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# Building a sustainable future: perspectives on primary school sustainability projects from teachers and pre-service teachers

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**ABSTRACT**

Teachers play a critical role in implementing sustainable development education in the classroom and fostering sustainability awareness among students. The foundational knowledge and skills gained at the primary level help students develop sustainable practices and become environmentally conscious individuals. This study examines the experiences and perspectives of primary school teachers and pre-service teachers regarding sustainable development projects at the primary level, providing a qualitative, in-depth look at the feasibility and impact of sustainability education in classrooms. Insights were gathered from 52 participants (40 pre-service teachers with course experience in "sustainable development and education" and 12 primary teachers) using a phenomenological design. Findings show that pre-service teachers primarily used students'-based methods such as group work, brainstorming, and drama supported by mostly Web 2.0 tools and visuals, evaluating learning outcomes with pre and post-tests. However, they faced challenges in engaging students, accessing materials, and funding. Notably, sustainable development projects were found to enhance sustainability awareness in teachers and students while promoting global citizenship and critical thinking skills. These findings, consistent with literature, underscore the role of sustainable development education in fostering social awareness and competency development, offering strategic insights to improve its classroom implementation and the effectiveness of teachers' contributions.



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## 1. INTRODUCTION

In the last few decades, the acceleration of environmental degradation and the increasing danger of depletion of natural resources have made the concepts of sustainable and sustainable development important topics of discussion. The term sustainability was first defined in 1987 in the report entitled 'our common future' (Brundtland Report) published by the United Nations (UN)-sponsored World Commission on Environment and Development. This report defined sustainable development as 'meeting the needs of the present without compromising the ability of future generations to meet their own needs' [1]. Since then, thousands of initiatives have been undertaken at local, national and global levels to address different aspects of environmental challenges. Sustainable development refers not only to environmental objectives but also to social and economic goals [2]. Initiatives targeting sustainable development have yielded a series of promising outcomes. However, the impact of these initiatives on shaping our "common future" in a more sustainable way remains limited in the face of the magnitude of global environmental challenges. This situation has led to increasing frustration among various groups supporting the concept of sustainable

development [3]. Sustainability has gained a global framework today through the UN' 2030 sustainable development goals (SDGs). It is a roadmap adopted by all UN member states in 2015, aiming for peace and prosperity for both people and the planet, in the present and in the future. This agenda is shaped around 17 SDGs, which require the rapid mobilization of both developed and developing countries within a framework of global cooperation. These goals emphasize that ending poverty and other forms of deprivation must be addressed in an integrated manner, alongside strategies aimed at improving health and education, reducing inequalities, and promoting economic growth. It is essential to continue efforts to combat climate change and protect oceans and forests while achieving all these goals. The SDGs reflect an understanding that sustainable development must address economic growth, social well-being, and environmental protection as an integrated whole in every region [4]. The sustainable development approach, which is defined as ensuring the continuity of resources that can meet the needs of future generations while meeting the needs of the current world population in a fair and equal manner without limiting the needs of the current world population, requires the development of development policies that cover all countries on a global scale with its environmental, social and economic dimensions and are compatible with the balance of the ecosystem.

Education, through the integration of the principle of sustainable development into instructional processes, can increase children's and young people's awareness of the shared future of humanity; this, in turn, may foster awareness regarding the development and implementation of solutions to environmental and social problems [5], [6]. The UN 2030 agenda identifies education for sustainability as the key to achieving other goals through its emphasis on the target of quality education [7]. Knowledge related to sustainable environmental development is considered a fundamental element in shaping citizenship awareness and, consequently, in educational processes [8]. The role of teachers as educators is to encourage the next generation to engage in the processes of shaping society and to equip them with the competencies required for this purpose. [9]. While basic education forms the basis of environmental and development education, these elements need to be integrated as an integral part of learning. Education, both formal and non-formal, is indispensable to improve people's attitudes and capacities to assess and address their concerns towards sustainable development [6]–[10]. Educational initiatives aimed at achieving the SDGs are often categorized under the concept of "education for sustainable development" (ESD). The adoption of the 2030 sustainable development agenda has provided new momentum for sustainable development education and created a highly favorable environment for the widespread implementation of ESD. ESD is globally recognized as an important tool for transformation, granting students the authority to make the necessary decisions and take actions to build a society that is respectful of the environment and cultural diversity, fair, and economically sustainable [11]. Research shows that the learning of sustainability competencies is based on collaboration and dialogue with other students and teachers, where children use their imagination to achieve environmental goals in their daily lives [12].

Considering that the knowledge and skills learned during childhood directly influence adulthood [13], it is crucial to teach sustainability-related knowledge and skills at the primary school level. A review of the literature reveals that sustainability competencies are predominantly addressed at the higher education level, with limited research conducted at the primary education level [12]. Teachers, who play a significant role in educating future decision-makers as agents of change [14], hold a critical position in shaping the instructional process for teaching sustainability at the primary school level. Developing diverse strategies to enhance the understanding of sustainability positively impacts the teaching process [15]. Improving teachers' competencies in sustainable development education projects and assessing the impact of these projects on both teachers and students are essential for enhancing the quality of educational processes. Accordingly, strategic priority should be given to teacher education [16], and examining the perspectives of pre-service teachers on this process is considered to contribute significantly to sustainability education. This study aims to evaluate the ESD projects implemented by pre-service and current primary school teachers at the elementary level and to determine the reflections of these projects on students. In this context, the research questions are given:

- What are the general characteristics of the sustainable development projects prepared by pre-service primary school teachers?
- What are the views of pre-service primary school teachers regarding the contributions of sustainable development projects in primary schools to students' learning processes and awareness?
- According to the opinions of pre-service teachers and in-service teachers, what teaching methods and techniques can be utilized within the curriculum to attain SDGs in primary education?

## 2. METHOD

In this study, phenomenological design, which is a qualitative research method, was employed to evaluate how pre-service teachers experienced the projects they implemented within the framework of ESD

and to assess the contributions of these projects to the learning process. Phenomenology is a method that focuses on the evaluation of lived experiences, perceptions, events, and attitudes. It pertains to subjective experiences and sensations that, while not directly known, are nonetheless recognized [17].

### 2.1. Study group

In the study, purposive sampling was employed. Purposive sampling allows for the in-depth study of cases that are considered to be information rich [18]. To ensure that the practitioner is well-versed in SDGs and to prevent potential issues arising from gaps in content knowledge during the teaching process, it was established as a criterion that practitioners must have completed the 'sustainable development and education' course during their undergraduate education and have prepared at least one lesson plan related to a SDGs aligned with the learning outcomes of the primary school curriculum. The study group consisted of 40 pre-service primary school teachers selected according to predefined criteria. The pre-service teachers carried out their projects through collaborative group work. Pre-service teachers were observed by 12 more experienced teachers.

### 2.2. Data collection tools

In this study, a semi-structured interview form was used as the data collection tool for both teachers and pre-service teachers. The questions in the semi-structured interview form were prepared based on the sub-objectives of the research. To assess the relevance and clarity of the research questions, the opinions and approval of two experts in the field were obtained. The research data were collected during the 2023-2024 academic year in a primary school in Ankara, Türkiye. After preparing the projects, the 40 pre-service teachers consulted an academic expert in sustainability. After forming their project teams, the pre-service teachers conducted a comprehensive literature review on the SDGs they had selected and defined the objectives and content of their projects. They then made preparations for the teaching process, considering the target audience and the learning outcomes of the relevant curriculum. After creating a timeline, they obtained the necessary permissions from the school administration and communicated with the teachers of the classes where they would implement their projects, informing them about the project plan.

After the projects, interviews were conducted with pre-service teachers and classroom teachers. Interview transcriptions were imported into MAXQDA 24 software, and content analysis was conducted. As a result of the analysis, categories and themes appropriate to the codes determined were reached. The codes obtained from the data were re-examined three different times. Some of the codes were changed as a result of the first two reviews and the codes, categories and themes were finalized as a result of the third review.

### 2.3. Validity and reliability

In qualitative research, validity is directly related to the processes of data collection, analysis, and interpretation by the researchers. At the same time, in content analysis, validity concerns the relationship between the objectives and the tools used [19]. In the study, in-depth data was collected through interviews with 40 pre-service teachers who implemented sustainable development projects for primary school students, as well as 9 classroom teachers who observed the projects. To ensure the transferability of the research, purposive sampling was used, and detailed descriptions were provided. Whether the findings of the study are meaningful and hold credibility for the reader constitutes the issue of internal validity [20].

In order to enhance the internal validity of the study, a comprehensive review of the relevant literature was conducted, and data collection tools were developed accordingly. The themes identified through content analysis were carefully delimited to encompass relevant concepts and exclude unrelated ones. The relationships between categories and themes were evaluated to ensure a holistic structure. The methodological details of the study are critical for ensuring external validity. The detailed presentation of the data collection, implementation, and analysis processes enhances the replicability of the study by other researchers and increases the generalizability of the findings Creswell [21]. To ensure external validity, the data collection, implementation, and analysis phases of the research process were explained in detail. The codes, categories, and themes derived from the research data were reviewed for consistency by two researchers, one specializing in ESD and the other in primary education. To calculate the consistency between the coding made by the two experts, the formula by Miles and Huberman [20] was used.

$$\text{Reliability} = \frac{\text{number of agreements}}{\text{number of agreements} + \text{number of disagreements}}$$

As a result of the calculation, this coefficient was found to be 93%. Since the calculated coefficient is above 70%, the coding provided by the experts was considered consistent.

## 3. RESULTS

Within the scope of the study, 40 pre-service primary school teachers implemented sustainable development projects at the primary school level, and 12 classroom teachers observed the pre-service teachers. At the end of the implementation, the pre-service teachers were asked questions regarding the implementation process, and three categories were identified: general features of the project, teaching process, and challenges and proposed solutions. Subsequently, both the pre-service teachers and the classroom teachers were asked questions about their evaluation of the project, leading to the identification of two additional categories: impacts and planned teaching process for future SDGs.

### 3.1. Pre-service primary school teachers' perspectives on the general features of the project

Interviews conducted with pre-service classroom teachers following the sustainable development projects revealed general evaluations of the projects. These evaluations included insights into the overall features of the projects as well as reflections based on the experiences of the pre-service teachers. Detailed views of the pre-service teachers regarding the projects are presented in Figure 1.

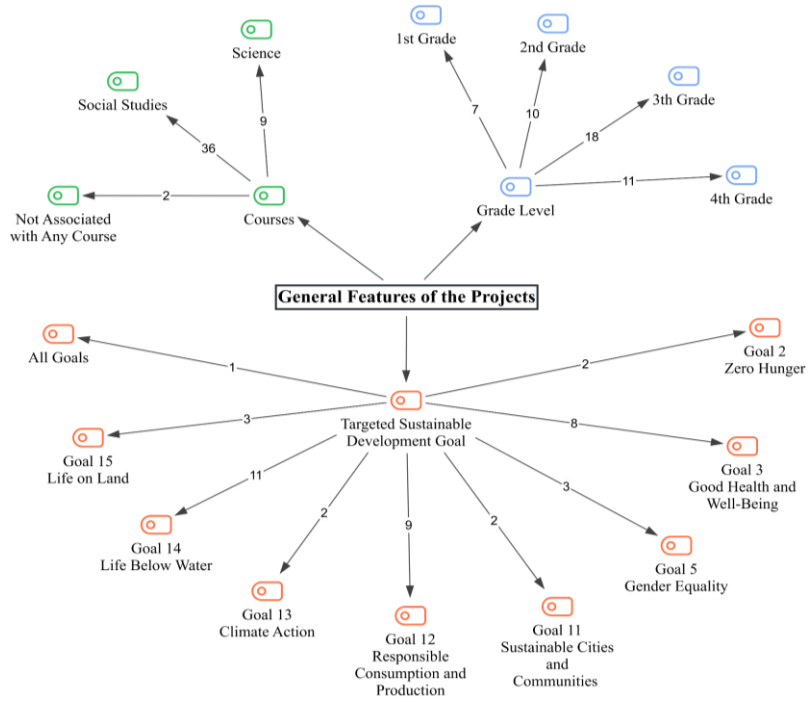


Figure 1. Pre-service primary school teachers' perspectives on the general features of the project

According to Figure 1, the general features of the project are divided into three categories: lessons, grade level, and the targeted SDGs. Pre-service teachers (P40 and P11) stated that their projects were not associated with any specific subject, as indicated by the comments: "*Our project was not related to any particular subject; it was a project that covered all subjects in general*" (P40) and "*It was not associated with any subject*" (P11). On the other hand, nine pre-service teachers mentioned that their projects were linked to science lessons, with comments "*It was prepared in relation to science lessons*" (P1). During the interviews, it was found that most of the projects were associated with life sciences/social studies lessons.

Upon examining Figure 1, it was found that the pre-service teachers implemented projects at all grade levels of primary school. The most frequently implemented projects were in the 3rd, 4th, 2nd, and 1st grades, respectively. Seven pre-service teachers indicated that they conducted their projects in 1st grade, with statements such as "*We implemented it with 1st-grade students*" (P14) and "*Our project was suitable for all primary school grade levels*" (P40). There were 10 pre-service teachers mentioned that they worked with 2nd-grade students, with expressions like "*It was implemented in 2nd grade*" (P15) and "*We conducted the project with 2nd-grade students*" (P6). There were 11 pre-service teachers stated that they implemented their projects with 3rd-grade students, saying "*I implemented the project with 3rd-grade primary school students*" (P8). Lastly, 18 pre-service teachers indicated that their projects were conducted with 4th-grade students, with comments such as "*We implemented our project with 4th-grade primary school students*" (P22).

Finally, regarding the general features of the project, it was determined which SDGs each project was related to. Based on the interviews, two pre-service teachers stated that they focused on the zero-hunger goal, with comments such as "*We selected the zero-hunger sustainable development goal*" (P3). Eight pre-service teachers mentioned that they worked on the good health and well-being goal, saying "*We focused on combating infectious diseases under the good health and well-being goal*" (P6). Three pre-service teachers indicated that their projects addressed the gender equality goal, with comments like "*The focus was on the gender equality goal*" (P38). Two pre-service teachers referred to the sustainable cities and communities' goal, with statements "*Our project focused on the eleventh goal of sustainable development, Sustainable cities and communities. The students were asked to design their cities considering individuals with special needs, solve transportation issues, and use renewable energy sources*" (P27), thus, addressing topics aimed at solving social problems. Regarding environmental issues, two pre-service teachers focused on the climate action goal, 11 focused on life below water, and three focused on life on land. Lastly, nine pre-service teachers mentioned that they addressed the responsible consumption and production goal, with comments such as "*We chose the 12th sustainable development goal, responsible consumption and production*" (P31) addressing economic issues. One pre-service teacher (P1) stated, "*We focused on all 17 sustainable development goals*," indicating that all goals were included in her project. It was observed that no pre-service teachers conducted projects related to goal 1, goal 4, goal 6, goal 7, goal 8, goal 9, goal 10, and goal 16.

### 3.2. Pre-service primary school teachers' perspectives on the teaching process

The perspectives of pre-service classroom teachers on the teaching process were categorized into three main areas: "methods and techniques used," "materials used," and "methods and techniques used in assessment and evaluation." These categories are based on the analysis of the experiences gained by the pre-service teachers during the implementation process. Detailed views of the pre-service teachers on the teaching process are presented in Figure 2.

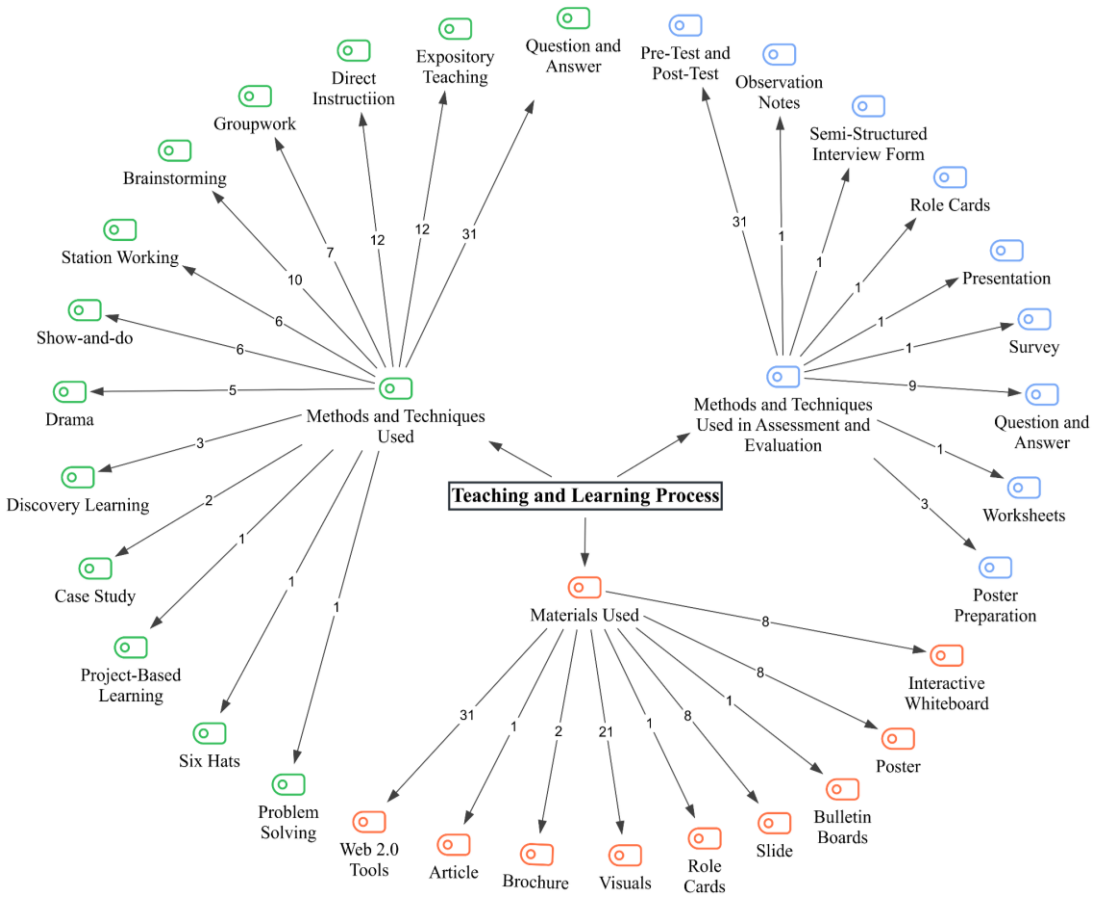


Figure 2. Pre-service primary school teachers' perspectives on the teaching process

According to Figure 2, it is observed that the question-and-answer method was the most frequently used during the process. The pre-service teachers expressed their opinions on this matter with the statements: "*We proceeded using the question-and-answer method to understand their readiness*" (P5), "*We asked them to respond to the questions we had prepared in advance, and we brought a few visuals to the classroom and asked them what they meant*" (P13), and "*In the implementation, the students were first acquainted with, then visuals were shown, and the students were prompted to reflect on the future of the Earth and environmental pollution using the question-and-answer method*" (P27). After the question-and-answer method, the pre-service teachers stated that they mostly used direct instruction methods. Seven of the pre-service teachers mentioned using group work, six used station work, six used the show-and-do method, five employed drama, three applied discovery learning, two used case study, one used project-based learning, one employed the six thinking hats method, and one used the problem-solving method, all of which are considered constructivist teaching methods. The pre-service teachers referred to group work with statements such as, "*Afterwards, students who were divided into groups were asked to design a city using the Little Architects project paper, prepared in accordance with the objectives of the sustainable cities and communities' goal. The designed cities were drawn collaboratively and later presented by the students*" (P27). They referred to discovery learning activities with statements like, "*I also conducted an activity in the classroom. I polluted a clean water sample over a week and told the students that we would observe it together the following week. I also facilitated collaboration among the students as part of my activity*" (P33). Additionally, they mentioned case study activities with statements like, "*A sustainability poster was shown to encourage students to reflect on the goals. Information about the concept of sustainability was provided through a video, and students were helped to understand the concept through good and bad case examples*" (P27).

The analysis of Figure 2 revealed that pre-service teachers used nine different materials, including Web 2.0 tools, articles, brochures, visuals, role cards, slides, bulletin boards, posters, and interactive whiteboards. Among these, Web 2.0 tools were identified as the most frequently used materials during the projects. The pre-service teachers expressed their thoughts on this with statements such as: "*We used Word programs and the Canva web tool*" (P4), "*We utilized YouTube and Canva*" (P6), and "*The Canva web tool was used during the project preparation and implementation*" (P23). Additionally, 21 pre-service teachers indicated that they used visual materials, making them the second most frequently used materials after Web 2.0 tools. The pre-service teachers highlighted their use of visual materials with statements like, "*Afterwards, we showed the visuals and pictures we brought to the classroom and asked what they were. We focused on visual and auditory aspects*" (P13), and "*While explaining the topic, we used visuals and videos to capture the students' attention*" (P20). This finding suggests that visuals play a significant role in engaging students and reinforcing the content in sustainable development projects.

Slides, posters, and interactive whiteboards were preferred by eight pre-service teachers. Among those who used slides, P4 stated, "*We prepared a slide to address what infectious diseases are*." Among those who used posters, P23 noted, "*We used a sustainability poster to draw attention*," indicating the use of ready-made posters during the attention-grabbing phase, while P21 mentioned, "*We prepared the visuals ourselves and gave the students the opportunity to arrange them on the poster as they wished*," indicating that the posters were created by the students. Lastly, role cards, articles, and bulletin boards were among the less frequently used materials.

Data were collected regarding the assessment and evaluation process used during the teaching process, revealing that nine different assessment and evaluation methods were utilized during the project. It was determined that the most frequently used method within the project was the pre- and post-test approach. P2 expressed their use of this method with the statement, "*We applied a pre-test before the implementation to measure their readiness and used post-test methods to determine their progress*." Similarly, P6 shared, "*We applied pre-tests to assess students' knowledge levels about sustainability and infectious diseases, and post-tests to analyze whether the intended objectives were achieved at the end of the project.*"

Considering the responses of nine pre-service teachers, such as "*We asked students a lot of questions and gathered their opinions*" (P21) and "*We used the question-and-answer technique*" (P20), it was determined that the question-and-answer method was the second most used method after the pre-test and post-test approach. Another method and technique used during the assessment and evaluation phase was poster preparation. Three pre-service teachers indicated their use of this method with statements like, "*We asked students to prepare a poster using the station technique for evaluation*" (P18) and "*We asked students to prepare a poster at the end of the process for this purpose*" (P25).

Various methods were also employed in the assessment and evaluation process, including presentations, surveys, semi-structured interview forms, observation notes, role cards, and worksheets. Among the pre-service teachers who used the presentation method, P23 stated, "*We asked them to present the cities they designed as a group and the products they created and used*," indicating that group work was evaluated through presentations. P40, on the other hand, highlighted their use of surveys in this process with

the statement, "*Questions were prepared using surveys and presented to the teachers. The information obtained was then used to create posters, which were displayed in classrooms*." Lastly, it was determined that pre-service teachers used observation forms and semi-structured interview forms less frequently compared to other methods.

### 3.3. Pre-service primary school teachers' perspectives on challenges and suggested solutions

The findings from the interviews indicated that pre-service teachers faced certain challenges while implementing sustainable development projects. Additionally, it was found that they proposed specific solutions to address these challenges. The challenges encountered by pre-service teachers during the implementation process, along with their proposed solutions, are presented in Figure 3.

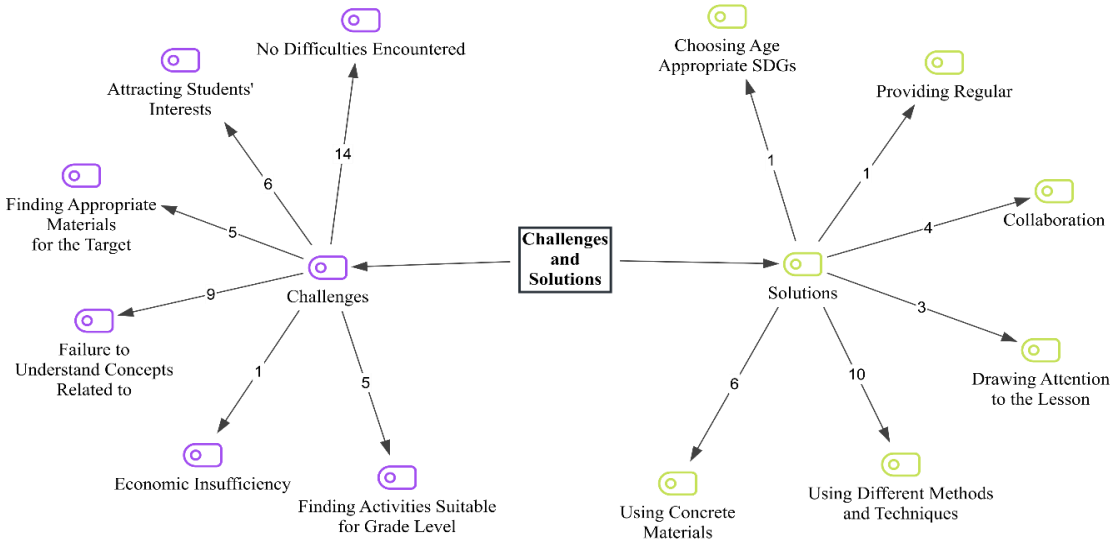


Figure 3. Pre-service primary school teachers' perspectives on challenges and suggested solutions

When Figure 3 is examined, 14 pre-service teachers expressed that they did not encounter any difficulties, with statements such as, "*I thought it would be difficult, but contrary to my expectations, everything was much simpler*" (P15), "*I cannot say that we had difficulty reaching the goals*" (P22), and "*We did not encounter any obstacles*" (P11). However, 26 pre-service teachers indicated that they faced challenges in six different areas. Nine of the pre-service teachers mentioned difficulties in understanding concepts related to sustainability, with statements like, "*I initially faced challenges because they did not know some of the concepts in the classroom*" (P10), "*Since we conducted the project with first-grade students, they had difficulty understanding the concept of sustainability*" (P18), and "*It was difficult to explain the abstract concept of sustainability to the children at first*" (P32).

While preparing lesson plans within the scope of the project, they mentioned having difficulty finding activities suitable for the class level with expressions such as, "*I had difficulty finding a project suitable for the class level*" (P2). They mentioned having difficulty finding materials suitable for the objectives with statements such as, "*Classroom materials were insufficient*" (P8), and noted challenges in attracting students' interest with remarks like, "*Creating awareness in a way that would capture the students' interest was one of the challenges we faced*" (P14). Additionally, one of the pre-service teachers (P6), expressed that "*Finding the funding required for the project and involving participants in the project could sometimes be challenging*," highlighting economic constraints as a challenge.

The pre-service teachers proposed some solutions to the challenges they encountered. When Figure 2 is examined, it is seen that the most common approach to solving the problems encountered during the implementation process was using different methods and techniques. P33 explained that they used the question-and-answer method in addition to direct instruction, stating "*To prevent this, I made an effort not to rely solely on direct instruction. I tried to ensure interaction in the classroom by engaging in frequent question-and-answer sessions*." Similarly, P17 indicated that they used active learning methods with the statement, "*While implementing the plan, we prepared a plan that allowed the children to be more active with the methods and techniques we selected, enabling them to learn through fun and hands-on experiences*."

The pre-service teachers who mentioned the difficulty of understanding abstract topics like sustainability at the primary school level explained the need to use concrete materials to address these issues. P38 stated, "*Since we were working with a younger age group, they had some difficulty understanding at first. Despite being younger, gender pressure created by society has had a significant impact. To overcome this, I simplified it to a more concrete and understandable level by giving examples from events they encountered in daily life. I tried to add more meaning through videos and visuals.*" Similarly, P36 noted, "*We observed that they got bored when talking about the 17 global goals, so we addressed the abstract topics in a concrete manner by showing examples of what each goal actually is*." P3 indicating that they used concrete materials as a solution when they struggled to capture the students' attention. Similar to the perspective of P36, three pre-service teachers indicated that they attempted to draw students' attention to the lesson in order to address the challenges they faced during the process. This is expressed by P2 as: "*I had difficulty finding a project suitable for the grade level. However, by observing the students, I identified the aspects that captured their attention and shaped my project accordingly.*"

On the other hand, P6 emphasizing the collaboration with students and external institutions to address the economic challenges encountered during the process. "*To overcome these obstacles, we focused on strengthening collaboration and communication, as well as adopting a flexible approach. For instance, while preparing the hygiene kits, we encouraged students to take responsibility for completing some of the required materials themselves. Additionally, we established communication with various organizations for the printing of the brochures.*" Likewise, P22, P27, and P8 reported that they collaborated with students throughout the process, which contributed to maintaining students' engagement and interest in the lesson. P23, who encountered challenges in facilitating students' understanding of the subject matter, addressed this issue by providing consistent feedback, stating "*To mitigate these challenges, we actively provided feedback and corrections throughout the implementation process and responded to their questions.*" Similarly, P4 reported resolving this issue by selecting a SDGs that was appropriate for the students' developmental level.

### 3.4. Perspectives of pre-service primary school teachers and primary school teachers on the impact of sustainable development project

Following the SDGs projects, questions were posed to the primary school teachers and the pre-service teachers who implemented the projects regarding their impact. Based on the findings obtained, it was determined that the project provided different contributions to both students and teachers. The perspectives of primary school teachers and pre-service teachers regarding the impact of the project on students are presented in a comparative manner in Figure 4.

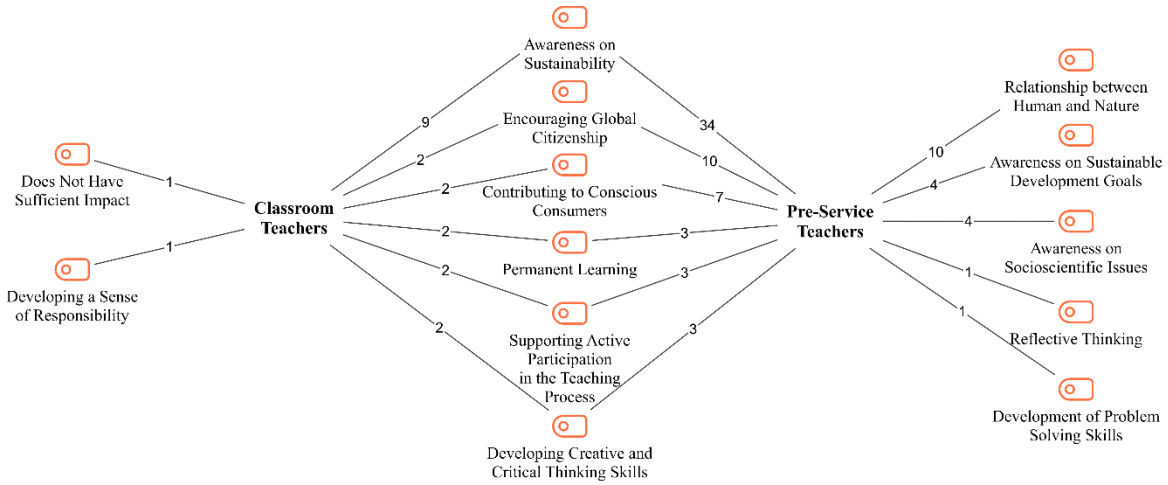


Figure 4. Perspectives of pre-service classroom teachers and classroom teachers on the impact of sustainable development projects

It was determined that, upon examining Figure 4, six shared perspectives on the educational impact, as well as some differing themes, emerged from the interviews conducted with primary school teachers and pre-service teachers. There were nine primary school teachers indicated that the projects enhanced students' understanding of sustainability concepts, using expressions such as, "*They have started to act more*

*consciously and with greater self-control*" (T5). Similarly, 34 pre-service teachers expressed aligned perspectives with those of primary school teachers, "*Through education, students' awareness of sustainability improves, and they become more sensitive individuals towards their environment*" (P14).

The pre-service teachers, in addition to the primary school teachers, highlighted that the projects raised awareness of the 17 SDGs. P5 stated, "*They were already familiar with the frequently discussed goals among the 17 SDGs; we provided explanations about the others, ensuring that they became aware of those as well.*" Another topic emphasized by the primary school teachers and pre-service teachers is that the projects encourage global citizenship. An examination of the SDGs reveals that they also promote global citizenship among individuals. In line with this objective, two primary school teachers and 10 pre-service teachers indicated that the projects encouraged global citizenship. Primary school teachers expressed their thoughts on the subject with statements such as, "*I believe that they have gained and imparted a conscious perspective, acting with consideration for future generations*" (T3) and "*They are becoming more aware that we will shape our future through sustainable projects*" (T2). Pre-service teachers (P19) shared their views on the topic, stating, "*From the perspective of students, sustainable development projects enhance their sense of social responsibility by focusing on real-world issues*."

Another aspect that supports global citizenship is fostering conscious consumer behavior. Two primary school teachers and seven pre-service teachers noted that the projects encouraged students to adopt conscious consumption habits. In contrast to the primary school teachers, four pre-service teachers emphasized that sustainable development projects enhanced students' awareness of socio-scientific issues, which are crucial for developing global citizenship skills. They articulated this with statements such as, "*These projects primarily raise awareness of environmental, economic, and social issues, thereby deepening participants' knowledge and understanding in these domains*" (P6). Two primary school teachers and three pre-service teachers argued that the projects contributed to students' deep learning and their creative and critical thinking skills. One of the pre-service teachers (P4) stated, "*Focusing on the targeted topic in the prepared projects, addressing the topic effectively, all the preparations made for this purpose, and the emerging ideas bring a different perspective to both students and teachers*," highlighting that the projects also contributed to reflective thinking skills. Additionally, two primary school teachers and three pre-service teachers indicated that sustainable development projects support active participation in the teaching process.

Another aspect most frequently emphasized by pre-service teachers is the contribution of these projects to the relationship between humans and nature. P1 argued that "*Sustainable development projects are crucial for balancing the relationship between humans and nature, building more equitable societies, preventing waste, fostering conscious individuals in resource management, and raising awareness in this regard*," suggesting that the relationship between humans and nature can be enhanced through such projects. There are two aspects highlighted by the primary school teachers that were not mentioned by the pre-service teachers. T6, one of the primary school teachers, argued that the projects helped develop students' sense of responsibility, stating, "*I see students' awareness of sustainability, their sense of responsibility, and their ability to convey this with a sense of happiness and confidence as an investment in the future.*" Meanwhile, T1, another primary school teacher, pointed out that "*The project should primarily introduce sustainable materials, but it was observed that due to time constraints, this practice was not sufficient and not fully understood by all students. Nevertheless, the provided information, the videos watched, and the feedback received had a positive impact on the students*," emphasizing that the project's impact was limited due to the constraints of a short implementation period.

### 3.5. Perspectives of pre-service primary school teachers and primary school teachers on the impact of sustainable development projects on teachers

The interviews revealed that the projects provided various benefits not only to students but also to teachers. These benefits were particularly noteworthy in terms of their impact on teachers' professional development and their instructional practices. The effects of the projects on teachers are presented comparatively in Figure 5, based on the perspectives of classroom teachers and pre-service teachers.

When Figure 5 is examined, it is seen that primary school teachers and pre-service teachers expressed that the projects primarily contributed to raising awareness of sustainability among teachers. Primary school teachers expressed their views with statements such as, "*Sustainable development projects in education will provide positive contributions to increasing teachers' awareness*" (T9), while pre-service teachers who implemented the projects shared their thoughts with statements like, "*Teachers also become aware of this issue and convey it appropriately to the children, helping them integrate it into their own lives*" (P28). Another common theme addressed by both primary school teachers and pre-service teachers is the contribution of the projects to professional development. T10, with the statement, "*It allows teachers to gain experience in project development*," indicated that sustainability projects contribute to professional development in terms of project development. P29 with the statement, "*It adds knowledge, attitudes, and skills to teachers and students*," indicated that it contributes to teachers in terms of subject knowledge. Pre-

service teachers, differently from primary school teachers, highlighted aspects such as the identification of learning needs, with statements like, "*For teachers, if this topic has not been addressed, the questions from the children in the classroom where the implementation is conducted may create a need to address the issue of sustainability*" (P16). They also emphasized the importance of raising awareness on socio-scientific issues with statements such as, "*These types of projects create awareness on topics like environmental consciousness, sustainability, and global issues*" (P19). Additionally, they noted the role of teachers in promoting global citizenship with expressions like, "*Teachers can become more conscious and responsible individuals by taking active roles in creating a sustainable future*" (P7). No codes were identified that were addressed by primary school teachers but not by pre-service teachers. Moreover, four primary school teachers and nine pre-service teachers did not address the contributions of sustainability projects to teachers.

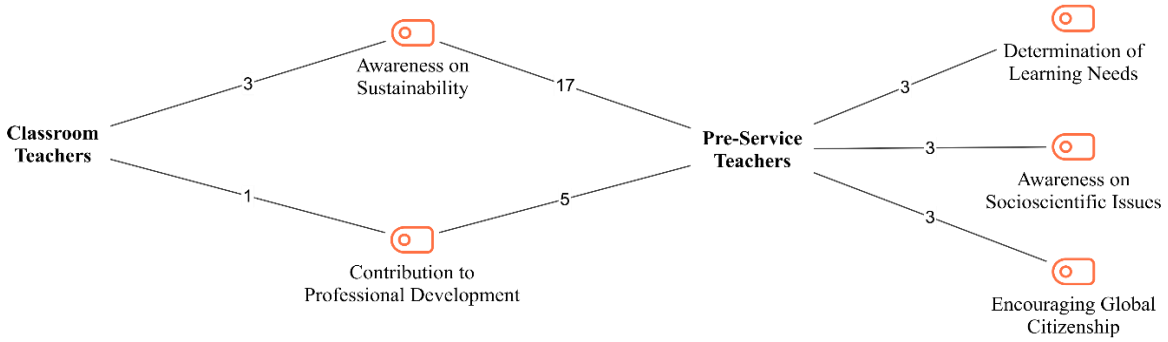


Figure 5. Perspectives of pre-service primary school teachers and primary school teachers on the impact of sustainable development projects on teachers

### 3.6. Perspectives of pre-service primary school teachers and primary school teachers on the SDGs to be used in the development of future sustainable development projects

The findings from the interviews revealed that both classroom teachers and pre-service teachers expressed a willingness to incorporate sustainable development projects into their future lessons. Additionally, the specific SDGs they intend to focus on in their future projects were identified. These targeted goals are presented in Figure 6.

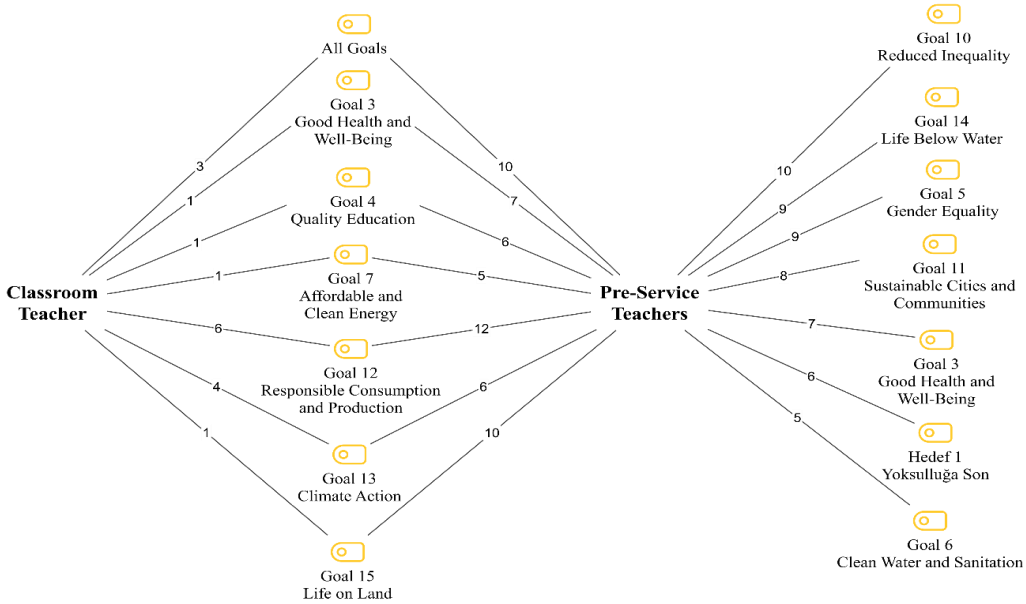


Figure 6. Perspectives of pre-service primary school teachers and primary school teachers on the SDGs to be utilized in the development of future sustainable development projects

An analysis of Figure 6 reveals that both primary school teachers and pre-service teachers plan to focus on common goals in their future plans. However, it is also evident that pre-service teachers, in contrast to primary school teachers, aim to address goals 1, 3, 5, 10, 11, and 14, specifically. Six primary school teachers, with statements such as "*It could be about waste projects, efficient use of resources*" (T3), and 12 pre-service teachers, with statements like "*I would like to implement projects that demonstrate the importance of recycling to contribute to a better future*" (P20), indicated that, following their experiences with sustainability project implementations, they plan to focus most on goal 12 (responsible consumption and production) in their future plans. Both primary school teachers and pre-service teachers mentioned their intention to focus on environmental goals such as goal 7 (affordable and clean energy), goal 13 (climate action), and goal 15 (life on land). However, pre-service teachers, in addition to these, expressed their plans to address other environmental goals with statements like, "*Specifically, I think I can easily address the goals related to life below water and life on land both in and outside the classroom*" (P2) for goal 14 (life below water) (f=9), and "*Water scarcity is increasing; I am considering what I can do about this as a teacher. I am thinking about suitable concrete materials to better raise my students' awareness*" (P10) for goal 6 (clean water and sanitation) (f=5). Three primary school teachers and 10 pre-service teachers expressed their aspiration to develop projects that encompass all 17 SDGs, with statements such as, "*Previously, I did not have such an idea, but after this project, I thought, why not? I aspire to organize projects with numerous activities for my students. While I am uncertain about the specific focus, I would certainly address all 17 goals of sustainability*" (P13).

Primary school teachers and pre-service teachers have indicated that they are considering developing projects related to two societal goals: goal 2 (zero hunger) and goal 4 (quality education). Pre-service teachers have emphasized social issues to a greater extent compared to primary school teachers by also addressing goals 1, 3, 5, 10, and 11. Six pre-service teachers expressed their aspiration to develop projects related to goal 1 (no poverty), with statements such as, "*I want to create projects that will make them aware of their own savings while also raising sensitivity towards people in need*" (P33). Seven pre-service teachers indicated their plans to implement projects associated with goals 3, 4, 5, 7, 10, 11, 12, and 15 of the SDGs, stating, "*I am considering implementing studies related to sustainable development goals 3, 4, 5, 7, 10, 11, 12, and 15*" (P23). Nine pre-service teachers expressed their desire to carry out projects with statements like, "*As a future teacher, I certainly want to implement such projects to raise awareness among children, creating informed children who are knowledgeable about our world. I would love to address humanitarian issues such as gender discrimination*" (P24) for goal 5 (gender equality). There were 10 pre-service teachers expressed, "*If I ever reach great heights, I would very much like to implement equal opportunity projects. I believe that everyone should have equal access to all resources and that anyone can achieve their goals through their own effort and will*" (P30) in relation to goal 10 (reduced inequalities). Lastly, nine pre-service teachers stated, "*Raising awareness among children means impacting all generations, and I specifically want to carry out studies in terms of sustainable cities and responsible production and consumption*" (P39), regarding goal 11 (sustainable cities and communities).

## 4. DISCUSSION

The current study examined the experiences of pre-service primary school teachers in the process of designing and implementing projects for education into sustainable development and the views of teachers on the contribution of these projects to the learning process of primary school students. It also focused on identifying teaching methods and techniques to support the achievement of SDGs at the primary school level in line with the views of pre-service primary school teachers and teachers. Different strategies used in the teaching process improve students' sustainable competencies [22]. Pre-service teachers used student-centered approaches such as group work, brainstorming, station work, drama, and discovery learning in their sustainable development projects. Similarly, it is emphasized in the literature that the educational approach for sustainable development needs different methods that make the student active [23] and are suitable for the classroom climate [9]. Among the methods that make students active are methods and techniques such as group work, drama [24], project-based teaching [25], which were also used in the current study. In addition, Jeronen *et al.* [26] drew attention to field studies and field trips with project-based activities as factors that increase students' interest and knowledge in sustainability. These findings suggest that student-centered and experiential learning-based approaches are effective in achieving SDGs. In order for teachers to effectively implement SDGs, they need to update their competency profiles and review the teaching strategies they use to achieve these goals and the competencies they need to develop to achieve SDGs [27].

Teachers face problems such as limited time, inadequate skills and lack of support in creating effective educational materials for sustainability projects [28]. In the current study, it was found that during sustainable development projects, teachers face difficulties in planning the process such as engaging students, finding appropriate materials and activities for the target. In addition, the difficulties faced by teachers in

financing projects and providing materials revealed that such projects require more resources and support. The major challenges encountered in implementing sustainable development education practices are teachers' lack of awareness on this subject and, particularly, the insufficient financial resources and time required for effectively executing educational programs [29]. In order to effectively implement ESD and increase student participation, it is critical to provide sufficient resources and support to teachers at all levels of education. Otherwise, the applicability and sustainability of such projects may be limited.

In this study, primary school teachers and pre-service teachers reported that sustainable development projects have enhanced both student and teacher awareness regarding sustainability concepts and SDGs. ESD is instrumental in increasing public awareness of sustainability issues [30]. Emphasizing projects, fostering societal awareness, and organizing in-service training are recognized as effective strategies to advance sustainable development through education [31]. Properly structuring the educational process for sustainable development and adequately preparing future educators in this domain is essential [32]. Teachers, playing a pivotal role in nurturing sustainability awareness from an early age, should provide students with opportunities to acquire and develop competencies essential for active engagement in global sustainability efforts [33]. The findings of this study underscore the importance of teachers' awareness of sustainable development in cultivating sustainability awareness among students, reinforcing their attitudes, and shaping their behaviors toward sustainable practices.

Another key finding of the study is that sustainable development projects encourage both students and teachers to become global citizens. These projects foster various attributes in students, including a sense of global citizenship, creative and critical thinking skills, a sense of responsibility, and awareness as conscientious consumers. Education plays a pivotal role in cultivating global citizenship awareness by fostering individuals' sense of responsibility toward the world. There exists a positive relationship between ESD and the promotion of global citizenship [34]. The present study demonstrates that teaching SDGs plays a significant role in developing students' global citizenship awareness and that this awareness can be further supported and strengthened through project-based initiatives.

Adopting interdisciplinary approaches has been shown to significantly enhance elementary students' comprehension, reflective, and critical thinking development. Collaborative learning, in particular, provides students with a stronger understanding of sustainability competencies, including critical analysis, interpersonal relationships, collaboration, and strategic action toward sustainable development [35]. Collaborative learning environments enable students to develop a deeper perception of sustainability competencies and apply these skills in real-life contexts. The instructional methods and collaborative learning strategies employed in the present study demonstrate that sustainable development projects are powerful tools for fostering active engagement in education and enhancing students' critical thinking abilities. Given the inherently abstract nature of sustainability concepts [15], the findings of this study underscore the critical importance of using concrete materials and hands-on activities to deepen students' conceptual understanding and enhance the learning process. The materials used in sustainable development projects can support the comprehension of abstract concepts by providing concrete examples, thus improving students' awareness and understanding of sustainability issues.

Well-planned education plays a significant role in achieving SDGs [36], as primary school teachers have the potential to encourage all students toward sustainable development. Therefore, it is essential that primary teachers possess comprehensive knowledge and skills related to sustainable development during their pre-service training. However, a review of research on ESD conducted between 2013 and 2022 reveals a limited number of studies focused on teacher education in this field [37]. Findings from the current study, based on observations from both pre-service teachers and experienced teachers, indicate that the importance of teacher education must be strengthened to effectively implement sustainable development projects. The challenges faced by pre-service teachers during project processes, along with the insights from experienced teachers, underscore the critical role of structured and ongoing professional development programs in enhancing competencies related to sustainable development. This underscores the need for promoting sustainability-focused approaches and practice-based learning experiences within teacher education.

ESD can instill a sense of environmental and social responsibility in both students and teachers, thereby making a significant contribution toward building a more sustainable society in the future. The effective implementation of sustainability-focused education depends on the preparation of competent teachers in this field. Conducting this study with both pre-service teachers and experienced teachers has allowed for an in-depth examination of sustainable development projects from perspectives across different levels of experience. This approach has enabled a more comprehensive identification of the strengths of these projects as well as areas in need of improvement, thus providing a holistic understanding of their effectiveness and potential enhancements.

Based on the findings of the study, the following recommendations are made. Considering the challenges faced by pre-service teachers and in-service teachers in sustainable development projects, it is

crucial to structure in-service training programs for teacher education with a sustainability-based approach. These programs should specifically aim to enhance teachers' competencies in the use of concrete materials, interdisciplinary approaches, and project-based teaching strategies. Adequate financial resources and material support play a critical role in the implementation of sustainability education practices. Educational institutions and governments should provide increased resources and support for teachers during the planning and implementation of sustainable development projects in schools. This support should include the provision of necessary materials, and the development of educational resources related to sustainable development.

## 5. CONCLUSION

This study examined the future plans of classroom teachers and pre-service teachers within the scope of sustainable development projects and found that these plans primarily focus on environmental and social SDGs. One of the most significant contributions of this research is identifying both the areas for improvement and the strengths of sustainable development projects conducted with elementary school students. Pre-service teachers emphasized the importance of student-centered learning methods in achieving SDGs, noting the positive impact of approaches such as group work, drama, and project-based learning on student motivation and the learning process. Additionally, the study highlights that sustainable development projects contribute to raising awareness, fostering global citizenship, and enhancing critical thinking skills among both teachers and students. However, challenges faced by teachers, such as a lack of resources and access to materials, underscore the need for additional support and resources to implement sustainable development education on a broader scale. These findings suggest that teachers require more comprehensive training and resource support for sustainable development education. In this context, the study emphasizes the importance of establishing educational policies to ensure the lasting impact of projects aimed at contributing to sustainable development education. The findings underscore the necessity of equipping teachers with the skills and knowledge required to effectively work toward SDGs.

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This journal uses Contributor Roles Taxonomy (CRediT) to recognize individual author contributions, reduce authorship disputes, and facilitate collaboration.

| Name of Author | C | M | So | Va | Fo | I | R | D | O | E | Vi | Su | P | Fu |
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| Çiğdem Kozaner | ✓ | ✓ | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | |

C : **C**onceptualization
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O : Writing - **O**riginal Draft
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Vi : **Vi**sualization
Su : **Su**pervision
P : **P**roject administration
Fu : **Fu**nding acquisition

## CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

## INFORMED CONSENT

Informed consent was obtained from all subjects involved in the study.

## ETHICAL APPROVAL

This study has received ethical approval from the Başkent University Ethics Committee (Başkent University, Ankara, Türkiye) with reference number E-62310886-605-331719.

## DATA AVAILABILITY

The data that supports the findings of this study are available on request from the corresponding author [ÇK]. The data, which contains information that could compromise the privacy of research participants, is not publicly available due to certain restrictions.

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