Hungarian tourism and hospitality VET context with the involvement of domestic professionals.

The adaptation of international sustainability education practices within the framework of Hungarian tourism and hospitality

vocational education and training can be considered successful when global principles are aligned with local needs. This entails tailoring educational content and pedagogical approaches to the structure of the Hungarian VET system and to the specific challenges of the tourism and hospitality sector, while also taking into account labour market expectations and current environmental issues.

During the implementation process, empirical data were collected within institutions of the Budapest Centre of Economic Vocational Training. Interviews were conducted with 13 teachers of natural sciences, and questionnaire data were collected from 122 vocational subject teachers. Based on the responses, project-based learning (PBL) emerged as the second most frequently applied instructional method (86.90%). According to the respondents (on a 1–5 scale), its use facilitates the development of stronger teacher–student relationships (M = 3.73), while also enabling students to acquire applicable, practice-oriented knowledge (M = 3.69). Among the application disadvantages, 73% cited the difficulty of being too time-consuming, whereas adding innovative tools to teaching, such as digital technologies and simulations, can further increase learners' interest and engagement.

Drawing on the experience of the four ERASDG projects, the findings of the teacher interviews and questionnaires, and the characteristics of existing environmental education programmes, I developed four project packages adapted to the Hungarian tourism and

hospitality sector. These were later tested by participating teachers during the implementation phase.

The adapted projects were implemented in a total of 9 Hungarian and 6 cross-border Hungarian-language vocational institutions, involving 16 teachers and 1,622 students. Based on qualitative feedback from participating teachers, the effectiveness of PBL was primarily attributed to its focus on real-life situations, its capacity to enhance students' collaboration and problem-solving skills, and its ability to incorporate professionally authentic examples through cooperation with enterprises and industry partners.

Based on the development process of the projects and the feedback from implementing teachers, the implementation can be considered successful; therefore, Hypothesis H1 is confirmed.

H2: The adaptation of projects to the specific characteristics of the tourism and hospitality sector contributes to strengthening their practical relevance.

When adapting projects, it is essential to take into account the specific needs and training objectives of the given VET sector. In the tourism and hospitality sector, for example, the integration of practical knowledge related to sustainable hospitality becomes particularly important. During the adaptation process, special attention must be paid to incorporating sector-specific work environments and real-life

challenges into the project design. Furthermore, the involvement of key stakeholders—such as educators, local businesses, and professional organizations—is crucial for ensuring effectiveness.

Alignment with the sector was implemented through tasks such as medicinal and herb plant knowledge within the Living Lab project, which provided valuable experiential learning for students. As one student noted: *"In hospitality, it is important to know the plants we use, because this way we understand their functions, how to store them, and how to present them effectively in dishes."* Similarly, within the Gamification project, students developed tourism itineraries linked to hospitality venues. This led to reflections such as: *"A good hospitality professional not only understands the kitchen but also knows the surrounding area—this cannot simply be saved or digitized; it must be experienced."*

The importance of sector-specific alignment is further supported by the results of knowledge assessments. These findings indicate that students participating in the experimental group, learning through project-based methods, demonstrated greater improvement in knowledge levels compared to those in the control group, who were taught using traditional instructional methods. Notably, in the Team Learning project, tourism-related knowledge developed differently under the two instructional approaches, as confirmed by repeated-measures ANOVA ($F(1,39) = 67.39$, $p < 0.001$). Post hoc test results showed that the post-test scores of the experimental group were

significantly higher than those of the control group (MD = -1.45, t = -8.08, $p < 0.001$).

Based on student feedback and the results of the knowledge assessment questionnaires, sector-specific adaptation proved to be both necessary and effective. Therefore, Hypothesis H2 is confirmed.

H3: Educators require support for the effective implementation of project-based learning in environmental education and education for sustainability.

The high proportion of project-based tasks among the applied pedagogical methods indicates that educators increasingly recognize the importance of project-based learning (PBL) in enhancing student motivation and developing competencies. This also suggests that the transmission of practice-oriented knowledge has become a priority within vocational education and training (VET).

The role of educators is crucial in ensuring the success of adaptation processes. Continuous professional development and inter-institutional collaboration facilitate the integration of innovative pedagogical approaches and sustainability principles into everyday teaching practice. The exchange of experiences between institutions, as well as the sharing of best practices, can further contribute to the widespread dissemination of sustainability-oriented approaches within the Hungarian VET system.

Based on questionnaire data collected from educators of the Budapest Centre of Economic Vocational Training, two major challenges were identified. First, the implementation of PBL is difficult to align with school timetables, as indicated by 72.1% of respondents. Addressing this issue requires institutions to provide adequate resources, including teaching materials, tools, and technical support. Second, 73% of respondents reported that projects are excessively time-consuming. The workload associated with project-based learning can be reduced through the use of structured, ready-to-use project packages. Interviews with participating educators confirmed that pre-tested pilot project descriptions—offering concrete and practical guidance—provided substantial support for their work. These materials enable educators to incorporate project-based learning into their teaching practice with less additional effort. Furthermore, curriculum development and more flexible scheduling frameworks can create opportunities for embedding projects as an integral part of the instructional process. During the implementation phase, professional consultations among educators also facilitated valuable knowledge exchange, including the involvement of external partners.

Findings from both interviews and questionnaire data confirm that the efficient use of resources is a key factor in the successful pedagogical implementation of PBL. This can be effectively supported through experience sharing and the provision of "ready-to-

use" project packages. Based on the research results collected during the implementation process, Hypothesis H3 is confirmed.

H4: In experimental project groups, both students' knowledge and attitudes develop more effectively compared to students taught through traditional instructional methods.

The findings of the research support this hypothesis. The results clearly demonstrate that the application of project-based learning (PBL) leads to more effective development of students' knowledge and cognitive outcomes compared to traditional instructional approaches. In the Team Learning and Gamification projects—both primarily focused on knowledge acquisition—students in the experimental groups showed significantly greater improvement in knowledge expansion than those in the control groups. In the case of the Team Learning project, across all thematic areas (e.g., Agenda 2030, nutrition, trade, tourism), students in the experimental groups achieved significantly higher gains in knowledge compared to those taught using traditional methods. This is further supported by the overall knowledge scores, where repeated-measures ANOVA confirmed the superiority of PBL in enhancing knowledge ($F(1,39) = 96.29$, $p < 0.001$). Similarly, within the Gamification project, students expanded their knowledge related to the natural environment. The results of repeated-measures ANOVA also indicated significantly

greater improvement in the experimental groups compared to the control groups ($F(1,39) = 56.68$, $p < 0.001$).

These findings suggest that, in terms of cognitive development and knowledge acquisition, project-based learning is both more motivating and more effective for students than traditional, teacher-centred instruction. Differences observed between participating institutions further reinforce the role of PBL in supporting knowledge development. Overall, the progress of the control groups confirmed hypothesis H4 that the project method provides more effective learning outcomes.

The Gamification project aimed to develop attitudes towards nature, in addition to knowledge about nature, while the Innovation Camp reinforced attitudes towards giving, self-discipline and the environment. Although the students' attitudes mostly improved between the two measurements, no significant difference in the extent of improvement between the experimental and control groups could be detected. In the Gamification project, repeated-measures ANOVA showed no significant difference in the development of attitudes toward nature between the experimental and control groups ($F(1,39) = 2.09$, $p = 0.149$). Similarly, in the Innovation Camp, no significant differences were observed between the two groups regarding attitudes toward donation ($F(1,45) = 0.87$, $p = 0.349$), volunteering ($F(1,45) = 0.39$, $p = 0.533$), or environmental attitudes ($F(1,45) = 0.60$, $p = 0.438$).

These results indicate that deeper attitudinal transformation likely requires longer-term and more complex pedagogical interventions. Overall, the study does not confirm that PBL leads to significantly stronger attitudinal change compared to traditional instruction.

On the basis of these findings, Hypothesis H4 can be accepted only in part: although project-based learning did not prove more effective than traditional instruction in developing students' attitudes, the progress achieved by the experimental groups confirms that it was more effective in terms of learning outcomes and knowledge development.

H5: Students perceive project-based learning as an instructional approach that supports the development of practical skills, creativity, and collaboration.

Project-based learning enables students to engage in solving real-world problems, thereby fostering the development of practical skills. In the tourism and hospitality sector, for instance, designing the operation of a sustainable restaurant allows students to acquire essential knowledge related to resource management and waste management practices.

During the Innovation Camp, students evaluated their level of engagement more positively compared to the Gamification project.

Topics such as volunteering, donation, waste management, recycling, and guest awareness were directly linked to everyday professional practices in the tourism and hospitality sector. Students demonstrated a higher level of involvement in these tasks, as they represent realistic and recurring decision-making situations relevant to their future careers.

Based on evaluative questionnaires administered during the adaptation phase, group work and coordination (measured on a 0–3 scale) were rated as most important in the Innovation Camp ($M = 1.88$), while the lowest—but still relatively high—ratings were observed in the Team Learning project ($M = 1.63$). During the implementation phase, students most frequently (27.23%) spontaneously identified group work as a preferred element of the projects, with particularly high emphasis in the Innovation Camp (34.60%). Students consistently expressed positive attitudes toward interactive, collaborative activities that allowed them to realize their own ideas.

In terms of creativity, results from the extended phase indicated statistically significant differences between projects. According to the Kruskal–Wallis test ($H(3) = 9.39$, $p = 0.024$), students rated their own creativity significantly higher in the Innovation Camp compared to the Living Lab project ($p = 0.012$). Creativity demonstrated in the Living Lab project was also lower compared to the Team Learning project ($p = 0.022$). In open-ended

responses of the comprehensive evaluation questionnaires, students spontaneously mentioned creativity (15.74%) as a key learning outcome. As one student reflected: *"I liked creating the project board because I could be creative, and it felt great to see how everything we worked on came together."*

The variety and quality of student-generated outputs—ranging from audiovisual materials and presentations to digital texts and handmade creative posters—clearly reflect the development of students' visual expression and problem-solving skills. The diversity of these outputs, along with competition results, awards, and recognitions, further support the effectiveness of creative task implementation.

Overall, students were able to apply their creativity while developing innovative and sustainable ideas, and their collaboration skills were enhanced through group work. Based on these findings, Hypothesis H5 is confirmed.

H6: Students perceive the application of project-based learning as useful in the context of learning about sustainability.

Projects focusing on environmental problem-solving make learning content more engaging and relevant for students.

The evaluation of students' project experiences also highlights that different projects contributed in varying ways to their perceptions

of the learning process. In the case of the Living Lab project, student satisfaction with project presentations was significantly lower compared to both the Innovation Camp ($p = 0.012$) and the Team Learning project ($p = 0.035$). One possible explanation is that preparatory gardening activities and fieldwork were less motivating for some students, which negatively influenced their attitudes toward the presentation component as well.

During the adaptation phase, evaluation questionnaires indicated that the projects effectively supported the expansion of sustainability-related knowledge, resulting in increased student confidence. As one student noted: *"The future of hospitality is sustainability, and those who understand and apply it well will succeed."* In comprehensive questionnaires, students also emphasized that the projects facilitated their understanding of sustainability: "*It made me realize that we really need to live consciously and protect the environment."*

In the implementation phase, evaluation data revealed that 21.38% of students spontaneously mentioned environmental awareness and sustainability among the skills they had acquired. This proportion was even higher in the Living Lab (29.61%) and Gamification (30.46%) projects. Furthermore, when reflecting on their future professional success, students most frequently identified sustainability-related knowledge as a contributing factor (19.43%),

with even higher proportions in the Team Learning project (n = 69, 33.17%).

Overall, students consistently ranked sustainability-related knowledge among the most important competencies acquired through the projects, both in terms of learning outcomes and future career relevance. Therefore, Hypothesis H6 is confirmed.

H7: Students believe that acquiring a sustainability-oriented mindset enhances their competitiveness in the labour market.

Within the framework of vocational education and training (VET), the development of complex competencies is essential, particularly those related to environmental awareness, responsible consumption, and problem-solving. These competencies are not only crucial for achieving sustainability goals but also significantly improve students' employability, especially in rapidly changing industry environments.

In the tourism and hospitality sector, for example, there is an increasing demand for sustainable resource management and environmentally conscious services. Practical knowledge acquired through project-based learning—such as collaboration, innovation, and problem-solving—represents valuable competencies for employers. Students develop a deeper understanding of the business

advantages of sustainable practices and become capable of applying these principles in their future professional activities.

During the adaptation phase, evaluation questionnaires revealed that students perceived the projects as contributing to the development of skills that enhance their future competitiveness. As one student noted: *"We designed a poster, which can be useful in hospitality later, for example when promoting offers or events."* Similarly, in comprehensive questionnaires, students emphasized the practical applicability of their learning: *"I will be able to use this later in life, especially knowledge about herbs in the kitchen."*

In the implementation phase, students were able to clearly articulate which competencies they had developed and how these could be applied in the labour market. Among spontaneous responses, the most frequently mentioned were sustainability-related skills (19.43%), followed by the integration of innovation, scientific knowledge, and hospitality expertise (17.53%), and personal development (17.15%). Students also highlighted the importance of professional networking (13.62%), as well as communication skills and teamwork (11.85%) for their future careers. In relation to workplace readiness, responses from comprehensive evaluation questionnaires indicated that students most frequently identified teamwork (55.5%), time management (40.8%), communication skills (33.8%), and the ability to compromise (23.9%) as key competencies developed through the projects.

Overall, students were able to identify and reflect on the skills and knowledge acquired during the projects that will support their future professional advancement. Therefore, Hypothesis H7 is confirmed.

5. Conclusions

Education for sustainability is of key importance in tourism and hospitality vocational education and training (VET), as the sector has a direct impact on the environment, the economy, and local communities. In Hungary, the sector accounts for approximately 6–10% of GDP (Hungarian Central Statistical Office, 2020), highlighting its economic significance. Therefore, it is essential for VET to promote sustainability-oriented thinking and practical solutions, enabling future professionals to make responsible decisions.

To enhance educational effectiveness, sustainability perspectives need to be more broadly integrated into teaching and learning processes. This involves not only the transmission of theoretical knowledge but also the development of skills applicable in everyday life and professional practice. In this context, methodological support for educators and the adaptation of international best practices play a crucial role.

The findings of the research demonstrate that project-based learning (PBL) effectively supports environmental education and the development of sustainability-oriented thinking within VET. Tasks

built around real-world problems foster active student engagement while simultaneously enhancing creativity and collaboration skills.

According to educators' experiences, the project method strengthens students' practical competencies and promotes active learning. At the same time, its implementation presents certain challenges, particularly in terms of time requirements and the availability of resources.

The results of the projects contributed to the expansion of students' knowledge and the development of their perspectives, although attitudinal changes appear to require a longer time frame to become measurable. The analysis of student-generated outputs also indicated improvements in creativity, systems thinking, and reflective skills.

Based on both student and teacher feedback, project-based learning creates a more motivating and experience-oriented learning environment. Tasks grounded in real-life situations enhance collaboration and communication skills, thereby contributing to improved preparedness for the labour market.

6. Directions for Further Research

In order to enhance the effectiveness of education for sustainability, future research should devote greater attention to the development of educational tools, pedagogical methods, and leadership strategies. The following recommendations aim to

strengthen the integration of environmental education and sustainability principles within sector-specific vocational education and training.

Development of Sector-Specific Project-Based Teaching Packages

One key direction for future research is the design of project-based teaching packages tailored to the sustainability challenges of specific sectors. These packages could be built around real-world problem-solving tasks and support educators in implementing already tested project models, while also fostering the development of students' sustainability-oriented thinking.

Introduction of Mandatory School-Based Projects

To ensure the effective implementation of these teaching packages, it is recommended that institutions incorporate at least two project-based learning activities per academic year. This would promote active student engagement and facilitate the practical application of theoretical knowledge. Project topics should be aligned with the specific characteristics and professional requirements of each sector.

The Importance of Leadership Attitudes and Institutional Sensitivity

The successful institutional integration of education for sustainability largely depends on the attitudes and commitment of school leaders. Therefore, future research should examine how leadership decisions and supportive institutional environments

contribute to the implementation of transformative, sustainability-focused projects.

Organisation and Incentivisation of Teacher Professional Development

For the effective implementation of instructional packages, it is essential to ensure teachers' methodological preparedness. Therefore, it is recommended to organize in-service training programs that support the expansion of sustainability-related knowledge and the acquisition of project-based learning methodologies. Recognizing these training programs through a credit-based system could further motivate teachers to participate.

Impact Assessment of the Results and Ongoing Improvement of the Program

Following the implementation of the programs, it is crucial to conduct regular impact assessments. Based on feedback from both students and institutions, the programs can be continuously refined, thereby contributing to the long-term effectiveness of sustainability education within vocational education and training.

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