Little Voices, Big Impact: Exploring Primary School Children's Perceptions of Zero Waste

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Abstract

This fully integrated arts-based mixed methods case study investigated the effectiveness of the Zero Waste Project implemented in a fourth-grade classroom of the lead author at Selçuklu Belediyesi Primary School in Konya, Turkey, focusing on students' attitudes and behaviors towards sustainability. The study employs a combination of semi-structured interviews, nonverbal communication analysis, analysis of demographic data, and visual content analysis of 107 photographs taken during the project. Four meta-themes emerged from the interviews: Environmental Awareness, Proposed Solutions and Initiatives, Personal Responsibility and Emotional Connection, and Education and Community Involvement. Complementarily, the visual content analysis identified two meta-themes: Sustainability Education and Active Participation. An incidence-based, inter-respondence matrix revealed that Environmental Awareness was the most prevalent meta-theme, with Pollution and Its Impact being the most recognized theme. Conversely, Proposed Solutions and Initiatives emerged as the least prevalent meta-theme, with Role Modeling and Influence as the least recognized theme. Correspondence analyses highlighted significant associations between students' demographic characteristics and their engagement with specific meta-themes and themes. The study underscores the importance of integrating environmental education into the curriculum through creative expression and community-based activities, particularly within the Turkish, in general, and Konya context, in particular, wherein communal responsibility is a deeply rooted cultural value. The findings also suggest that addressing both the emotional and cognitive aspects of environmental education can enhance students' engagement with sustainability issues. The article concludes with recommendations for future research to explore the long-term impacts of such programs and the role of technological innovations and nonverbal communication in environmental education.

Keywords: Zero Waste Project, mixed methods research, mixed methods case study, fully integrated mixed methods case study, fully integrated arts-based mixed methods case study, 1 + 1 = 1 integration approach, environmental education, sustainability, primary education, Konya, Turkey, student engagement, nonverbal communication, visual content analysis, demographic analysis, environmental awareness, community involvement, personal

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responsibility, creative expression, technological innovations, cultural context

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Zero Waste Worldwide

Zero waste is a visionary and holistic approach to waste management wherein the aim is to eliminate waste by rethinking the way that materials are used, managed, and discarded (Pietzsch et al., 2017; Zaman, 2015). This approach challenges the traditional linear economy—whereby products are made, used, and then discarded—by advocating for a circular economy in which materials are reduced, reused, and recycled, thereby reducing the need for virgin resources (i.e., natural resources that are extracted from the Earth in their raw, unprocessed form; e.g., newly mined metals, fresh timber from forests, crude oil, natural gas) and minimizing environmental impact (Zaman, 2015). The zero waste philosophy is built on the premise that waste is not an inevitable byproduct of consumption, but, rather, should be viewed as a resource that can be managed sustainably through careful design, production, and disposal practices; that is, waste can be cycled back into the economy through sustainable practices, ultimately aiming to achieve a circular economy wherein materials are reused continuously rather than discarded (Song et al., 2015).

Implementing zero waste strategies involves a comprehensive shift in waste management practices—necessitating a systemic change across various sectors, including industrial production, urban planning, and consumer behavior. Various cities, countries, and organizations worldwide increasingly are adopting these strategies to enhance their waste management practices by achieving significant reductions in waste sent to landfills and incinerators. For instance, cities like San Francisco, Stockholm, and Adelaide have set ambitious goals to achieve zero waste, aiming to divert at least 90% of waste from landfills through aggressive recycling, composting, and waste prevention initiatives (Pietzsch et al., 2017). These initiatives not only contribute to environmental protection, but also offer economic advantages by creating new business opportunities and careers in the recycling and waste management sectors (Paes et al., 2019; Ratnasabapathy et al., 2021). Such cities serve as models for others aiming to transition towards more sustainable waste management systems (Wikurendra et al., 2023). The successful implementation of zero waste strategies in these cities demonstrates the potential of these initiatives significantly to reduce waste generation and to promote resource recovery on a large scale (Tan, 2021). Indeed, by adopting zero waste principles, cities and organizations significantly can reduce their environmental footprints, can enhance resource efficiency, and can promote sustainability (Meng et al., 2021).

However, despite the progress made in certain regions, the transition to a zero waste system is complex and involves overcoming significant challenges, such as the need for adequate infrastructure, technological innovation, policy support, and behavioral change at both individual and community levels (Song et al., 2015). Additionally, developing nations often struggle with inadequate waste management systems, making the implementation of zero waste strategies more difficult (Meng et al., 2021). Nonetheless, the growing awareness of the environmental impact of waste and the increasing support from international organizations and governments suggest that the zero waste movement will continue to expand, offering a viable solution to the global waste crisis (Awogbemi et al., 2022; Meng et al., 2021).

Zero Waste in Turkey

In Turkey, the concept of zero waste has gained traction as part of broader efforts to integrate sustainable practices into the country's waste management system (Akdağ & Beldek, 2017; Ayçin & Kayapinar Kaya, 2021; Aydin, 2017). The Turkish government has implemented the "Zero Waste Project," initiated by the Presidency under the leadership of Emine Erdoğan, which is designed to reduce waste generation, to promote recycling, and to improve resource efficiency across various sectors (Ayçin & Kayapinar Kaya, 2021; Rızvanoğlu et al., 2020; Salihoglu et al., 2018). This project aligns with the principles of the circular economy, emphasizing the need to view waste as a valuable resource that can be reintegrated into the production cycle rather than being discarded (Tan, 2021).

The zero waste initiative in Turkey has been marked by both successes and challenges (Ayçin & Kayapinar Kaya, 2021). On one hand, it has raised significant awareness about waste reduction and recycling among the Turkish population, particularly in urban areas where waste management issues are more pronounced (Bulut, 2020; Erten & Atmaca, 2021; Salihoglu et al., 2018). On the other hand, the implementation of zero waste practices has been hindered by various barriers, including insufficient infrastructure, lack of financial support, and the need for more comprehensive policies to guide and to sustain these efforts (Ayçin & Kayapinar Kaya, 2021; Rızvanoğlu et al., 2020). Addressing these challenges is crucial for Turkey to realize fully the benefits of its zero waste initiatives and to contribute to global sustainability goals (Tan, 2021).

Efforts to promote zero waste in Turkey also include educational campaigns and community engagement programs aimed at fostering a culture of sustainability among citizens (Bulut, 2020; Erten & Atmaca, 2021). These initiatives are crucial for ensuring the long-term success of the Zero Waste Project because they help to embed sustainable practices into everyday life and to encourage broader participation in waste reduction activities (Ayçin & Kayapinar Kaya, 2021; Haktanır et al., 2016). By continuing to invest in these programs and addressing the existing barriers, Turkey can make significant progress towards achieving a sustainable, zero waste future (Salihoglu et al., 2018).

Purpose of Study

Early education plays a crucial role in shaping lifelong attitudes and behaviors. By understanding how primary school children perceive and engage with zero waste concepts, educators and policymakers more effectively can tailor environmental education programs to instill sustainable practices from a young age. Research conducted among preschool teachers in Turkey led to the conclusion that pre-school teachers believe that children's awareness of zero-waste and recycling is insufficient, and that using educational games, visual materials, and abstract experiences can enhance their learning (Bulut, 2020).

Children often act as catalysts for change within their families. When children are educated about zero waste and sustainability, they are likely to influence their household's waste management practices, leading to broader community impact. Research indicates that when children are involved in environmental education, they often bring these practices home, encouraging their families to adopt more sustainable habits (Alaydin et al., 2014).

In the context of Turkey, where waste management challenges are significant, understanding how children view zero waste initiatives can provide insights into cultural and educational barriers to sustainability. Given that Turkey has implemented a national Zero Waste Project (Ayçin & Kayapinar Kaya, 2021; Rızvanoğlu et al., 2020; Salihoglu et al., 2018)—as noted previously—it is essential to assess how effectively these concepts are being

communicated to younger generations, particularly in urban settings where waste management issues are more acute (Ayçin & Kayapinar Kaya, 2021). Therefore, the present study examined views on zero waste of the fourth-grade children of the lead presenter through a series of interviews.

Significance of the Study

Children play a critical role in shaping society and protecting the environment as the future adults. Therefore, instilling a zero-waste mindset from an early age is essential for raising environmentally conscious individuals (Bulut, 2020). When children grow up with zero-waste awareness, they learn to use natural resources efficiently, to understand the importance of recycling, and to protect the environment. This conscious lifestyle not only positively impacts the students themselves, but also influences their families, friends, and communities. Because children easily can spread these learned values to their surroundings, they help promote and sustain environmental awareness among larger groups.

In Turkey, the Zero Waste Project has ensured that local governments take on significant responsibilities in environmental protection and sustainability (Ministry of Environment and Urbanization, 2019). Local governments aim to prevent environmental pollution, to curb the waste of natural resources, and to promote recycling by implementing this project in various ways. Municipalities are establishing waste management systems, increasing the availability of recycling containers, and setting up waste separation centers. Local governments particularly collaborate with schools because young individuals, as future adults, will play a crucial role in the zero-waste movement.

The school where this study took place—the school where the first author teaches—has been conducting zero-waste and recycling activities to become a green school (UI Green Metric, 2019). While conducting these activities, its district municipality has contributed to the Zero Waste Project through competitions and theater plays (Selçuklu Municipality, 2024). Through our eTwinning project at our school, teachers at this school also have taught children about recycling and zero waste through adapted fairy tales like Rapunzel and Pinocchio to align with the zero-waste theme (Zipes, 2012). These efforts significantly contribute to increasing environmental awareness and to protecting natural resources throughout Turkey. Instilling this awareness in children from a young age will help them become more responsible individuals in the future.

By focusing on fourth-grade children, it was expected that this study would provide valuable data on how effectively current educational strategies are working and where improvements can be made. This age group is at a critical stage of cognitive and moral development, making it an ideal target for interventions aimed at fostering long-term sustainable behaviors (Kagitcibasi et al., 2001). Moreover, understanding the perspectives of children at this developmental stage can guide the creation of more effective educational programs that align with Turkey's broader sustainability goals, particularly in embedding environmental awareness from an early age (Haktanir et al., 2016).

Method

Research Approach

The research approach that drove the current study is what Onwuegbuzie and Abrams (in press) referred to as a *fully integrated mixed methods case study*. A mixed methods case study (Guetterman & Fetters, 2018; Kamei et al., 2021; Onwuegbuzie & Wisdom, 2013; Sharp

et al., 2012; Walton et al., 2020) is a research approach that involves the integration of both qualitative and quantitative research methods within a single study or a series of studies to explore complex phenomena in depth. This methodology particularly is valuable for gaining a comprehensive understanding of complex phenomena by leveraging the strengths of both qualitative and quantitative data within the context of a specific case.

A mixed methods case study involves the systematic combination of qualitative methods (e.g., interviews, observations) and quantitative methods (e.g., surveys) to address research questions. This approach allows for a richer and more nuanced understanding of the research subject than does either method could achieve alone (Guetterman & Fetters, 2018; Kamei et al., 2021; Onwuegbuzie & Wisdom, 2013; Sharp et al., 2012; Walton et al., 2020). It can be structured either sequentially, wherein one strand (e.g., quantitative) follows the other strand (e.g., qualitative), or concurrently, wherein all strands occur simultaneously. The choice between these two sets of structures depends on the research questions and the specific context of the study (Onwuegbuzie & Abrams, in press).

Mixed methods case studies typically involve focusing on a specific case, which could be an individual, group, organization, or event. The case is studied in its real-life context, allowing researchers to explore how different factors interact within the case (Guetterman & Fetters, 2018). In the present study, the case represented the primary school students of the lead author, and the factors that interact within the case represent the zero-waste and recycling activities.

Whereas a mixed methods case study represents the *systematic combination* of qualitative and quantitative research methods, a fully integrated mixed methods case study is a research approach that involves the *systematic integration* of quantitative and qualitative research methods within the framework of a single case study. This method is designed to minimize bias and to maximize rigor by following a structured, methodical, and transparent process. The aim is to achieve a comprehensive, replicable, and trustworthy exploration of a case, ensuring that the study provides a holistic understanding that is grounded in both numerical data and narrative insight.

The hallmark of a fully integrated mixed methods case study is the optimal integration of quantitative data (e.g., numerical data measuring variables such as frequency, prevalence, or relationships) and qualitative data (e.g., narratives from interviews, focus groups, observations, or documents) at every stage of the research process, including during data collection, data analysis, and data interpretation stages. Rather than treating quantitative and qualitative data as separate or merely additive components, this approach synthesizes them into a single, unified, holistic, and cohesive understanding of the case that transcends the individual contributions of each method.

This synthesis, referred to by Onwuegbuzie (2017) and Onwuegbuzie and Hitchcock (2019a) as the *1 + 1 = 1 integration approach* (see also Onwuegbuzie, 2023), implies that the insights derived from qualitative data are intertwined with the quantitative data to produce a deeper, more nuanced understanding that could not be achieved by either data type alone. This optimal integration leads to more meaningful and applicable findings, offering a comprehensive view that combines the "what" (quantitative data) with the "how" and "why" (qualitative data). That is, a mixed methods case study can provide a more holistic understanding by integrating both the breadth (quantitative) and depth (qualitative) of data. Consequently, researchers can make more informed recommendations that not only are evidence-based, but also are contextually grounded, thereby enhancing the study's relevance and applicability.

Furthermore, conducting a fully integrated mixed methods case study not only adheres to the principles of mixed methods research, but also enhances the legitimation of the findings. By systematically integrating qualitative methods with quantitative data, our study contributes to the ongoing dialogue about best practices in research methodology, promoting more nuanced,

comprehensive studies in the future. This approach also underscores the versatility and potential for cross-disciplinary applications of mixed methods, making it a valuable tool for addressing complex and complicated research questions in real-life contexts.

In summary, our fully integrated mixed methods case study, through its structured and rigorous process of optimal integration, offered a comprehensive and nuanced understanding of the views on zero waste of the fourth-grade children of the lead presenter. This approach allowed us to capture both the quantitative data reflecting the children's overall knowledge and attitudes, as well as the qualitative insights into their personal beliefs and motivations. The findings not only highlighted the children's awareness and commitment to zero waste practices, but also revealed the influence of their educational environment and familial values on their understanding of sustainability.

Research Philosophy

Our study was grounded in a research philosophical stance known as the critical dialectical pluralistic (CDP) approach, as described by Onwuegbuzie and Frels (2013). This CDP 1.0 stance, as they termed it, operates on the premise that social injustices are embedded deeply in every society. Within this framework, one of the primary aims of the study was to empower the student participants and their teacher by providing data that would enable them to make informed decisions about zero waste initiatives.

Although CDP 1.0 focuses on aspects of procedural justice, process justice, and philosophical justice, CDP 2.0—referred to simply as CDP—expands on these foundations, as introduced by Onwuegbuzie et al. (2024). This evolved version of CDP emphasizes the many "SIDES" of CDP, which—consistent with the acronym—stands for **s**ocial justice, **i**nclusion, **d**iversity, **e**quity, and **s**ocial responsibility (Onwuegbuzie et al., 2024). These five core elements are seen as being essential in advancing global justice (Al-Rodhan, 2009).

Embracing the CDP approach fostered a research environment wherein the study participants were valued as co-creators and co-decision makers. Through their active involvement, they became agents of change, dedicated to identifying issues and implementing the changes that they wished to see in both local and global contexts.

CDP aligns with fully integrated mixed methods case studies through its emphasis on inclusivity, social justice, and the integration of diverse methodological perspectives. In a fully integrated mixed methods case study, CDP provides a multidimensional metaphilosophy that enhances the blending of quantitative and qualitative research approaches, ensuring that both types of data not only are combined, but also are intertwined in a way that honors the complexity and richness of the research context.

CDP's commitment to democratizing the research process particularly is relevant in mixed methods case studies, wherein participants are viewed not just as subjects but as co-creators and co-decision makers. In the current inquiry, this alignment allowed for the integration of their voices and perspectives throughout the research process. By adopting a CDP framework, our fully integrated mixed methods case study enabled us to achieve a more nuanced understanding of the case under investigation, promoting findings that were both methodologically rigorous and socially responsive.

Moreover, CDP supports the development of research designs that are flexible and responsive to the needs of diverse stakeholders, making it an ideal framework for fully integrated mixed methods case studies that aim to address complex social issues. Our CDP approach ensured that the research process was ethically grounded and that the findings contributed to meaningful social change, which is a key objective of many mixed methods case studies (Onwuegbuzie & Abrams, in press). Through its focus on social justice, inclusion,
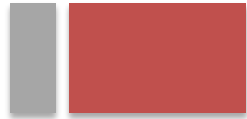
diversity, equity, social responsibility, and participant empowerment, our use of CDP not only enhanced the methodological robustness of mixed methods case studies, but also aligned them with broader societal goals, thereby maximizing their impact and relevance.
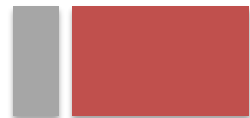
Participants

Participants were 15 fourth-grade students from the classroom of the lead author. These students were selected via a purposive sampling scheme—specifically, a convenience sampling scheme—wherein participants were selected based on their availability (Onwuegbuzie & Collins, 2007, 2014, 2017). Generally, in order to achieve saturation, a sample size of 12 (Guest et al., 2006) or between 8 and 16, on average (Namey et al., 2016), for individual interviews has been empirically established as being effective. In fact, Guest et al. (2006) demonstrated that six interviews might be "sufficient to enable development of meaningful themes and useful interpretations" (p. 78). This suggests that our sample size was adequate for obtaining data saturation.

Table 1 presents selected demographics of the 15 student participants—specifically, gender, academic achievement, artistic and sports skills, family socioeconomic status, and child order in the family. The sample included a nearly even distribution of boys ($n = 8$) and girls ($n = 7$). In terms of academic achievement, six students were classified at the "excellent" level, indicating a very high level of understanding and proficiency. Seven students achieved at the "good" level, representing solid and consistent performance, meeting expected standards. Two students were classified at the "below good" level, suggesting inconsistent performance and a need for additional support to reach the expected standards. Regarding artistic and sports skills, seven students demonstrated artistic skills, whereas the remaining eight students excelled in sports.

Table 1

Demographic Information of the Fourth-Grade Students

Student Pseudonym	Gender	Academic Achievement	Artistic and Sports Skills	Family Socio-Economic Status	Child Order in Family
Ali	Boy	Excellent	Sports (Football)	Medium	2nd
Aylin	Girl	Excellent	Painting, Reading Books	Good	1st
Ece	Girl	Excellent	Painting, Music (Choir)	Good	3rd
Rana	Girl	Excellent	Rhythmic Dance (Musical Performance), Sports (Handball)	Below Average	3rd
Ata	Boy	Excellent	Mathematics, Sports (Handball)	Medium	3rd
Kemal	Boy	Good	Painting, Sports (Cycling)	Good	3rd
Emre	Boy	Excellent	Mathematics, Reading Books	Good	1st
Hakan	Boy	Good	Painting, Reading Books	Good	2nd
Erhan	Boy	Good	Music, Painting, Rhythmic Dance	Medium	1st

Student Pseudonym	Gender	Academic Achievement	Artistic and Sports Skills	Family Socio-Economic Status	Child Order in Family
			(Folk Dance)		
Esin	Girl	Good	Painting, Sports (Handball)	Below Average	3rd
Alaz	Boy	Good	Sports (Football)	Medium	2nd
Eliz	Girl	Below Good	Painting	Medium	2nd
Nazan	Girl	Good	Reading Books, Visual Memory	Below Average	3rd
Duygu	Girl	Good	Painting, Reading Books	Medium	3rd
Metin	Boy	Excellent	Sports (Football), Mind Games (Chess)	Good	3rd

With respect to family socioeconomic status, four students had parents with "good" socioeconomic status, characterized by higher income levels, the ability to invest in additional educational opportunities (e.g., private schooling or extracurricular activities), higher educational qualifications, and living in well-maintained homes with access to high-quality healthcare and education. Nine students had parents with "medium" socioeconomic status, which generally involves a stable income sufficient to cover basic needs, secondary education, and access to healthcare, although with some financial constraints. Lastly, two students had parents with "below average" socioeconomic status, often associated with lower-paying jobs, limited educational attainment, substandard housing, and restricted access to healthcare and educational resources. Finally, regarding the child order in the family, four students were the first child, four were the second, and seven were the third child in their families.

Instruments and Procedure

The methods of data collection utilized in this study involved semi-structured interviews and an array of photographs. These semi-structured interviews were conducted face-to-face by the second author in Ravza Park, adjacent to Selçuklu Municipality Primary School. These interviews took place between 09:00 and 14:30. Each student individually was called to respond to the questions, with each interview lasting approximately 10 minutes. The interviews were conducted in a green area where students engaged in activities while waiting for their turn. The children were aware that they would be interviewed by a different teacher, but they were not informed of the specific questions beforehand. A valid trip plan was in place for the students to visit the park for the interviews. Additionally, the students had permission slips valid for the entire academic year, allowing their participation in all types of project work and similar activities.

Each interview was audio recorded via two digital sound recording devices. Each interview was transcribed by the third author. Specifically, the student participants were asked the following seven questions, respectively:

1. What is the most important environmental problem related to recycling that you see around you?

2. If you were a mayor, what would you do about the problems you see around you? What would you like to change?
3. As a mayor, what would you do to make the solutions you found for the problems permanent?
4. What do you like most about recycling and zero waste?
5. What do you dislike most about recycling and zero waste?
6. How can this project be improved in the future?
7. What do the concepts of recycling and zero waste mean to you?

These questions represented basic descriptive (i.e., aiming to elicit straightforward, factual information about the participant's activities and environment), experience/example (i.e., aiming to gain deeper insights into how participants experience particular events or situations), or comparison/contrast (i.e., aiming to explore differences or similarities between experiences, providing insight into the participant's perceptions and judgments) categories (Janesick, 2016).

By asking pre-formulated, open-ended questions, we hoped to receive rich responses from the participants to allow them fully to tell their stories (Kvale, 1996). By conducting interviews face-to-face, the second author was able to clarify meanings, to verify interpretations, and to ask relevant follow-up questions while also recording any nonverbal behaviors (Kvale, 1996).

Because the interviews were conducted face-to-face, the interviewer was able to document any nonverbal communication displayed by the participants. As participants recounted their experiences, close attention was paid to any nonverbal cues that might reveal emotions—specifically, amusement, anger, contempt, contentment, disgust, embarrassment, excitement, fear, guilt, pride in achievement, relief, sadness/distress, satisfaction, sensory pleasure, or shame (Ekman, 1999). These emotions were interpreted through the analysis of changes in paralinguistic features and the observation of natural facial expressions (Ekman, 1999). Additionally, we sought to identify nonverbal behaviors that could offer deeper insights into the participants' personal experiences and emotional states. Special focus also was given to the use of McNeill's (1992) five categories of gestures, which include (a) iconic (i.e., visual representations of concrete actions, objects, or events), (b) metaphoric (i.e., abstract concepts rather than concrete objects or actions), (c) beats (i.e., simple, rhythmic movements, often repetitive, that are used to emphasize what is being stated), (d) deictic (i.e., used to indicate or to draw attention to specific objects, locations, or directions), and (e) emblems (i.e., culturally specific gestures that have a direct verbal translation or meaning within a particular cultural context).

Further, data were collected via a debriefing process, wherein the interviewer was debriefed by another member of the research team (i.e., fourth author) as a means of creating an audit trail (Collins et al., 2013; Frels & Onwuegbuzie, 2012; Onwuegbuzie et al., 2008). In particular, the debriefing process focused on the nonverbal communication exhibited by all 15 students. These debriefing transcriptions were prepared and added to the interview data.

Taking an array of photographs during the Zero Waste Project at the school played a critical role in documenting, enhancing, and promoting the environmental efforts being undertaken. These photographs served several important purposes. First, the photographs provided a visual record of the activities and initiatives implemented as part of the Zero Waste Project. This included capturing the students' participation in recycling activities, competitions, and theater plays organized by the district municipality. These images helped in documenting the progress and milestones of the project, serving as a historical record of the school's journey toward becoming a green school.

Second, these visual images served as powerful tools for raising awareness about environmental issues. By photographing the various activities, the school could create educational materials that vividly demonstrate the importance of recycling and zero waste.

These images can be used in presentations, reports, and displays within the school and the broader community to educate others about the benefits of environmental conservation.

Third, these photographs also can serve to engage and to motivate both students and the wider community. Seeing their efforts and achievements captured in photographs can boost students' enthusiasm and commitment to the project. Additionally, these images can be shared with parents and the local community to showcase the positive impact of the project, potentially inspiring others to adopt similar practices.

Fourth, through the use of adapted fairy tales like Rapunzel and Pinocchio that align with the zero waste theme, photographs played an important role in helping the story of the project to be told in a compelling way. Visual storytelling makes the concepts of recycling and zero waste more relatable and memorable, particularly for younger audiences. It helps in reinforcing the lessons learned and the values being instilled in the students.

Lastly, we determined that photographs were essential for promoting the Zero Waste Project beyond the school. They can be used in social media campaigns, school newsletters, and collaborations with organizations like the UI Green Metric to highlight the school's commitment to environmental sustainability. These images also can be shared with local government bodies, like the Selçuklu Municipality, to demonstrate the impact of their support and to encourage continued investment in such initiatives.

In summary, our use of photographs—which transformed our fully integrated mixed methods case study into a *fully integrated arts-based mixed methods case study*—served as a multifaceted tool that not only documented the Zero Waste Project, but also enhanced its educational value, engaged the community, told a compelling story, and promoted the school's efforts to become a model green school. Additionally, these photographs facilitated a deeper analysis by allowing us visually to capture and to reflect on the impact of the project, thereby enriching the interpretative process and supporting a more holistic understanding of the outcomes.

Data Analysis

Mixed analyses were used to analyze the array of data. According to Onwuegbuzie and Combs (2010),

Mixed analysis involves the use of both quantitative and qualitative analytical techniques within the same framework, which is guided either a priori, a posteriori, or iteratively (representing analytical decisions that occur both prior to the study and during the study). It might be based on one of the existing mixed methods research paradigms (e.g., pragmatism, transformative-emancipatory) such that it meets one of more of the following rationales/purposes: triangulation, complementarity, development, initiation, and expansion. Mixed analyses involve the analyses of one or both data types (i.e., quantitative data *or* qualitative data; or quantitative data *and* qualitative data), which occur either concurrently (i.e., in no chronological order), or sequentially in two phases (in which the qualitative analysis phase precedes the quantitative analysis phase or vice versa, and findings from the initial analysis phase informs the subsequent phase), or more than two phases (i.e., iteratively). The analysis strands might not interact until the data interpretation stage, yielding a basic parallel mixed analysis, although more complex forms of parallel mixed analysis can be used, in which interaction takes place in a limited way before the data interpretation phase. The mixed analysis can be design based, wherein it is directly linked to the mixed methods design (e.g., sequential mixed analysis techniques used for sequential mixed methods designs). Alternatively, the mixed analysis can be phase based, in which the

mixed analysis takes place in one or more phases (e.g., data transformation). In mixed analyses, either the qualitative or quantitative analysis strands might be given greater priority or approximately equal priority as a result of a priori decisions (i.e., determined at the research conceptualization phase) or decisions that emerge during the course of the study (i.e., a posteriori or iterative decisions). The mixed analysis could represent case-oriented, variable-oriented, and/or process/experience-oriented analyses. The mixed analysis is guided by an attempt to analyze data in a way that yields at least one of five types of generalizations (i.e., external statistical generalizations, internal statistical generalizations, analytical generalizations, case-to-case transfer, naturalistic generalization). At its most integrated form, the mixed analysis might involve some form of cross-over analysis, wherein one or more analysis types associated with one tradition (e.g., qualitative analysis) are used to analyze data associated with a different tradition (e.g., quantitative data). (pp. 425-426)

In the present study, the mixed analysis approach was implemented in several phases. The first phase involved analyzing 15 sets of interview transcripts using Braun and Clarke's (2019) reflexive thematic analysis, a qualitative method that provides a flexible yet systematic approach to data analysis. This method emphasizes the researcher's active role in identifying, analyzing, and reporting patterns (e.g., themes) within the data. Reflexive thematic analysis is adaptable to various theoretical frameworks and research questions, making it a popular choice among qualitative researchers across different fields. It can be employed inductively (data-driven) or deductively (theory-driven) based on research goals. A key principle of this approach is acknowledging the researcher's subjectivity, with reflexivity requiring critical awareness of how the researcher's values, experiences, and theoretical commitments influence the research process.

Braun and Clarke's (2019) reflexive thematic analysis involves a six-phase process, which is iterative rather than linear:

1. *Familiarization with the Data*: Immersing oneself in the data by reading and re-reading, noting initial ideas.
2. *Generating Initial Codes*: Systematically coding interesting features across the dataset.
3. *Searching for Themes*: Collating codes into potential themes, collecting all data relevant to each theme.
4. *Reviewing Themes*: Checking whether the themes work in relation to the coded extracts and the entire dataset, refining them as necessary.
5. *Defining and Naming Themes*: Ongoing analysis to refine the specifics of each theme, generating clear definitions and names for each.
6. *Producing the Report*: The final opportunity for analysis; selecting vivid, compelling extract examples, finalizing the analysis of selected extracts, relating the analysis back to the research question and literature, producing a scholarly report.

As such, Braun and Clarke's (2019) analytical approach is iterative, meaning that researchers often move back and forth between phases. Themes may be developed and refined multiple times before the final report is produced. This approach allows for the development of a rich, detailed, and nuanced account of the data.

As part of the data analysis, we analyzed each interview with respect to the nonverbal behaviors exhibited by participants. In particular, we analyzed these nonverbal data via Ekman's (1999) *Neurocultural Model of Facial Expression* for observing innate facial expressions, and McNeill's (1992) classification scheme of gestures, as noted previously.

Examining the nonverbal cues of all the primary school student participants provided a deeper insight into their experiences. Using the typology of Onwuegbuzie and Abrams (2021), our integration of nonverbal information/data with verbal information/data served to (a) *repeat* the message (i.e., repetition), (b) *corroborate* speech narrative; (c) *capture* underlying messages; (d) *accentuate* the underlying message; (e) *substitute* the underlying message; (f) *expose* nonverbal behaviors that contradict the verbal communication; (g) *broaden* the scope of the understanding; (h) *moderate* the underlying message; (i) *mediate* the underlying message; and/or (j) *create new directions* based on additional insights.

After the meta-themes and themes had been extracted via Braun and Clarke's (2019) reflexive thematic analysis, both of these organizing frameworks were quantitized. That is, the qualitative meta-themes and themes were transformed into numerical codes that can be analyzed statistically (Miles & Huberman, 1994; Onwuegbuzie, 2024; Onwuegbuzie & Teddlie, 2003; Sandelowski et al., 2009; Tashakkori & Teddlie, 1998). Specifically, for each meta-theme and each theme, we assigned a "1" to participants whose responses represented that meta-theme and theme, respectively, and a "0" to all others. This quantitizing led to what Onwuegbuzie (2003) referred to as an inter-respondent matrix of meta-themes/themes that consisted of "1s" and "0s" (see also Onwuegbuzie & Teddlie, 2003). Specifically, an *incidence-based inter-respondent matrix* of meta-themes and themes, which represents an inter-respondent matrix that presents the presence or absence of each meta-theme and theme—as opposed to a *frequency inter-respondent matrix* that presents the frequency of each meta-theme and theme, or an *intensity-based inter-respondent matrix* that presents the degree or strength of each meta-theme and theme.

Cross-Case Analyses

Three quantitizing techniques were employed, namely, *descriptive-based quantitizing inferential-based quantitizing*, and *exploratory-based quantitizing*. Descriptive-based quantitizing refers to the process of transforming qualitative data into quantitative measures to describe the characteristics of the data (Onwuegbuzie, 2024). This method involves the use of statistical techniques to summarize and to present the patterns observed in qualitative responses—in this case, the meta-themes and themes. It encompasses the following types of descriptive statistics: (a) measures of central tendency (e.g., mean, median, mode), which identify the central or typical value in a qualitative dataset; (b) measures of variation or dispersion (e.g., range, interquartile range, variance, standard deviation), which describe the spread or variability within the dataset; (c) measures of position or relative standing (e.g., percentiles, quartiles, z scores, t scores), which indicate the relative position of specific data points; and (d) measures of distributional shape (e.g., skewness, kurtosis), which describe the shape and nature of the data distribution. Overall, descriptive-based quantitizing involves using statistical methods to create a detailed summary of qualitative data, allowing for a structured and quantifiable representation of the core elements and nuances of the data. This approach is especially useful in the early stages of data analysis, wherein identifying broad trends and patterns is crucial (Onwuegbuzie, 2024).

Inferential-based quantitizing refers to the process of converting qualitative data into estimates or predictions, enabling researchers to apply findings from a specific data set to a broader context (Onwuegbuzie, 2024). This approach involves the use of inferential statistics to draw conclusions about a larger population based on a sample, allowing researchers to extend their interpretations beyond the immediate qualitative data to broader contexts (Onwuegbuzie, 2024). In the present study, once the meta-themes and themes had been quantitized, inferential-based quantitizing was employed using Onwuegbuzie and Levin's (2005) Binomial Test of

Trend. In the context of prevalence rates, this test involves the binomial distribution being used to determine whether the prevalence rate should be regarded as representing a statistically significant finding. Specifically, for a 5% level of statistical significance, when a study includes at least five participants and/or at least five meta-themes or themes, "the binomial formula can be used to determine the probability of obtaining the observed proportion of findings in the same direction, under the null hypothesis specification that p (the success probability) and q (the failure probability) are each equal to .5" (Onwuegbuzie et al., 2011, p. 130)—assuming that the presence of a meta-theme or theme is as likely as is the absence of a meta-theme or theme, respectively.

Contrastingly, exploratory-based quantitizing is a method used to discover new insights and patterns within qualitative data by applying techniques such as exploratory factor analysis, principal components analysis, cluster analysis, or correspondence analysis (Onwuegbuzie, 2024). This approach particularly is valuable in the initial stages of research for generating new hypotheses and theories from the data. In the present study, once the meta-themes and themes had been quantitized exploratory-based quantitizing was employed using correspondence analysis to identify distinct groups among the interview participants (Onwuegbuzie, 2024). Correspondence analysis is a multivariate analysis and graphical technique that enables researchers to perform cross-case analysis of emergent themes. It is an exploratory multivariate method that factors categorical (nominal level) variables and maps them in a property space, illustrating their associations across multiple dimensions (Michailidis, 2007). The QDA Miner 2004.0.5 software (Provalis Research, 2024) was employed to conduct the correspondence analysis. This approach aligns with what Onwuegbuzie and Combs (2010) describe as a crossover mixed analysis, wherein techniques from one tradition (quantitative: correspondence analysis) are applied to data from another tradition (qualitative: meta-themes, themes), reflecting our CDP perspective (Onwuegbuzie & Frels, 2013). Specifically, we used a qualitative-dominant crossover mixed analysis, wherein qualitative analysis was primary, but the inclusion of quantitative analysis enriched the data and interpretations (Onwuegbuzie & Combs, 2010). Additionally, using correspondence analysis helped us avoid what Bazeley (2009) criticizes as superficial theme reporting, wherein qualitative researchers rely mainly on presenting key themes supported by participant quotations as their primary form of analysis and reporting (p. 6).

In order to analyze the photographs and other visual material extracted throughout the project, we conducted a visual content analysis. This analysis is used widely in qualitative research to interpret systematically visual materials like photographs (Banks, 2008; Rose, 2022). This visual analysis involves systematic categorization, coding, and interpretation of visual data. Visual content analysis particularly is suitable for education research because it allows researchers to draw meaningful insights from visual data, such as student engagement, environmental changes, and the effectiveness of classroom activities (Banks, 2008; Rose, 2022).

The photographs taken during the Zero Waste Project, including those of the students, the classroom environment, and various artifacts (e.g., recycling bins, eco-friendly crafts), first were systematically categorized (e.g., "student engagement," "zero waste activities," "environmental changes," "artifacts created by students"). This initial categorization helped us to organize the data for more in-depth analysis. Once categorized, the photographs were subjected to coding, wherein specific elements within the images (e.g., classroom setup with zero-waste decorations) were tagged with relevant codes (e.g., "active participation," "environmental consciousness," "creative use of recycled materials"). Coding allowed us to identify patterns across the photographs. Following our coding, the photographs were analyzed to interpret how the visual elements convey the project's impact. In order to ensure the rigor

and reliability of our visual content analysis, the photographic data were triangulated with other sources, such as student interviews, teacher observations, and project outcomes. This triangulation helped us to validate the findings from our visual content analysis and ensured that our interpretations were well-founded. As such, our visual content analysis allowed us to draw meaningful insights into the project's impact on student behavior and environmental awareness, triangulated with other data sources for legitimation.

It should be noted that our collection, analysis, and interpretation of multiple forms of qualitative data meant that our fully integrated arts-based mixed methods case study involved the use not only of mixed methods research approaches, but also of multiple methods research approaches. This yielded what Onwuegbuzie and Hitchcock (2019b) referred to as *meta-methods research*. This approach involves the full(er) integration of multiple methods research approaches and mixed methods research approaches.

Within-Case Analyses

A within-case analysis involves exploring the patterns, themes, and relationships within the specific context of one individual at a time (Miles & Huberman, 1994; Miles et al., 2014). Moreover, the purpose of a within-case analysis is to develop a deep understanding of select individuals, to identify key variables and processes, and to generate initial insights. This type of analysis particularly is valuable in qualitative research, wherein the richness of the data from a single individual can provide a comprehensive understanding of the phenomena under study.

Once the meta-themes and themes pertaining to the 15 students had been quantitized, these quantitized data then were used to qualitize the data. The technique of qualitizing involves converting quantitative data into a qualitative form, such as creating narratives to explore the meaning behind numerical data (Onwuegbuzie & Teddlie, 2003; Sandelowski et al., 2009; Tashakkori & Teddlie, 1998), which then can be analyzed using qualitative methods. One effective method of qualitizing data is through narrative profile formation (Tashakkori & Teddlie, 1998), wherein narrative descriptions are derived from quantitative data. This process includes the creation of various types of profiles: modal profiles, average profiles, holistic profiles, comparative profiles, and normative profiles. Modal profiles provide detailed narrative descriptions of a group based on the most frequently occurring characteristics within that group. Average profiles are constructed based on the average of several attributes of individuals or situations. Holistic profiles capture the overall impressions of the researcher(s) regarding the unit of investigation. Comparative profiles are created by comparing one unit of analysis with one or more other units, highlighting their similarities and differences. Finally, normative profiles, similar to narrative profiles, are based on comparing an individual or group to a standard, such as a normative group (cf. Onwuegbuzie & Teddlie, 2003; Tashakkori & Teddlie, 1998). Recently, Onwuegbuzie and Leech (2019) expanded the definition of qualitizing, noting that it can involve five major elements (see also Onwuegbuzie & Leech, 2021). Specifically, qualitizing

1. can yield numerous representations,
2. can stem not only from quantitative data but also from qualitative data,
3. can involve qualitative analyses and/or quantitative analyses,
4. can involve a single analysis or multiple analyses, and
5. can yield a fully integrated analysis.

For the present study, our qualitizing process was used to obtain holistic profiles for each of the 15 fourth-grade students. Our goal here was to capture a comprehensive and nuanced understanding of each student's unique perspectives, attitudes, and behaviors towards the zero waste initiative. Qualitizing the data allowed us to explore how individual experiences and

characteristics influenced their engagement with the project, thereby providing deeper insights into the effectiveness of the environmental education efforts.

Results

Using Braun and Clarke's (2019) reflexive thematic analysis, the following four meta-themes were identified from the students' interviews regarding zero waste: (a) Environmental Awareness, (b) Proposed Solutions and Initiatives, (c) Personal Responsibility and Emotional Connection, and (d) Education and Community Involvement. Each of these meta-themes and their associated themes will be discussed in what follows.

Meta-Theme 1: Environmental Awareness

Environmental awareness, the first meta-theme, refers to the students' recognition (i.e., consciousness) and understanding of environmental issues around them and the impact of human activities on the natural world. In this context, it reflects the fourth-grade students' recognition of environmental problems, such as pollution and waste mismanagement, and the broader implications that they have on the natural world, as well as their understanding of the importance of sustainable practices. Further, it reflects their growing consciousness of how human activities impact the environment and the necessity of addressing these issues to protect nature. This meta-theme encompasses the students' identification of specific environmental issues and their articulation of the broader implications of these problems on nature and society.

During the interviews, the students demonstrated a solid understanding of various environmental problems, particularly the detrimental effects of pollution and improper waste disposal on nature and air quality. They frequently mentioned pollution as a significant concern, demonstrating a clear awareness of its impact on nature, air quality, and overall environmental health. For example, Ece declared that "Environmental pollution is the most important environmental problem." Ali also discussed "the pollution of nature and air pollution." The students' responses indicate that they are not only aware of these issues, but also understand the importance of adopting sustainable practices, such as recycling, to mitigate environmental damage. As an example, Erhan referred to "People throwing trash on the ground, harming animals and trees." Similarly, Alaz acknowledged that "Littering, especially cigarette butts, pollutes nature." The students' responses highlight their developing ecological consciousness and their role in addressing environmental challenges, forming a foundation for fostering future responsible environmental stewardship. Moreover, this awareness is foundational in fostering a generation that is knowledgeable about environmental sustainability and motivated to take action.

As a result, the Environmental Awareness meta-theme consisted of two themes: Pollution and Its Impact and Recycling as a Solution. Each of these themes will be discussed in what follows.

Theme 1: Pollution and Its Impact

This theme captures the students' concerns about pollution, particularly how it harms the environment and air quality. They identified pollution, particularly littering, air pollution from car exhausts, and improper waste disposal as major contributors to environmental degradation. As an example, Nazan concluded the following: "An area should not turn into a dump. The presence of litter is an important problem." The students articulated the negative effects of these issues, such as the damage to wildlife, ecosystems, and human health. They discussed how pollution harms animals, plants, and ecosystems. Also, they recognized the

broader implications, such as the role of pollution in contributing to climate change and its detrimental impact on quality of life. The students' awareness of the impact of pollution on human health and well-being indicates a foundational understanding of the interconnectedness of environmental health and quality of life, and the importance of reducing pollution to protect the planet. This theme reflects the students' ability to identify and to articulate the specific environmental challenges that they observe in their surroundings, highlighting their developing ecological literacy.

Theme 2: Recycling as a Solution

Recycling emerged as a key solution among the students, who recognized it as a practical method to reduce pollution, to conserve resources, and to promote environmental health. They emphasized the importance of recycling materials like plastic, metals, glass, and paper to prevent waste from ending up in landfills or natural environments. Eliz recognized that "Recycling bins are placed everywhere," while Ece acknowledged that "The waste thrown into recycling bins is being recycled." Moreover, the students discussed the importance of separating recyclables from other waste and ensuring that these materials are processed appropriately to prevent them from polluting the environment. Ali exclaimed, "I like the presence of recycling bins. I especially appreciate the recycling of plastic bottles." The students suggested that widespread recycling practices significantly could mitigate environmental problems, with Aylin noting that "Using recycling bins prevents pollution." They proposed increasing the availability of recycling bins and raising awareness about recycling practices as ways to encourage more people to participate. This theme underscores the students' understanding of, and belief in, the recycling process as a practical and essential component of waste management and their belief in its effectiveness in reducing pollution, highlighting their commitment to environmental sustainable practices.

Meta-Theme 2: Proposed Solutions and Initiatives

This meta-theme captures the students' ideas and suggestions for addressing the environmental issues that they have identified. It reflects their creative, proactive, and practical approaches to problem-solving, wherein they propose both technological innovations and community-driven initiatives aimed at reducing waste, enhancing recycling, and promoting environmental sustainability within their communities and beyond as potential solutions to environmental challenges.

The students exhibited creativity and critical thinking in proposing various solutions to environmental problems. They offered a range of solutions to the environmental problems that they observed, from advanced technological ideas like robots for sorting recyclables to community-based initiatives like public awareness campaigns and behavioral interventions, such as stricter enforcement of littering fines. For example, Ata proposed the following: "I would create a robot machine that separates recyclables and puts them into recycling bins" while Kemal proposed "I would install cameras around the environment that measure body temperature to identify people littering." These suggestions reflect their understanding that addressing environmental issues requires a combination of innovative technology and active community involvement. The students' proposals show a balance between leveraging technology to solve complex problems and recognizing the importance of changing community behavior to achieve lasting results. Further, they demonstrate a proactive attitude towards environmental issues, a forward-thinking mindset and an eagerness to contribute to broader environmental goals through practical and actionable ideas.

The Proposed Solutions and Initiatives meta-theme consisted of two themes: Technological Innovations and Community and Behavioral Interventions. Each of these themes will be discussed in what follows.

Theme 3: Technological Innovations

This theme highlights the students' creativity in proposing technological solutions to enhance recycling and waste management. Ideas such as creating robots to separate recyclables, using surveillance cameras to monitor littering, and designing smart trash bins that encourage proper waste disposal and that reward users for recycling correctly, exemplify their creativity and forward-thinking approach to solving environmental problems. The students believed that technology can play a crucial role in enhancing efficiency and effectiveness in recycling and waste management, reducing human error in environmental practices, and solving environmental issues, thereby making processes more efficient and, in turn, increasing compliance with environmental regulations. This theme underscores the students' belief in the potential of innovation in addressing environmental issues and their openness to integrating new technologies into sustainability effort, reflecting a modern perspective on problem-solving in environmental conservation. As examples, Alaz predicted the following: "We might have robotic trash bins in the future. These robotic bins could remind us to throw away trash by speaking." Similarly, Emre explained "I would create a game-like system for disposing of trash. For example, I would design trash cans that look like basketball hoops."

Theme 4: Community and Behavioral Interventions

Students suggested that addressing environmental issues requires community-driven and behavioral interventions. Specifically, community and behavioral interventions involve strategies that target collective behavior change and community engagement to address environmental problems. These interventions included public awareness campaigns, the implementation of fines for littering, and educational initiatives to change behavior at the community level. Community and behavioral interventions were seen as being essential for promoting environmentally responsible behaviors. The students suggested various interventions, including public awareness campaigns, stricter enforcement of anti-littering laws (e.g., fines), and community clean-up events. With regard to the latter, Rana suggested, "We can politely warn those who litter," while Rana concluded, "I would appoint many cleaning workers to prevent littering." They recognized that changing individual behaviors and fostering a sense of collective responsibility are crucial for the success of environmental initiatives. Also, they recognized that, although individual actions are important, collective action and broader community involvement are necessary to achieve meaningful environmental outcomes, ensuring that sustainable practices are adopted widely. This community action can be gleaned from Emre's statement: "I would gather people and inform them about this issue. This might encourage them not to litter." This theme illustrates the students' understanding of the social dimensions of environmental action and their belief in the need for community-driven efforts to reinforce positive environmental behaviors, ensuring that sustainable practices are adopted widely and consistently. In the words of Ece, "People can be encouraged to be good. This way, the world will also be protected."

Meta-Theme 3: Personal Responsibility and Emotional Connection

The Personal Responsibility and Emotional Connection meta-theme refers to the students' sense of duty towards environmental protection and their deep emotional investment in environmental issues. It reflects their feelings of pride, responsibility, and emotional

investment in the outcomes of their actions. This meta-theme captures the internalization of environmental values and the personal significance that these issues held for the students.

Many students expressed strong emotional connections to the environment, often discussing their personal responsibility in maintaining it. This connection manifested itself in feelings of pride when engaging in recycling activities and a sense of duty to influence others positively. As stated by Ali, "They mean good things to me. I feel emotional and proud." The students often described their involvement in recycling and zero waste initiatives as a source of pride and emotional fulfillment. They viewed themselves as active participants in environmental protection, not just as observers. Their responses indicate that environmental responsibility is not just a task, but also an integral part of their identities, deeply rooted in their emotional responses to the state of the environment. This emotional connection to the environment suggests that the students not only are aware of environmental issues, but also are personally invested in making a difference, driven by a genuine concern for the natural world. This theme highlights the importance of fostering an emotional connection to the environment in young people because it can be a powerful motivator for sustained environmentally responsible behaviors. In the words of Ece, "If we protect the world, the world will protect us."

Theme 5: Emotional Engagement

Emotional engagement refers to the students' deep emotional investment that students feel towards environmental issues. They expressed feelings of pride, responsibility, and emotional investment in their actions to protect the environment. Ali stated, "They mean good things to me. I feel emotional and proud." For many students, protecting the environment is not just a duty, but a source of personal fulfillment and joy, being tied to their identity and emotional well-being. Many students discussed how participating in recycling and zero waste activities made them feel good about themselves and their contributions to something larger than themselves. This theme illustrates the powerful role that emotions play in driving environmental behaviors, motivating students to engage in environmentally responsible behaviors. This suggests that fostering an emotional connection to nature can be an effective strategy in environmental education.

Theme 6: Role Modeling and Influence

Role modeling and influence involve the students' awareness of the impact that their actions can have on others, as well as recognition of their ability to inspire others through their actions. They discussed the importance of setting a positive example for peers, family members, and the broader community by engaging in environmentally friendly practices, such as recycling and avoiding littering. The students believed that, by modeling good practices, they can influence their peers, family members, and community to adopt similar practices. This theme highlights the social aspect of environmental responsibility, wherein individuals can influence collective action through their personal choices and behaviors—which can lead to broader changes in community norms and behaviors—reinforcing the idea that everyone has a role to play in environmental stewardship. As Erhan stated, "I would inform everyone about my initiatives. I would put up slogans about environmental cleanliness and invite people to participate."

Meta-Theme 4: Education and Community Involvement

This meta-theme highlights the importance that the students placed on education and community engagement in promoting environmental awareness and action. It reflects their belief that informed communities and well-educated individuals are crucial for fostering

widespread environmental responsibility. Further, it reflects the students' belief in the importance of learning about environmental issues and the need for collective efforts to address them.
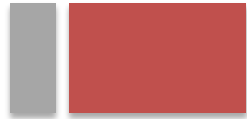
The students emphasized the need for enhanced environmental education and greater community participation in environmental initiatives and sustainability efforts. They recognized that educating themselves and others, especially from a young age, is key to raising awareness and to promoting sustainable behaviors. Additionally, they understood that community involvement is essential for driving collective action and meaningful environmental change. This meta-theme suggests that students view education as a critical tool for empowerment and for shaping attitudes and behaviors. To this end, Eliz revealed the following: "I would create recycling courses in schools." Furthermore, they valued the role of community in supporting and reinforcing individual efforts towards environmental sustainability and in driving meaningful change. As noted by Erhan, "It can be improved with the contributions of other mayors, district officials, and volunteers."

Theme 7: Importance of Environmental Education

This theme captures the students' recognition of the critical role that environmental education plays in raising awareness about environmental issues and promoting sustainable behaviors. They stressed the need for more comprehensive environmental education in schools, including lessons on recycling, waste management, pollution, sustainability, and the broader implications of environmental conservation. The students believed that education is key to raising awareness and encouraging people to take action to protect the environment, and that, by learning about environmental issues, they and their peers can become more responsible and proactive in protecting the environment. The students highlighted the need for enhanced environmental education to raise awareness and to encourage sustainable behaviors. They suggested incorporating environmental topics into the school curriculum and community programs, as well as offering more hands-on learning opportunities in order to ensure that everyone is informed about the importance of recycling, waste management, and other sustainable practices. Consistent with these recommendations, Eliz indicated the following: "I would write a project on our current phones every week with a good message. I would also create recycling courses in schools." This theme reflects their understanding that education is a crucial foundation for fostering a generation of environmentally responsible citizens. Also, this theme underscores the value of knowledge in empowering students to make a positive impact on the environment.

Theme 8: Community Engagement

Community engagement involves the students' emphasis on the need for collective action and participation in environmental initiatives. Community engagement was seen as being vital for the success of environmental initiatives. The students emphasized the need for collective action and the involvement of all community members in sustainability efforts. The students suggested that involving the entire community—including families, schools, and local governments—is essential for the success of zero waste projects and other environmental efforts. The students proposed ideas such as community clean-up events, public workshops on recycling, and collaborations with local authorities to promote environmental responsibility. This theme reflects their understanding that environmental challenges are too large for individuals to tackle alone, and that community-wide efforts are necessary to create lasting change. That is, this theme highlights their belief that addressing environmental issues requires a united effort, with everyone playing a part in making a difference. As Rana stated, "We can politely warn those who litter." The students' responses suggest that they value community-

based approaches to problem-solving and understand the power of collective action in driving environmental change.

The four meta-themes and eight themes are summarized in Table 2. This table highlights the comprehensive understanding and strong commitment of the fourth-grade students to environmental issues. The students demonstrated a clear awareness of the detrimental effects of pollution and recognized recycling as a key solution for promoting environmental health. Their responses also showcased creative problem-solving skills, proposing technological innovations and community-driven initiatives as effective strategies for environmental sustainability. Moreover, the students expressed a deep personal responsibility and emotional connection to environmental protection, emphasizing the importance of education and community involvement in fostering long-term, widespread environmental stewardship.
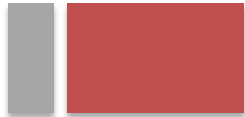
Table 2

Meta-Themes and Themes Emerging from the Fourth-Grade Students' Responses

Meta-Theme	Summary of Meta-Theme	Theme	Summary of Theme
Environmental Awareness	This meta-theme reflects the students' growing recognition and understanding of environmental issues, particularly pollution and waste mismanagement, and their awareness of the importance of sustainable practices to protect the natural world and promote environmental health.		
		Pollution and Its Impact	This theme highlights the students' deep concerns about pollution, particularly its harmful effects on the environment, wildlife, and human health, as well as their understanding of the broader implications of pollution on climate change and quality of life.
		Recycling as a Solution	This theme reflects the students' strong belief in recycling as a practical method to reduce pollution, to conserve resources, and to promote environmental health, emphasizing the importance of widespread recycling practices and the proper separation and processing of recyclables.
Proposed Solutions and Initiatives	This meta-theme highlights the students' creative and proactive approaches to environmental problem-solving, wherein they propose a mix of technological innovations and community-		

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Meta-Theme	Summary of Meta-Theme	Theme	Summary of Theme
	driven initiatives to reduce waste, to enhance recycling, and to promote sustainability.		
		Technological Innovations	This theme highlights the students' creative and forward-thinking proposals for using technology, such as robots, surveillance cameras, and smart trash bins, to enhance recycling and waste management, reflecting their belief in the potential of innovation to improve efficiency and effectiveness in addressing environmental issues.
		Community and Behavioral Interventions	This theme reflects the students' belief in the importance of collective behavior change and community engagement, proposing strategies such as public awareness campaigns, stricter enforcement of anti-littering laws, and community clean-up events to promote environmentally responsible behaviors and to ensure widespread adoption of sustainable practices.
Personal Responsibility and Emotional Connection	This meta-theme captures the students' strong sense of duty and deep emotional investment in environmental protection, reflecting their pride, personal responsibility, and internalization of environmental values as integral parts of their identity and motivation for sustained environmental action.		
		Emotional Engagement	This theme highlights the students' deep emotional investment in environmental issues, wherein feelings of pride, responsibility, and personal fulfillment drive their commitment to environmentally responsible behaviors, emphasizing the importance of emotional connection as a motivator in environmental education.
		Role Modeling and Influence	This theme underscores the students' belief in the power of setting a positive example and inspiring others through their environmentally friendly practices, recognizing that their actions can influence peers,

Meta-Theme	Summary of Meta-Theme	Theme	Summary of Theme
			family members, and the community to adopt similar behaviors, thereby contributing to broader environmental stewardship.
Education and Community Involvement	This meta-theme emphasizes the students' belief that comprehensive environmental education and active community participation are essential for fostering widespread environmental responsibility and driving meaningful change.		
		Importance of Environmental Education	This theme reflects the students' belief that comprehensive environmental education is essential for raising awareness, promoting sustainable behaviors, and empowering individuals to take proactive steps in protecting the environment, emphasizing the need to integrate environmental topics into school curricula and community programs.
		Community Engagement	This theme highlights the students' belief that collective action and the active participation of all community members—including families, schools, and local governments—are crucial for the success of environmental initiatives, emphasizing the power of united efforts in driving meaningful and lasting change.

Cross-Case Analysis

Table 3 presents the incidence-based inter-respondent matrix pertaining to the four meta-themes and eight themes. It can be seen from this matrix that it serves as a detailed analytical tool that organizes and visualizes the distribution of meta-themes and themes across the 15 primary school students. Its major function is to provide a structured way to assess how frequently certain concepts (themes and meta-themes) are mentioned or recognized by different students. This inter-respondent matrix allows for the identification of which meta-themes (i.e., broad categories) and themes (i.e., specific aspects within those categories) are most and least commonly acknowledged by the students. In particular, by tallying the number of "1s" (indicating presence) and "0s" (indicating absence) across the students, the matrix quantitizes the prevalence of each meta-theme and theme. The matrix also includes statistical calculations such as standard deviations, which measure how much the students' recognition of meta-themes and themes varies. This helps in understanding which concepts are consistently understood or

valued across the group, and which concepts show more diversity in recognition or understanding.

Furthermore, the incidence-based inter-respondent matrix allows for a comparison of individual students. engagement with the various meta-themes and themes. By summing the scores for each student across meta-themes and themes, the matrix identifies which students are most and least engaged with the content, providing insights into who might need additional support or who could act as peer leaders. The matrix visually represents the data, making it easier to see patterns at a glance—such as which themes are dominant or underrepresented, or how individual students contribute to the overall distribution of themes.

Cross-Case Analysis of Meta-Themes

Descriptive-Based Quantitizing and Inferential-Based Quantitizing. It can be seen from this incidence-based inter-respondent matrix in Table 3 that, by far the most prevalent meta-theme was Environmental Awareness, with 13 out of the 15 students (i.e., 86.67%) being categorized under this meta-theme. Using Onwuegbuzie and Levin's (2005) Binomial Test of Trend—which can involve the binomial distribution being used to determine whether the prevalence rate of each meta-theme and theme should be regarded as being statistically significant, with the effect-size index being the observed prevalence rate itself (Onwuegbuzie et al., 2011)—the prevalence rate for the Environmental Awareness meta-theme is statistically significant ($p = .018$). This finding suggests that the concept of environmental consciousness is well-rooted among the students, which is crucial for the success of the Zero Waste Project because it reflects a baseline awareness of the importance of waste management.

No other meta-themes yielded statistically significant prevalence rates, with the next highest prevalence rates being both the Personal Responsibility and Emotional Connection meta-theme and the Education and Community Involvement meta-theme, each being endorsed by 8 out of 15 students (53.33% each), which is not statistically significant ($p = .50$). This 53.33% prevalence rate indicates that slightly more than one half of the students feel a sense of personal responsibility and emotional connection to environmental issues and see the importance of education and community involvement. These areas are vital for fostering a proactive attitude towards waste reduction and sustainability because they involve both personal accountability and community action. Interestingly, these two meta-themes also demonstrated the highest variability ($SD = 0.52$, $SD\% = 3.47$ each), indicating that students' perceptions of their personal role in environmental stewardship and the importance that they place on education and community involvement vary relatively widely. This variability could be due to differences in personal experiences or levels of engagement with environmental issues. This level of relative variability is followed very closely by that pertaining to the Proposed Solutions and Initiatives meta-theme ($SD = 0.51$, $SD\% = 3.4$). The variability in this meta-theme suggests that students are inconsistent in their engagement with proposing solutions to environmental issues. Some students appear to have strong ideas about solutions, whereas others might not have considered them. In contrast, the Environmental Awareness meta-theme had the least variability ($SD = 0.35$, $SD\% = 2.33$), indicating a uniform understanding and recognition of environmental issues among the students. The least frequent meta-theme was Proposed Solutions and Initiatives, with 6 out of 15 students (i.e., 40%) being categorized under this theme ($p = .85$).

Table 3

Incidence-Based Inter-Respondent Matrix of Meta-Themes and Themes

Meta-Themes and Themes	Aliin	Aylin	Ece	Rana	Ata	Kemal	Emren	Hakan	Erhan	Eslian	Alaz	Elizz	Nazgun	Duygun	Metin	Sum	%	*SD*	*SD* (%)
Meta-Themes:																			
Environmental Awareness	1	1	1	1	1	0	1	1	1	1	1	1	0	1	1	**13**	**86.67**	0.35	2.33
Proposed Solutions and Initiatives	0	0	0	1	1	1	1	0	0	1	0	1	0	0	0	**6**	**40.00**	0.51	3.4
Personal Responsibility and Emotional Connection	1	1	1	1	1	0	0	0	0	0	0	0	1	1	1	**8**	**53.33**	0.52	3.47
Education and Community Involvement	0	1	1	0	1	1	1	0	0	0	0	1	1	0	1	**8**	**53.33**	0.52	3.47
Meta-Themes Score (0-4)	**2**	**3**	**3**	**3**	**4**	**2**	**3**	**1**	**1**	**2**	**1**	**3**	**2**	**2**	**3**	**35**			
Themes:																			
Pollution and Its Impact	1	0	1	1	1	0	1	1	1	1	1	1	0	1	1	**12**	**80.00**	0.41	2.73
Recycling as a Solution	1	1	1	0	1	1	1	1	0	0	0	0	0	0	0	**7**	**46.67**	0.52	3.47
Technological Innovations	0	0	0	0	1	1	1	0	0	1	0	1	1	0	0	**6**	**40.00**	0.51	3.4
Community and Behavioral Interventions	0	0	0	1	1	0	1	0	0	0	0	1	0	1	0	**5**	**33.33**	0.49	3.27
Emotional Engagement	1	1	1	1	0	0	0	1	1	1	1	0	0	1	1	**10**	**66.67**	0.49	3.27
Role Modeling and Influence	0	0	0	1	0	1	0	0	0	1	0	0	1	0	0	**4**	**26.67**	0.46	3.07
Importance of	0	1	1	0	1	0	0	0	0	0	0	1	0	0	0	**4**	**26.67**	0.46	3.07

Meta-Themes and Themes	A l i i n	A y l n	E c e a	R a n a	A t a m a l	K e m e l	E m r e n	H a k h a n	E r h i a n n	E s i z z	A l a a n	E l i z z a	N a z a g n u n	D u y y g u	M e t i i n	Sum	%	*SD*	*SD* (%)
Environmental Education																			
Community Engagement	0	0	0	1	1	0	1	0	0	0	0	0	1	0	1	**5**	**33.33**	0.49	3.27
Themes Score (0-8)	3	3	4	5	6	3	5	3	2	4	2	4	3	3	3	53			

Cross-Case Analysis of Themes

Descriptive-Based Quantitizing and Inferential-Based Quantitizing. The incidence-based inter-respondent matrix in Table 3 also indicates that the most prevalent theme was the Pollution and Its Impact, with 12 out of 15 students (i.e., 80%) being characterized by this theme. The prevalence rate of this theme, which is statistically significant (p = .018), reflects a widespread concern among students about the effects of pollution. This indicates that pollution is a well-recognized issue, which aligns with global concerns about waste and its environmental impact. The second most prevalent theme was Emotional Engagement, with 10 out of 15 students (i.e., 66.67%) representing this theme. Although this prevalence rate is not statistically significant (p = .15), it shows that many students are emotionally invested in environmental issues.

In contrast, the Role Modeling and Influence theme and the Importance of Environmental Education theme, each with 4 out of 15 students (i.e., 26.67%), were the two least frequent themes, indicating that few students see role models or education as being critical components in addressing environmental issues. This could reflect a lack of visible role models in their lives who practice zero waste or a gap in how environmental education is being conveyed. The Community and Behavioral Interventions and Community Engagement themes, each being represented by 5 out of 15 students (i.e., 33.33%), are slightly more frequent than are the two least frequent themes, but still, a minority of students recognize the importance of community actions and interventions.

Interestingly, in terms of the variability of the themes, whereas the Recycling as a Solution theme was the most variable (*SD* = 0.52, SD% 3.47), followed very closely by the Technological Innovations theme (*SD* = 0.51, SD% 3.4), the least variable themes were the Role Modeling and Influence theme and the Importance of Environmental Education theme (*SD* = 0.46, SD% = 3.07 each). This range of 0.46 to 0.52, which is relatively small, suggests that there is not a large difference in how students engage with or perceive these various themes in the context of the Zero Waste Project.

Cross-Case Analysis of Student Contributions to Meta-Themes

Descriptive-Based Quantitizing. Of the 15 primary school students, Ata was the only student who contributed to all four meta-themes. This indicates that Ata had a comprehensive understanding and involvement in various aspects of environmental issues. This student could be seen as a key advocate or leader within the Zero Waste Project, potentially influencing peers to engage more deeply with these concepts. Six students (Aylin, Ece, Rana, Emre, Eliz, and

Metin) each contributed to three meta-themes. These students also show a strong engagement with a variety of meta-themes, indicating that they have a well-rounded understanding of the issues. They could be leveraged as peer educators or ambassadors within the project to encourage broader engagement among their classmates.

At the other end of the spectrum, three boys—Hakan and Erhan, and Alaz—each contributed to one meta-theme. These students contributed the least to the meta-themes, which might suggest a narrower focus or less engagement with environmental issues. Finally, five students—Ali, Kemal, Esin, Alaz, Nazan, and Duygu—each contributed to two meta-themes. These students contributed slightly more than did the least engaged, but still relatively few meta-themes.

Cross-Case Analysis of Student Contributions to Themes

Descriptive-Based Quantitizing. Of the eight themes, Ata contributed the most themes, specifically six themes (i.e., 75.0%). Ata's high contribution across themes suggests a deep and multifaceted understanding of zero waste concepts. As suggested by his contribution to all four meta-themes, this student likely has a strong commitment to waste reduction and could be a valuable leader or role model within the project, helping to drive engagement among other students. Rana and Emre also made large contributions, each providing responses that were characterized under five themes. These students also showed a high level of engagement across multiple themes, indicating a strong awareness and understanding of the various aspects of waste management. On the other end of the spectrum, Erhan and Alaz contributed to the smallest number of themes, each providing responses that were classified under two themes. This suggests that these students had the least engagement with the range of topics covered by the Zero Waste Project.

### *Overall Comparison of Meta-Themes and Themes*

Descriptive-Based Quantitizing and Inferential-Based Quantitizing. The number of meta-themes to which the primary school students contributed ranged from 1 to 4 ($M = 2.40$, SD = 0.80). The number of themes ranged from 2 to 6 ($M = 3.47$, SD = 1.08). This means that every student contributed to at least one meta-theme and at least two themes. Interestingly, a strong positive (Spearman rank) correlation emerged between the number of meta-themes and themes to which students contributed, $r_s = .77$, $p < .001$. This means that students who contributed to more meta-themes also tended to contribute to more themes.

Exploratory-Based Quantitizing of Meta-themes. Figure 1 illustrates the 15 participants mapped, via correspondence analysis, onto the space that displays the four meta-themes (i.e., Environmental Awareness, Proposed Solutions and Initiatives, Personal Responsibility and Emotional Connection, and Education and Community Involvement). This figure shows (a) how the participants related to each other with regard to these four meta-themes, (b) how the meta-themes were related to each other, and (c) the relationship between the students and the meta-themes. The spatial arrangement in Figure 1 allows for the identification of patterns and associations that reveal how students' perceptions align with specific meta-themes.

In the top left quadrant, it can be seen that Nazan and Metin are clustered together nearest to the meta-theme of Personal Responsibility and Emotional Connection. Interestingly, although they vary with respect to their other demographics, both students are the third children in their families. The clustering of Nazan and Metin in the top left quadrant near the meta-theme of Personal Responsibility and Emotional Connection suggests that these students share a significant connection to this meta-theme—namely, with respect to birth order—despite their differences in other demographic characteristics.

Figure 1

Correspondence Analysis Plot of the Four Emergent Meta-Themes
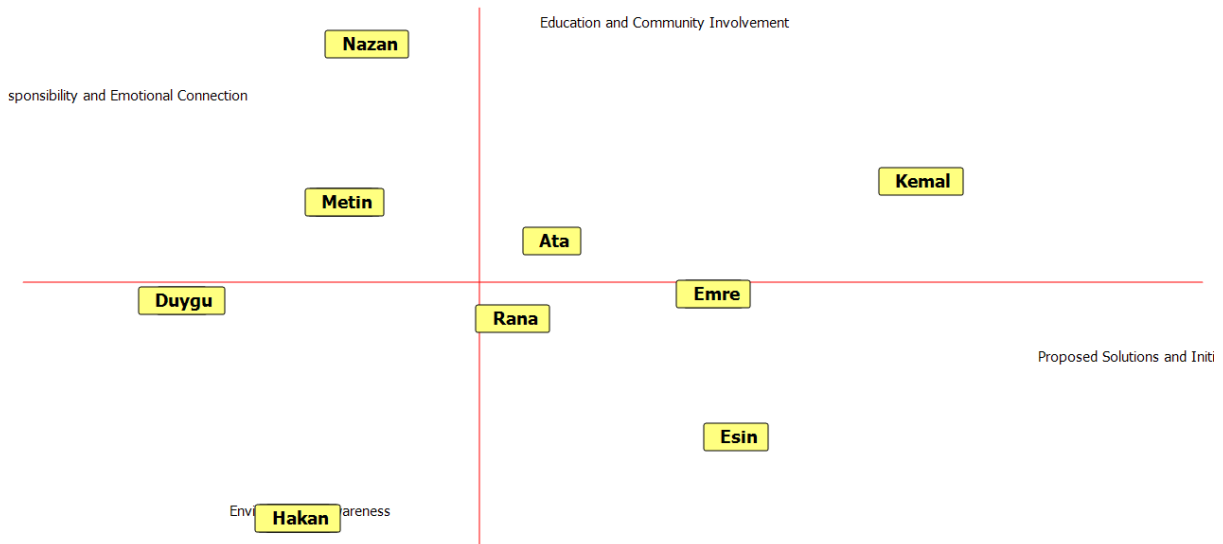
In the top right quadrant, it can be seen that Ata and Kemal are clustered together nearest to the meta-theme of Education and Community Involvement. Both students are boys and are third the children in their families. Also, both students are involved in sports—Ata in handball and Kemal in cycling. The clustering of Ata and Kemal in the top right quadrant near the meta-theme of Education and Community Involvement suggests that these two students share certain demographic characteristics and interests that might influence their focus on this meta-theme.

In the bottom right quadrant, it can be seen that Emre, Esin, and Rana are clustered together nearest to the meta-theme of Proposed Solutions and Initiatives. Interestingly, whereas Emre is a boy and the first child in his family, both Esin and Rana are girls and are the third children in their family. Furthermore, whereas Emre and Rana have "Excellent" academic achievement, Esin has "Good" academic achievement. In addition, whereas Rana and Esin are involved in sports—specifically handball—Emre is involved in mathematics and reading books. Emre is from a "Good" economic status family, whereas Rana and Esin are from "Below Average" economic status families. Therefore, despite their different backgrounds, these three students share a common interest or focus on finding solutions and taking initiatives related to the Zero Waste Project.

Finally, in the bottom left quadrant, it can be seen that Duygu and Hakan are close to the meta-theme of Environmental Awareness. Both have "Good" academic achievement. Further, both have artistic skills, being involved in painting and reading books. This suggests that these two students share two common characteristics that might influence their focus on and engagement with environmental issues.

Exploratory-Based Quantitizing of Themes. Figure 2 illustrates the 15 participants mapped, via correspondence analysis, onto the space that displays the eight themes (i.e., Pollution and Its Impact, Recycling as a Solution, Technological Innovations, Community and Behavioral Interventions, Emotional Engagement, Role Modeling and Influence, Importance of Environmental Education, and Community Engagement). This figure shows (a) how the participants related to each other with regard to these four meta-themes, (b) how the meta-

themes were related to each other, and (c) the relationship between the students and the meta-themes. In particular, the spatial arrangement in Figure 2 provides insights into how students' perspectives align with specific themes and how these themes cluster together.

Figure 2

Correspondence Analysis Plot of the Eight Emergent Themes
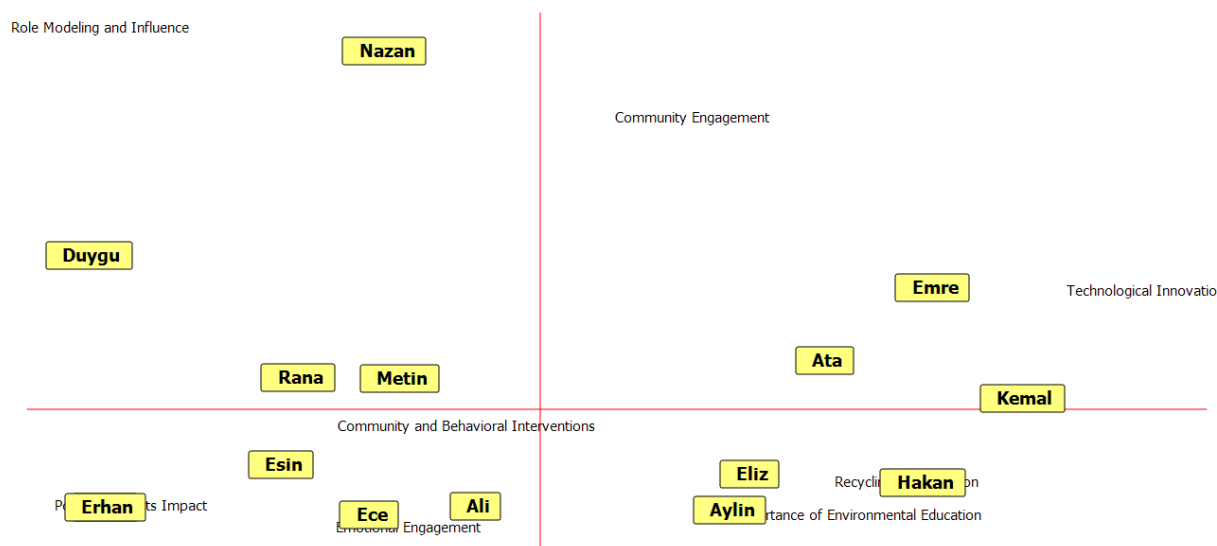
In the top left quadrant, it can be seen that Nazan, Dyugu, Rana, and Metin are clustered together nearest to the theme of Role Modeling and Influence. Interestingly, whereas Nazan, Duygu, and Rana are girls, Metin is a boy. Therefore, the group is predominantly female, with three out of four students being girls. This suggests that girls in this group might have a stronger association with the theme of Role Modeling and Influence, which could be related to their socialization and possibly a greater emphasis on empathy, nurturing, and leadership in interpersonal relationships. Nazan and Duygu have "Good" academic achievement, whereas Rana and Metin have "Excellent" academic achievement. This suggests that students with solid academic performance, although not necessarily the top achievers, might still be highly engaged with themes related to role modeling and influence, indicating that leadership and influence are not exclusively the domain of the highest achievers. Nazan and Rana are from families with "Below Average" economic status, whereas Metin and Duygu are from families with "Good" and "Medium" economic statuses, respectively. Therefore, the students come from varying economic backgrounds, with no clear pattern suggesting that family economic status significantly influences their association with role modeling and influence. This diversity implies that the capacity to be a role model or to exert influence is not limited by economic factors. All students have involvement in artistic activities; Nazan and Dyugu are involved in reading books, Metin is involved in chess, and Rana is involved in rhythmic dance (musical performance). The fact that all students in this group are engaged in some form of artistic activity indicates a possible link between creative expression and the theme of Role Modeling and Influence. All four students are third children in their families. This is a significant pattern, which indicates that birth order might influence their perspectives on leadership and role modeling within their peer groups or families. Moreover, it suggests that third children, who often navigate dynamics between older and younger siblings, might develop strong skills in mediation, empathy, and leadership—traits that align well with the theme of Role Modeling

and Influence. The demographic patterns observed in this group of students indicate that the potential for role modeling and influence is influenced by a combination of factors, including gender, birth order, and a balance of artistic and athletic involvement.

In the top right quadrant, it can be seen that Emre, Ata, and Kemal are clustered together nearest to the themes of Community Engagement and Technological Innovations. Interestingly, all three students are boys. This suggests that the boys in this group might have a stronger interest or engagement with themes related to Community Engagement and Technological Innovations. Two of the three students (Emre and Ata) have excellent academic achievement, indicating that high-performing boys might be particularly inclined towards these themes. Two of the three students (Ata and Kemal) are engaged in sports or physical activities, with one (i.e., Kemal) involved in other activities (i.e., mathematics and reading books). Ata also is involved in mathematics. This combination of interests suggests that a balance of physical, intellectual, and creative skills might be associated with a focus on community engagement and technology. The students come from families with "Good" (i.e., Kemal and Emre) to "Medium" (i.e., Ata) economic status. This could indicate that students from families with stable economic backgrounds might have more exposure or access to resources that foster an interest in community involvement and technological innovation. Two of the students (Ata and Kemal) are third children, which might suggest that later-born children in this group are more inclined towards collaborative and innovative efforts, possibly due to their roles in their families wherein they might have observed and learned from older siblings. Overall, the demographic patterns in this group highlight the intersection of academic excellence, gender, sports participation, and family background in shaping students' interests in community and technological themes.

In the bottom right quadrant, it can be seen that Eliz, Hakan, and Aylin are clustered together nearest to the themes of Recycling as a Solution and Importance of Environmental Education. The group consists of two girls (i.e., Aylin and Eliz) and one boy (i.e., Hakan). Although there is no overwhelming gender dominance, the presence of females in this group might suggest a slightly stronger inclination among girls toward themes related to environmental education and recycling. Aylin has "Excellent" academic achievement, Hakan has "Good" academic achievement, and Eliz has "Below Good" academic achievement. Therefore, the students have varying levels of academic achievement, with no clear pattern suggesting that academic achievement significantly influences their association with the themes of Recycling as a Solution and Importance of Environmental Education. All three students share a common interest in the artistic activity of painting, with Aylin and Hakan also engaged in reading books. This suggests that artistic expression might correlate with an interest in environmental education, indicating that students with artistic activities are drawn to environmental themes. Two students (Aylin and Hakan) are from families with "Good" economic status, whereas Eliz is from a "Medium" economic status family. This suggests that economic status does not significantly differentiate the students' engagement with environmental themes. Both Eliz and Hakan are second children, whereas Aylin is a first child. This mix of birth order indicates that both first-born children and second-born children are likely to engage with environmental themes. The presence of second-born children suggests that they might have a balanced perspective, potentially mediating between older and younger siblings, which could contribute to an interest in broader societal issues like environmental education. The demographic patterns in this group suggest that environmental awareness, particularly around themes like recycling and education, is influenced by a combination of stable academic achievement, artistic involvement, and a balanced family role (as indicated by child order).

Finally, in the bottom left quadrant, it can be seen that Esin, Erhan, Ece, and Ali are close to the themes of Pollution and Its Impact, Community and Behavioral Interventions,

Emotional Engagement. The group is evenly split by gender, with two girls (Esin and Ece) and two boys (Erhan and Ali). This balance suggests that both male and female students are engaged equally with these themes, indicating that concerns related to pollution, community interventions, and emotional engagement are relevant across genders. The group consists of students with "Good" (i.e., Erhan and Esin) and "Excellent" (i.e., Ali and Ece) academic achievement. The inclusion of students with varying academic performances suggests that awareness and concern for environmental issues and community engagement are not limited to top academic achievers but are shared among students with different levels of academic success. Three students (i.e., Ece, Erhan, Esin) in this group are engaged in the artistic pursuit of painting. This suggests that these students might be particularly sensitive to themes that require emotional investment and social responsibility, such as pollution and community interventions. The students come from diverse economic backgrounds, with one student from a "Good" economic status family (Ece), two from "Medium" economic status families (Erhan and Ali), and one from a "Below Average" economic status family (Esin). This economic diversity suggests that the themes of pollution, community interventions, and emotional engagement resonate across socioeconomic lines, indicating that environmental and social concerns are universal issues that affect students regardless of their economic background. The group includes a mix of first-born (i.e., Erhan), second-born (i.e., Ali), and third-born (i.e., Ece and Esin) children. This variety in birth order suggests that the themes of pollution, community engagement, and emotional investment appeal to students regardless of their position in the family hierarchy. The demographic patterns observed in this group suggest that environmental and social themes are widely relevant and resonate across a diverse range of students. The balanced gender distribution, varied academic achievements, and economic diversity within the group indicate that concerns about pollution, community engagement, and emotional investment are shared across different demographic categories.

Qualitizing of Quantitized Themes

Table 4 presents the holistic profiles of the 15 fourth-grade students emerging from the qualitizing process, which were guided by the incidence-based inter-respondent matrix. This table focuses on their demographic characteristics, academic achievements, interests, and attitudes towards environmental issues, particularly within the context of the Zero Waste Project. Each student's profile highlights their concerns about specific environmental problems, their proposed solutions, and the personal values or motivations driving their engagement with these issues.

Table 4 indicates that the students demonstrate a variety of concerns about environmental issues, including littering, pollution, and the underutilization of recycling bins. Their engagement ranges from practical solutions like increasing the number of recycling bins to more innovative ideas such as technological interventions. Additionally, some students emphasize the importance of education and community involvement as key strategies for fostering a culture of environmental responsibility. This blend of practical and forward-thinking approaches highlights the students' capacity to think critically and creatively about solving environmental problems.
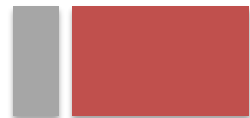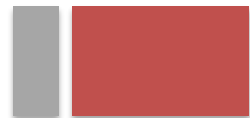
Table 4

Holistic Profiles of Each Student Emerging From the Qualitizing Process

Student	Holistic Profile
Ali	Ali is a boy and the second child in his family. He excels academically and has a strong talent for football. Coming from a medium economic status family, Ali is concerned deeply about environmental pollution, particularly air pollution and littering, which he views as major threats to nature. His strong academic performance and involvement in sports reflect his disciplined and proactive nature. Ali feels a strong emotional connection to the zero waste initiative, stating that it makes him feel emotional and proud. He values the availability of recycling bins for different materials, such as plastic and glass, and suggests practical improvements like increasing the number of recycling bins and raising public awareness through brochures and signs to prevent pollution.
Aylin	Aylin is a girl, the first child in her family, with an excellent academic record and a love for painting and reading books. She comes from a good economic status family. Aylin particularly is aware of the environmental issue of underutilized recycling bins. She believes that making recycling bins more visible and widespread would encourage their use and help prevent pollution. Motivated by the belief that recycling helps reduce pollution, Aylin dislikes seeing waste improperly discarded. Her solutions are practical and focused on increasing the number of visible recycling bins, which aligns with her strong academic background and belief in the power of education to promote sustainable practices.
Ece	Ece is a girl and the third child in a good economic status family. She is excellent in her studies and has a talent for painting and music (choir). Ece is highly aware of the dangers of environmental pollution, considering it the most pressing issue. She advocates for using social media and television to raise awareness about pollution, emphasizing the reciprocal relationship between protecting the environment and being protected by it in return. Ece's strong emotional connection to the environment is reflected in her pride in recycling and her desire for greater public engagement in positive environmental behaviors. Her responses demonstrate a deep understanding of the environment and a commitment to making a difference.
Rana	Rana is a girl from a below-average economic status family and the third child in her family. She is excellent academically and is actively involved in rhythmic dance (musical performance) and sports (handball). Rana identifies littering as a significant environmental issue and proposes a combination of enforcement and community interventions to tackle it. She suggests appointing more cleaning workers and imposing fines on those who litter. Rana also believes in setting a good example, emphasizing the importance of polite warnings and public education to reduce littering. Her sense of personal responsibility and commitment to community involvement is clear, reflecting her proactive nature and leadership skills in both academic and extracurricular activities.
Ata	Ata is a boy and the third child in a medium economic status family. He excels academically, particularly in mathematics, and also is active in sports (handball). Ata is concerned particularly about the underuse of recycling bins and the prevalence of littering. His innovative mindset leads him to propose the creation of a robot that can automatically sort recyclables and dispose of waste correctly. Ata also emphasizes the importance of public awareness, suggesting the use of slogans and public announcements to improve environmental cleanliness. His blend of technological innovation and community-based

Student	Holistic Profile
	initiatives demonstrates his strong problem-solving skills and desire to see tangible improvements in environmental practices.
Kemal	Kemal is a boy from a good economic status family and the third child. He has good academic performance and enjoys painting and cycling. Kemal's approach to environmental issues is heavily focused on technological solutions, particularly in addressing littering. He proposes the installation of cameras that detect littering and help security personnel issue warnings. Kemal also is interested in recycling, particularly in finding ways to recycle broken toys. His belief in the power of technology to create a cleaner environment reflects his innovative thinking and global perspective. His vision for a clean world involves both technological innovation and global cooperation.
Emre	Emre is a boy, the first child in a good economic status family. He has an excellent academic record and enjoys mathematics and reading books. Emre views littering and smoking as significant environmental problems. He suggests a creative solution to encourage proper waste disposal by designing trash cans that look like basketball hoops, making disposing of trash more engaging. Emre also stresses the importance of public education and the enforcement of fines to prevent littering. His responses indicate a practical approach to problem-solving, combining fun and creativity with the need for community involvement and behavioral change.
Hakan	Hakan is a boy, the second child in a good economic status family. He has good academic performance and enjoys painting and reading books. Hakan identifies littering as a key environmental issue and believes that increasing the availability of recycling bins could help address this problem. He values the role of recycling in creating new products from waste and suggests implementing zero waste practices in schools to further these initiatives. Hakan's responses reflect his commitment to practical solutions and his belief in the power of recycling to improve environmental outcomes.
Erhan	Erhan is a boy and the first child in a medium economic status family. He has good academic performance and is involved in music, painting, and rhythmic dance (folk dance). Erhan is concerned deeply about the environmental impact of littering, particularly its harm to animals and trees. He proposes a range of solutions, including the production of electric cars to reduce exhaust emissions and the enforcement of fines and jail terms for those who pollute the environment. Erhan also values recycling for its ability to keep beaches clean and reduce waste. His holistic view of environmental protection reflects a strong sense of responsibility and a desire to see significant changes in societal interactions with the environment.
Esin	Esin is a girl from a below-average economic status family and the third child. She has good academic performance and enjoys painting and sports (handball). Esin identifies littering as a major environmental problem and suggests increasing the number of trash bins in high-traffic areas to prevent it. She values the presence of recycling bins but is frustrated by people who pollute the environment. Esin's focus on practical, community-based solutions, such as placing more visible signs and warnings to discourage littering, reflects her belief in the effectiveness of simple, straightforward measures to improve environmental cleanliness.
Alaz	Alaz is a boy and the second child in a medium economic status family. He has good academic performance and is involved in sports (football). Alaz particularly is concerned

Student	Holistic Profile
	about littering, especially the impact of cigarette butts as pollutants. He suggests creating larger trash bins and increasing their availability to prevent littering. Alaz also supports recycling projects and believes that technological innovations, such as robotic trash bins, could further improve waste management in the future. His responses reflect a forward-thinking approach to environmental issues, combining practical solutions with a vision for future technological advancements.
Eliz	Eliz is a girl and the second child in a medium economic status family. She has below good academic performance and enjoys painting. Eliz identifies littering and the improper use of recycling bins as major environmental issues. She advocates for stricter enforcement measures, including fines and jail time for those who fail properly to dispose of waste. Eliz also believes in the importance of education and suggests creating recycling courses in schools to raise awareness and to improve environmental behaviors. Her strong commitment to rule enforcement and education underscores her belief in the necessity of disciplined, structured approaches to promoting environmental sustainability.
Nazan	Nazan is a girl from a below-average economic status family and the third child. She has good academic performance and talents in reading books and visual memory. Nazan is concerned about littering and its impact on the environment. She believes that education and warnings, particularly directed at children, are essential for reducing littering. Nazan also values recycling for its role in preserving natural resources, such as trees. Her responses indicate a strong belief in the importance of education and community engagement in promoting environmental responsibility, demonstrating her understanding of the long-term benefits of instilling these values early.
Duygu	Duygu is a girl and the third child in a medium economic status family. She has good academic performance and enjoys painting and reading books. Duygu identifies littering, particularly of paper, as a significant environmental problem. She suggests increasing the number of trash bins along roads and placing municipal staff to remind people not to litter. Duygu also values the recycling of paper and dislikes when it is not properly recycled. Her practical approach to environmental issues focuses on improving infrastructure and encouraging responsible behaviors, reflecting her belief in straightforward, actionable solutions.
Metin	Metin is a boy and the third child in a good economic status family. He has an excellent academic record and excels in sports (football) and mind games (chess). Metin sees littering as a major environmental issue and suggests increasing the number of recycling bins and green spaces as solutions. Also, he expresses a dislike for pollutants like deodorants and car exhausts. Metin's strong personal connection to environmental cleanliness, which he associates with happiness, drives his commitment to finding practical solutions and spreading awareness to achieve a cleaner, more sustainable environment.

Many students expressed a deep emotional connection to the environment, reflecting their sense of personal responsibility. This connection often manifested itself in feelings of pride, frustration with environmental degradation, and a desire to see tangible improvements in their communities. Their emotional investment is a driving force behind their proactive attitudes, motivating them to advocate for and to engage in actions that contribute to a healthier, more sustainable environment. This sense of ownership and commitment is crucial for fostering long-term environmental stewardship among young people.

Students' academic performance and involvement in artistic and sports activities appear to shape their perspectives on environmental issues. Those engaged in creative activities, for example, often propose solutions that involve education and community awareness, whereas those involved in sports might focus on teamwork and community interventions. This suggests that students draw on their personal strengths and interests when addressing environmental challenges.

The students come from diverse economic backgrounds; yet, there is a common thread of concern for environmental issues across these different contexts. This shared commitment suggests that environmental awareness transcends socioeconomic differences, highlighting the universal importance of sustainability education. Regardless of their financial circumstances, these students recognize the value of protecting the environment, which underscores the potential for collective action in addressing global environmental challenges.

The students' suggestions for addressing environmental issues range from practical, community-based interventions (e.g., increasing trash bins and public awareness campaigns) to more technologically driven solutions (e.g., robots for sorting recyclables). This indicates a forward-thinking approach and a willingness to embrace both traditional and modern methods to solve environmental problems. Their diverse ideas reflect an adaptive mindset, recognizing that a combination of grassroots efforts and innovative technology will be essential in tackling complex environmental challenges effectively.

In summary, based on Table 4, the holistic profiles of these fourth-grade students reveal a deep and multifaceted engagement with environmental issues, driven by a combination of personal responsibility, creativity, and a shared sense of urgency. Their diverse backgrounds and individual strengths contribute to a rich tapestry of ideas, from community-based solutions to cutting-edge technological innovations. This collective commitment to environmental stewardship, regardless of socioeconomic differences, highlights the potential for these young minds to play a crucial role in the ongoing efforts to achieve a sustainable future.

Nonverbal Communication Findings

Table 5 presents a summary of the nonverbal communication findings stemming from Ekman's (1999) neurocultural model of facial expressions as documented via a debriefing process by the second author during her individual semi-structured interviews with students. The observations are categorized based on Ekman's 15 emotional expressions: amusement, anger, contempt, contentment, disgust, embarrassment, excitement, fear, guilt, pride in achievement, relief, sadness/distress, satisfaction, sensory pleasure, and shame. Each category is accompanied by a summary of the students' facial expressions, body language, and the context in which these emotions were expressed, reflecting their attitudes and reactions toward environmental issues and their participation in the project. The following results arise from a nonverbal communication analysis using Braun and Clarke's (2019) reflexive thematic analysis, incorporating observations made by the second author during the interview process as well as those made by the first author throughout the Zero Waste project.
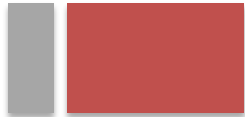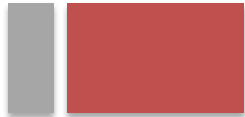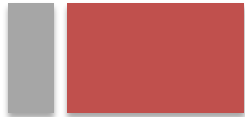
Table 5

Nonverbal Communication Findings Stemming Ekman's (1972) Neurocultural Model of Facial Expressions as Observed by the Second Author During the Individual Semi-Structured Interviews

Nonverbal Communication	Summary of Observations
Amusement	The students conveyed their joy and pleasure through their facial expressions and body language as they answered the questions, reflecting the enjoyment they derived from the activities they carried out during the project. They expressed that seeing recycling bins both in the classroom and outside made them happy, and using them correctly felt like playing a fun game. The most enjoyable part of the project was seeing the recycling bins being used effectively and the fun new products that emerged after the recycling process was completed.
Anger	During the survey, as the students answered the questions, I noticed a sense of anger towards people who littered and did not listen to them even after being politely warned. I could say that their clenched fists and furrowed brows as they talked about people who deliberately did not protect the environment or contribute to environmental awareness were clear indications of how their inner anger was reflected in their words.
Contempt	During the survey, while the students were answering the questions, I sensed that they felt contempt for people who littered and did not listen to them despite their efforts to raise awareness on this issue.
Contentment	The students experienced two different kinds of contentment. The first was the contentment from the sense of freedom provided by having outdoor activities that day. Their happiness was evident from their open arms and the way they walked while swinging them, their smiling faces, and the way that they walked with a skip in their step, enjoying the light breeze in the park. The second kind of contentment was clearly visible on their faces when they participated in the survey and realized that someone cared about their opinions and had come to interview them, taking their contributions to the project seriously. The light smiles, blinking eyes, relaxed postures, and their tone of voice all indicated that they were content. Additionally, after the survey, inviting me to the school picnic scheduled for the following week and some students hugging me

Nonverbal Communication	Summary of Observations
	were great examples of the contentment that the activity had brought them. I could say that their waving and smiling as they said goodbye was a sign of their contentment.
Disgust	During the survey, I noticed expressions on some students' faces that indicated that they felt discomfort and disgust towards people who polluted the environment and did not protect nature. Their lips parted, teeth clenched, their noses slightly lifted in disgust, and their eyes squinted—all pointing to this feeling.
Embarrassment	The students were somewhat embarrassed and shy when they first arrived for the survey. Initially, they kept their distance due to the uncertainty of meeting someone they had never seen before, but as I approached them, they showed a mix of embarrassment and relief. At first, their hands were closed, heads bowed, and they avoided eye contact with me. However, as the questions started and I showed them that I was listening carefully and respecting them, their embarrassment was replaced with joy and relaxation.
Excitement	The students experienced various excitements throughout the day. The excitement of the games that they played and the anticipation of meeting with me were different sources of excitement. When the girls saw me approaching from a distance, they tapped each other on the shoulders, whispered, and smiled. The boys, on the other hand, were excitedly planning their time during the match so as not to miss anything.
Fear	Because the students had internalized the project on which they were working, they expressed fear about the potential future problems caused by environmental pollution through their facial and body language while answering the questions. I could say that their wrinkled faces and fearful looks were only visible when they talked about negative possibilities.
Guilt	While answering the survey questions, most of the students expressed that society did not feel guilty. According to them, those who littered and did not contribute to recycling should feel guilty and pay the price for their irresponsibility.

Nonverbal Communication	Summary of Observations
Pride in achievement	All the students were filled with pride because they had seen the results of the work that they had undertaken throughout the year. After the interview, they left the meeting area with joy, their heads held high, body language showing confidence, and a sense of accomplishment, happy that someone had come to value their opinions.
Relief	When the interview questions ended, the students felt great relief. While expressing their feelings by saying things like "Was that it?" "It ended so quickly," "It was very easy," they were stretching and relaxing their hands and arms.
Sadness/Distress	The students expressed their distress when talking about people who lacked environmental awareness and the examples that they gave about them, and they conveyed their sadness about the situation both verbally and through body language. Their gazes drifted into the distance, filled with a sense of helplessness because they believed that there was nothing they could do. Their eyes fell to the ground, and they pouted their lips, expressing their sadness.
Satisfaction	The students conveyed that they were satisfied with the project work that they had undertaken, but, at the same time, they felt dissatisfied with the lack of attention and the lack of environmental awareness that they observed in their surroundings.
Sensory pleasure	It was evident from the answers that they provided to the questions that the activity had left them with a great sense of sensory pleasure. Their increased awareness and knowledge of what they could do for the environment had boosted their self-confidence, showing that they took great pleasure in the work they had done.
Shame	I noticed that the students felt a sense of shame when they saw litter in the places that they visited and when there were no recycling bins available. The leftover shells from people who consumed nuts created a significant sense of shame for them.

Braun and Clarke's (2019) reflexive thematic analysis of these nonverbal cues led to the identification of the following two meta-themes: (a) Environmental Concern and Responsibility

and (b) Social Dynamics and Emotional Expression. Each of these meta-themes contained one or more themes, all of which will be discussed in what follows.

Meta-Theme 1: Environmental Concern and Responsibility

This meta-theme encompasses a wide range of nonverbal communication types, including anger, contempt, disgust, fear, guilt, sadness/distress, shame, amusement, contentment, sensory pleasure, pride in achievement, and satisfaction. These expressions illustrate vividly the students' deep and multifaceted emotional engagement with both the environmental issues that they encounter and their participation in the Zero Waste Project. The negative emotions—such as anger, contempt, disgust, fear, guilt, sadness/distress, and shame— often arose in response to witnessing environmental degradation or when reflecting on their own or others' environmental behaviors. For instance, some students displayed anger or disgust when confronted with images of pollution or when discussing the careless disposal of waste by others. These emotions indicate a strong moral and ethical stance towards environmental protection, highlighting the students' sensitivity to the impact of waste and pollution on the planet. Guilt and shame particularly is telling because they suggest that students are internalizing the lessons of the Zero Waste Project, feeling personally responsible for environmental harm and motivated to rectify their actions.

On the other hand, the positive emotions—amusement, contentment, sensory pleasure, pride in achievement, and satisfaction—typically are linked to the students' active involvement in the project. These emotions reflect moments of joy and fulfillment that students experience when they successfully engage in zero waste activities, such as recycling, reducing waste, or educating others about environmental practices. Amusement and contentment emerged during hands-on activities, such as creative recycling projects, wherein students found joy in repurposing materials in fun and innovative ways. Sensory pleasure could be observed when the students interacted with nature, perhaps during outdoor clean-up activities, wherein the sights and sounds of a cleaner environment brought them a sense of peace and happiness.

Pride in achievement and satisfaction particularly are significant because they revealed the students' recognition of their contributions to the Zero Waste Project. These emotions suggest that students not only are participating in the project, but also are taking ownership of their actions, feeling proud of the positive impact that they are making. This sense of accomplishment is crucial in fostering long-term engagement with environmental stewardship because it reinforces the value of their efforts and encourages continued participation in sustainable practices.

In combining these emotional responses, the Environmental Concern and Responsibility meta-theme illustrates the students' comprehensive and nuanced relationship with environmental issues. Their emotions, whether negative or positive, are tied deeply to their sense of responsibility towards the environment and their role as stewards of the planet. This emotional investment is a powerful driver of their behaviors, motivating them to take action and to contribute to the Zero Waste Project with genuine commitment and enthusiasm. By experiencing and expressing a broad spectrum of emotions, students demonstrate a holistic understanding of environmental stewardship, recognizing both the challenges and rewards associated with protecting the environment. The Environmental Concern and Responsibility meta-theme contained the following two themes: (a) Concern for the Environment and (b) Positive Engagement and Ownership. These themes represent two sides of the students' engagement with environmental issues—one rooted in emotional responses to environmental harm, and the other in proactive and positive actions towards sustainability. Together, they illustrate a comprehensive approach to environmental stewardship, wherein concern drives action and positive experiences reinforce responsibility.

Theme 1: Concern for the Environment. This encapsulates the negative emotional responses that students exhibited when confronted with environmental issues. These emotions include anger, contempt, disgust, fear, guilt, sadness/distress, and shame. These responses reflect a deep-seated worry and distress about the state of the environment and the impact of human behavior on the natural world. Anger and contempt often surfaced when students were faced with acts of environmental harm, such as littering, pollution, or wastefulness. Anger was directed towards individuals or entities perceived as being responsible for environmental degradation, whereas contempt was reserved for behaviors or attitudes that were seen as neglectful or harmful to the environment. These emotions signify a strong moral and ethical stance, wherein students believe that environmental wrongdoing is not just unfortunate, but unacceptable. Disgust was expressed in reaction to the sight or idea of pollution and waste. This could be a visceral reaction to the ugliness or filth associated with environmental damage, reinforcing the students' desire to distance themselves from such negative impacts and to advocate for cleaner, more sustainable practices. Fear was an important component of this theme, often related to the students' anxieties about the future state of the environment. This could include fears about climate change, the depletion of natural resources, or the long-term consequences of continued environmental neglect. Fear reflects the students' understanding of the gravity of environmental issues and their potential to cause irreversible damage. Guilt and shame particularly were telling because they indicated an internalization of environmental values. Students felt guilty about their own past behaviors that were not environmentally friendly, or felt shame when they thought that they could be doing more to help. This guilt and shame were powerful motivators for change, pushing students to adopt more sustainable practices and to encourage others to do the same. Sadness or distress often arose when students were faced with the reality of environmental destruction. This emotional response was triggered by the loss of natural beauty, the extinction of species, or the deterioration of ecosystems. It reflected a sense of mourning for what has been lost and a desire to prevent further harm.

In summary, this theme highlights the students' deep emotional connection to environmental issues. Their negative emotions were not merely reactions, but were indicative of a profound concern for the well-being of the planet. This concern appeared to be a critical driver of their desire to engage in actions that mitigate environmental harm and to promote sustainability.

Theme 2: Positive Engagement and Ownership. This theme captures the positive emotional responses that students exhibited as they actively participated in the Zero Waste Project. These emotions—which include amusement, contentment, sensory pleasure, pride in achievement, and satisfaction—reflect the students' sense of fulfillment and accomplishment as they engaged in activities that contribute to environmental protection and sustainability. Amusement and contentment often arose during engaging and enjoyable activities related to the Zero Waste Project. For instance, students found joy in creative recycling activities, games that promote sustainability, or collaborative projects with peers. These emotions indicated that students not only were learning, but also were having fun, which is crucial for maintaining long-term engagement with environmental education. Sensory pleasure is tied to experiences that involved direct interaction with nature or the environment, such as planting trees, participating in clean-up activities, or enjoying a cleaner, greener space as a result of their efforts. This pleasure reinforced the positive outcomes of their actions, creating a feedback loop wherein students were motivated to continue their sustainable practices. Pride in achievement was a key emotion in this theme. Students felt proud when they saw the tangible results of their efforts, such as successfully sorting and recycling waste, reducing the amount of litter in their communities, or teaching others about the importance of zero waste. This pride not only boosted

their self-esteem, but also strengthened their commitment to environmental stewardship. Satisfaction came from the fulfillment of contributing to something greater than oneself. Students felt satisfied when their actions led to positive environmental outcomes, such as cleaner surroundings, reduced waste, or increased awareness among peers. This satisfaction was crucial for building a lasting sense of responsibility and ownership over the environmental initiatives in which they participated.

In summary, this theme emphasizes the students' active and joyful participation in the Zero Waste Project. Their positive emotions are a reflection of their investment in the project and their recognition of the impact they can make. This theme is essential for understanding how positive reinforcement, through enjoyable and meaningful activities, can lead to sustained engagement and a deeper sense of ownership over environmental practices.

Connection Between the Two Themes. The two themes, "Concern for the Environment" and "Positive Engagement and Ownership," are interconnected within the meta-theme of Environmental Concern and Responsibility. The students' deep concern for environmental issues (expressed through negative emotions) drives their positive engagement in sustainability efforts (expressed through positive emotions). Together, these themes show how a balance of concern and enjoyment can foster a comprehensive and sustained commitment to environmental stewardship among students.

Meta-Theme 2: Social Dynamics and Emotional Expression

This meta-theme encompasses the social and emotional interactions that influenced the students' experiences during the Zero Waste Project. It captures the range of emotions that emerged not only from the content of the project, but also from the interactions among peers, teachers, and the broader school community. The students' nonverbal communication—such as facial expressions, body language, and tone—during these interactions provided key insights into how social dynamics can significantly shape emotional responses.

For instance, emotions like embarrassment, excitement, and relief often arose in situations wherein students were required to present their ideas or to work collaboratively with others. Embarrassment might have been observed when students felt self-conscious or unsure about their contributions in front of their peers, indicating the impact of social pressure and the desire to be accepted or validated within the group. This emotion highlights the vulnerability that students felt in social settings, particularly when discussing or participating in activities related to new or challenging topics like environmental stewardship.

Conversely, excitement was a common response during group activities, especially when students were engaged in hands-on projects or when they observed the immediate results of their efforts, such as successfully recycling or creating something useful from waste materials. This excitement often was contagious, spreading among group members and enhancing the overall enthusiasm for the project. It reflects the positive reinforcement that students experience when they worked together, shared ideas, and achieved common goals, thereby strengthening their collective commitment to the Zero Waste Project.

Relief was another emotion that frequently appeared, particularly after completing tasks or presentations. This relief often signaled the release of tension or anxiety that had built up during the activity, showcasing the emotional journey students underwent when they faced social and academic challenges. The presence of relief indicates that although the project was engaging and rewarding, it also posed certain pressures that required emotional resilience.

Therefore, this meta-theme highlights the importance of social dynamics in shaping emotional responses, showing that students' emotional experiences during the project were deeply intertwined with their interactions with others. The way that students perceived and responded to environmental issues not only was a product of their individual understanding, but

also was significantly influenced by the social context in which they learn and act. The emotional support, camaraderie, and collective enthusiasm experienced in group settings were crucial in fostering a positive and lasting engagement with the project's goals.

Theme 3: Social Interaction and Emotional Responses. The Social Dynamics and Emotional Expression meta-theme contained the following theme: Social Interaction and Emotional Responses. This theme encapsulates how students' interactions with their peers and teachers during the Zero Waste Project shaped their emotional experiences, influencing both their engagement and learning outcomes. It highlights the critical role of social context in driving emotional responses, which can either enhance or hinder students' involvement in environmental initiatives. Moreover, this theme captures the complex interplay between students' social behaviors and their emotional experiences during the Zero Waste Project. It focuses on how interactions with peers, teachers, and the broader school environment influenced the emotions students exhibited and how these emotions, in turn, affected their engagement with the project.

Social interaction refers to the various ways in which students communicated, collaborated, and connected with one another throughout the project. These interactions included working together on group activities, sharing ideas, presenting projects, and receiving feedback from peers and teachers. The quality and nature of these interactions played a significant role in shaping the students' emotional landscape during the project. Students often participated in collaborative tasks that required teamwork and communication. These group dynamics evoked a range of emotions, such as excitement when the group worked well together and successfully completed a task, or frustration if there were disagreements or challenges in coordination. The emotions experienced during collaboration were crucial in determining how students perceived the value of group work and their willingness to engage in similar activities in the future.

The desire for social acceptance and validation was a significant factor in the students' emotional responses. Positive feedback from peers led to feelings of pride and satisfaction, boosting students' confidence and reinforcing their commitment to the project. On the other hand, fear of negative judgment or embarrassment in front of peers led to anxiety, nervousness, or shame. These emotions highlight the impact of social dynamics on students' willingness to take risks, to express their ideas, and actively to participate in the project. The emotions that students expressed in response to their social interactions were varied and often complex. These emotional responses were influenced by the social context, the specific activities in which they were involved, and their relationships with others in the group.

Many students exhibited excitement and enthusiasm when engaging in interactive and hands-on activities, particularly when they worked with others. This excitement often was amplified by the group setting, wherein the energy of one student could spread to others, creating a positive and motivating atmosphere. These emotions were indicative of the students' enjoyment and engagement with the project, highlighting the importance of interactive and collaborative learning experiences.

In contrast, situations that required individual presentations or public speaking in front of the class often led to feelings of embarrassment or nervousness. These emotions were particularly pronounced when students were unsure of their ideas or felt unprepared. Embarrassment also arose from making mistakes in front of others or from feeling different from the group. These emotional responses underline the challenges that students face in social situations, especially when they felt exposed or vulnerable.

After completing challenging tasks, such as presentations or difficult group discussions, many students experienced relief. This emotion was a sign of the tension or anxiety that had

been building up during the activity, which then then released once the task had been completed successfully. Relief often led to a sense of calm and satisfaction, reinforcing the value of perseverance and effort in overcoming social and academic challenges.

This theme demonstrates that students' emotional engagement with the Zero Waste Project was influenced deeply by their social experiences. Positive social interactions tended to enhance students' emotional investment in the project, making them more enthusiastic and willing to participate. Conversely, negative emotions related to social dynamics, such as embarrassment or fear of judgment, might have hindered their engagement and reduce their willingness to take part in future activities. As such, this theme highlights the crucial role of social dynamics in educational settings in the Zero Waste Project, which requires active participation and collaboration.

Findings from Visual Content Analysis of Photographs

A visual content analysis (Banks, 2008; Rose, 2022) of 107 photographs taking over the course of the Zero Waste project led to the identification of the following two meta-themes: Sustainability Education and Active Participation. These meta-themes reflect the students' deep engagement with environmental learning and their proactive involvement in hands-on activities related to waste management. Through various educational and community-driven initiatives, the project highlighted how the students not only learned about sustainability, but also actively applied their knowledge in practical contexts.

Meta-Theme 1: Sustainability Education
The Sustainability Education meta-theme underscores the holistic approach taken by the school to integrate sustainability into the students' education. It includes direct lessons on environmental topics, practical recycling activities, and creative endeavors that all contribute to a comprehensive understanding of sustainability. This approach ensures that students not only gain theoretical knowledge, but also engage in experiential learning, which reinforces their understanding of environmental issues. By embedding sustainability into various aspects of the curriculum, the school fosters a culture of environmental responsibility that extends beyond the classroom. This meta-theme encompassed the following three themes: Environmental Education, Recycling Practices, and Creative Expression. Each of these themes will be discussed in what follows.

Theme 1: Environmental Education. This theme encompasses activities and lessons aimed at increasing students' awareness and knowledge about environmental conservation and sustainability. Many of these photographs depict students learning about the environment through structured educational programs, such as lessons on ecosystems, forests, and the process of recycling (see Figure 3). The use of digital tools and creative methods (e.g., drawing and word clouds; see Figure 4) to teach these concepts is evident, highlighting the integration of environmental education into the curriculum.
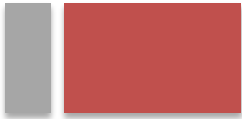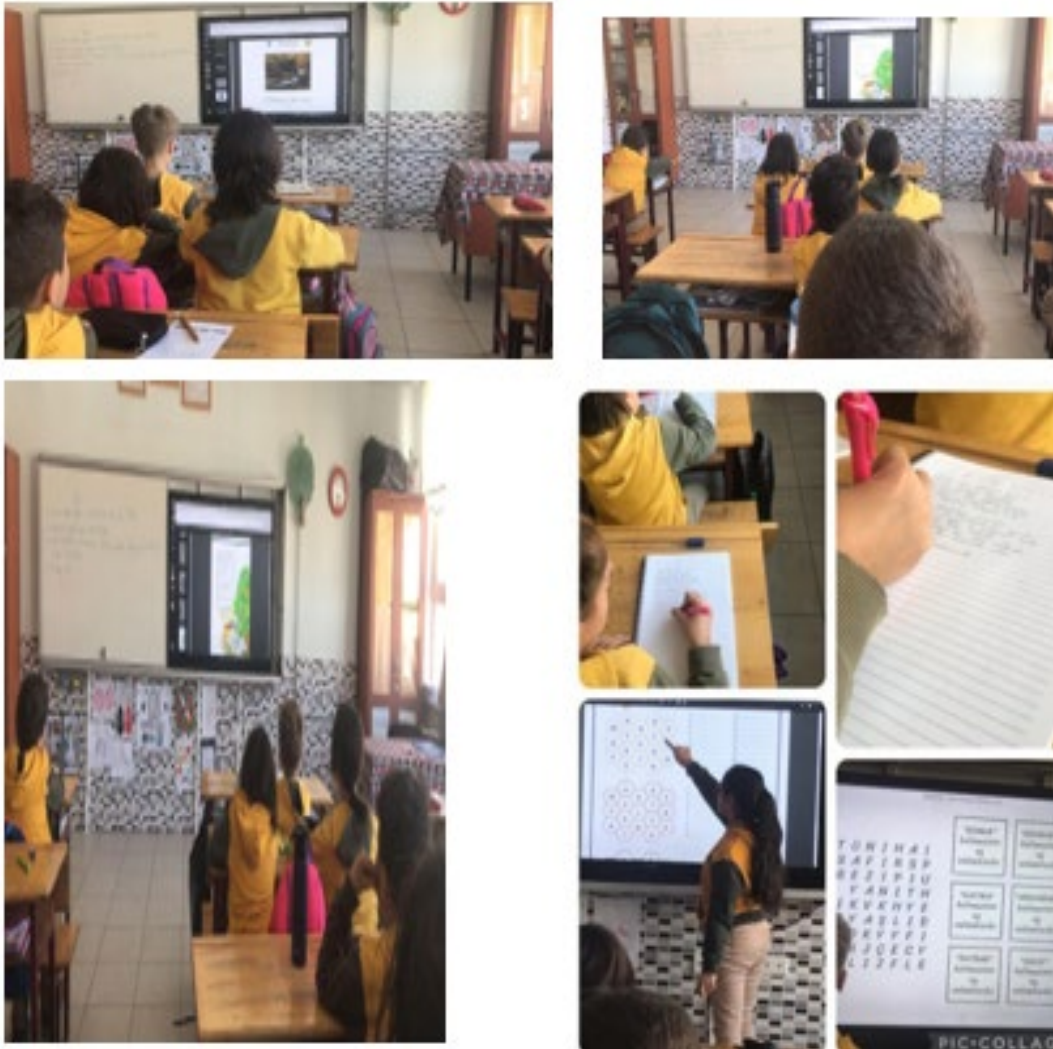
Figure 3

Photographs that Depict Students Learning about the Environment through Structured Educational Programs (e.g., Lessons on Ecosystems, Forests, and the Process of Recycling)
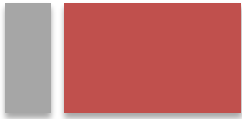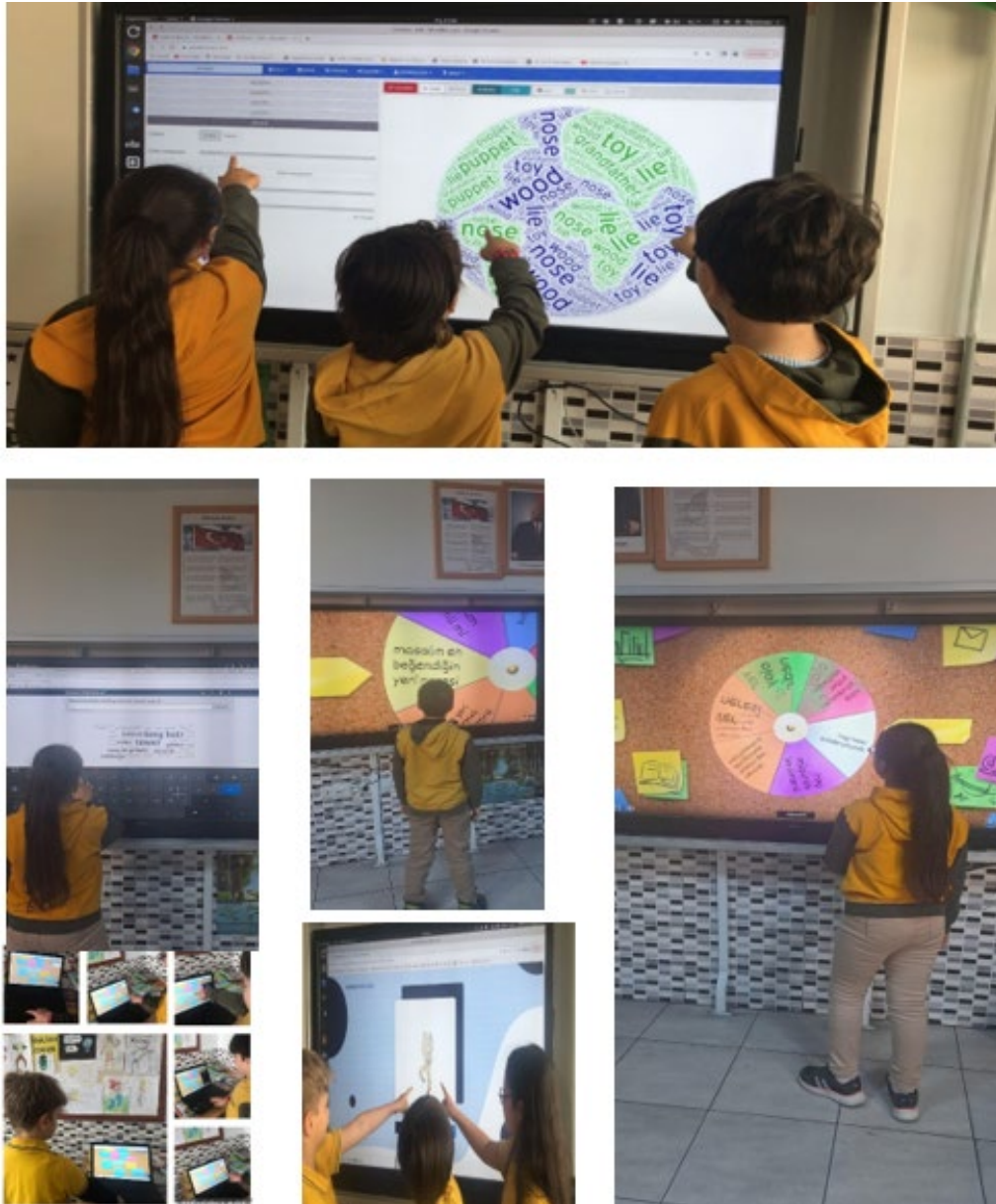
Figure 4

Photographs that Illustrate Use of Digital Tools and Creative Methods (e.g., Drawing and Word Clouds) to Teach Concepts

Theme 2: Recycling Practices. This theme revolves around the actions and practices related to recycling, such as separating waste, using recycling bins, and promoting recycling habits. Across many of these photographs, students are seen engaging in activities that involve sorting waste into different categories like paper, metal, and plastic, as shown in Figure 5. These activities are part of their everyday practices, emphasizing the importance of recycling and contributing to the school's zero waste goals.
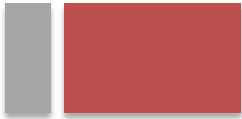
Figure 5

Photographs that Illustrate Students Engaging in Activities that Involve Sorting Waste into Different Categories (e.g., Paper, Metal, and Plastic)

Theme 3: Creative Expression. This theme captures the use of arts, crafts, and creative activities to express ideas related to the environment and recycling. Several photographs show students engaging in drawing, crafting, and other creative activities that convey messages about recycling and environmental stewardship (see Figure 6). This theme illustrates how students internalize and express their understanding of environmental issues through creativity.

Figure 6

Photographs that Illustrate Students Engaging in Drawing, Crafting, and Other Creative Activities that Convey Messages about Recycling and Environmental Stewardship

Meta-Theme 2: Active Participation

This meta-theme involves students actively participating in and contributing to environmental initiatives, both within the school and in the broader community. Active participation reflects the hands-on approach the school encourages, wherein students not only are learning about zero waste, but also are actively involved in applying these principles in real-world contexts. This meta-theme highlights the students' engagement in collective actions and their contributions to community and environmental well-being. This meta-theme encompasses the following two themes: Community Engagement and Collaborative Learning.

Theme 4: Community Engagement. This theme refers to activities that involve the students in broader community actions, such as group clean-up efforts and participation in environmental projects. Figure 7 prominently features students participating in clean-up activities in a public park. This theme highlights the students' involvement in community

service and their role in promoting zero waste practices beyond the classroom.

Figure 7

Photographs that Illustrate Students Participating in Clean-Up Activities in a Public Park

Theme 5: Collaborative Learning. This theme involves the students working together on projects and activities related to environmental education and recycling. Collaboration is evident across multiple sets (e.g., Figure 8), wherein students are seen working in groups to achieve common goals, such as participating in recycling competitions, group learning sessions, and joint creative projects.

Figure 8

Photographs that Illustrate Students Collaborating

Conclusions Across These Photographs

As a set, these photographs suggest that their teacher took a comprehensive approach to teaching them about the environment. This includes not only classroom learning, but also hands-on activities, creative expression, and community involvement. Furthermore, the students were highly engaged in the learning process, showing active participation in various activities related to zero waste. They were involved in both individual and group tasks, which indicates a deep level of commitment and interest in environmental issues. The use of creative methods, such as drawing, crafting, and digital animation, was prominent. This suggests that, in her role as their teacher, the lead author encouraged students to explore and to express their understanding of zero waste and environmental themes in imaginative ways. The emphasis on collaborative learning and community engagement highlights the teacher's strategy of promoting teamwork and social responsibility among students. The students' involvement in community clean-up efforts and their collaborative projects indicate that these values are central to the teacher's educational approach. Overall, the visual content analysis suggests that the Zero Waste Project was highly effective in engaging students and fostering a culture of environmental responsibility, both within the school and in the wider community.

Comparing and Contrasting Meta-Themes and Themes from Interview Responses and the Visual Content Analysis

Similarities.

Holistic Environmental Education. Both the interview analysis and the visual content analysis reveal a strong emphasis on environmental education. The Sustainability Education meta-theme from the photographs and the Environmental Awareness meta-theme from the interviews overlap significantly. Both sets underscore the importance of educating students about environmental issues, including pollution, recycling, and broader sustainability practices.

The themes of Environmental Education and Recycling Practices from the visual analysis align with the Pollution and Its Impact and Recycling as a Solution themes from the interview analysis.

Active Participation and Community Engagement. The Active Participation meta-theme from the photographs corresponds closely with the Proposed Solutions and Initiatives, and Education and Community Involvement meta-themes from the interviews. Both sets emphasize students' involvement in real-world environmental actions and community activities. The theme of Community Engagement from the photographs parallels the Community and Behavioral Interventions and Community Engagement themes from the interviews, highlighting a shared focus on collective action and community involvement.

Personal Responsibility and Emotional Connection. Both analyses reflect the students' emotional and personal investment in environmental issues. Although the visual content analysis does not explicitly categorize these aspects as a separate meta-theme, the Creative Expression theme captures students' emotional engagement through arts and crafts. This overlaps with the Personal Responsibility and Emotional Connection meta-theme from the interviews, wherein students express pride and emotional investment in their environmental actions.

Differences.

Technological Innovations. The interview analysis includes a distinct theme of Technological Innovations under the Proposed Solutions and Initiatives meta-theme, which is not reflected directly in the visual content analysis. The photographs focus more on practical and community-based activities rather than on technological solutions or futuristic ideas. This suggests that although the students are capable of envisioning advanced technological interventions in their interviews, the real-life application of their ideas during the project leaned more towards hands-on, community-oriented efforts. The focus on practical activities in the photographs highlights the students' active participation in addressing environmental issues through immediate and accessible means.

Creative Expression as a Theme. The visual content analysis uniquely identifies Creative Expression as a separate theme under Sustainability Education, which is not directly mirrored in the interview analysis. Although the interviews touch on the emotional connection to environmental efforts, they do not explicitly discuss creative methods as a means of expressing or reinforcing environmental values. This indicates that, although the students' emotional connection to environmental issues is evident in their verbal responses, the creative activities captured in the photographs reveal another dimension of their engagement. Through art, crafts, and other forms of creative expression, the students are able to internalize and to communicate their environmental values in ways that are not fully captured by the interview data.

Scope of Themes. The interview analysis provides a more detailed and nuanced exploration of students' thoughts and ideas, including the importance of role modeling, emotional engagement, and specific technological solutions. In contrast, the visual content analysis is broader, focusing on observable actions and participation in sustainability education and activities. This difference underscores the complementary nature of both methods: whereas the interviews delve into the internal motivations and cognitive processes of the students, the visual content analysis highlights how these ideas are translated into concrete behaviors and group activities. Together, they offer a comprehensive view of how students conceptualize and enact their understanding of zero waste principles.

Degree of Overlap Between Meta-Themes. The meta-themes of Sustainability Education and Active Participation from the visual content analysis can be mapped onto the meta-themes of Environmental Awareness, Proposed Solutions and Initiatives, and Education and Community Involvement from the interview analysis. There is substantial overlap, particularly in the emphasis on education, community involvement, and practical engagement in environmental actions. However, the Personal Responsibility and Emotional Connection meta-theme from the interviews has a less direct counterpart in the visual content analysis, suggesting that although these emotional aspects are present, they are not as explicitly documented in the photographs.

Degree of Overlap Between Themes. There is significant overlap between specific themes, such as Recycling Practices (photographs) and Recycling as a Solution (interviews), and Community Engagement (photographs) and Community and Behavioral Interventions (interviews). However, themes like Technological Innovations (interviews) and Creative Expression (photographs) reflect areas wherein the two sets of findings diverge, highlighting different aspects of the students' engagement with zero waste initiatives.

Mapping of Meta-Themes and Themes. Table 6 presents a mapping of the meta-themes and themes from two different data sources: (a) Braun and Clarke's (2019) reflexive thematic analysis of the interview responses and (b) the visual content analysis of the photographs taken during the Zero Waste project. Its primary purpose is to illustrate the degree of overlap and differences between the students' conceptual understanding of zero waste as expressed in interviews and their practical, observable behaviors, and expressions as captured in the photographs. The table provides a clear, side-by-side comparison of how the meta-themes and themes from the interviews align or diverge from those identified in the visual content analysis. This visual organization helps in understanding the relationship between the students' verbalized thoughts and their actual behaviors and creative outputs. By mapping the meta-themes and themes from both data sources, this table helps to identify areas of strong overlap (e.g., the alignment between environmental awareness and sustainability education) and areas where there are gaps or differences (e.g., the presence of technological innovations in the interviews but not in the photographs). The table allows for a holistic analysis of the Zero Waste project by integrating both the students' expressed ideas and their actions. This dual perspective enriches the understanding of how students engage with and internalize the principles of zero waste.

Conclusions Across All Meta-Themes and Themes. Table 6 highlights a significant overlap between the conceptual meta-themes derived from the interviews and the practical meta-themes observed in the photographs, indicating that the students' understanding of environmental issues is well-integrated with their actions. However, discrepancies, such as the focus on technological innovations in interviews versus the practical focus in photographs, suggest that, although students are capable of envisioning advanced solutions, their real-world applications were more grounded and immediate. The unique presence of creative expression in the photographs underscores the importance of diverse methods of engagement in environmental education.
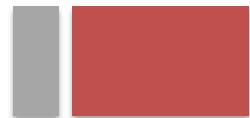
Table 6

Mapping the Meta-Themes and Themes from Braun and Clarke's (2019) Reflexive Thematic Analysis of the Interview Responses and the Visual Content Analysis of the Photographs

Interviews: Meta-Themes and Themes	Photographs: Meta-Themes and Themes
Meta-Theme 1: Environmental Awareness —Theme 1: Pollution and Its Impact —Theme 2: Recycling as a Solution	*Meta-Theme 1: Sustainability Education* —Theme 1: Environmental Education —Theme 2: Recycling Practices —Theme 3: Creative Expression
Meta-Theme 2: Proposed Solutions and Initiatives —Theme 3: Technological Innovations —Theme 4: Community and Behavioral Interventions	*Meta-Theme 2: Active Participation* —Theme 4: Community Engagement —Theme 5: Collaborative Learning
Meta-Theme 3: Personal Responsibility and Emotional Connection —Theme 5: Emotional Engagement —Theme 6: Role Modeling and Influence	
Meta-Theme 4: Education and Community Involvement —Theme 7: Importance of Environmental Education —Theme 8: Community Engagement	*Meta-Theme 2: Active Participation* —Theme 4: Community Engagement —Theme 5: Collaborative Learning

The interviews provide a deeper understanding of students' internal motivations and cognitive processes, including their emotional connections and futuristic ideas, whereas the visual content analysis captures how these concepts are translated into observable actions and collaborative activities within the project. Together, these analyses offer a broad perspective on the students' engagement with zero waste principles, combining theoretical knowledge, emotional investment, and practical application. The meta-themes and themes across both datasets suggest a well-rounded approach to environmental education that fosters both individual responsibility and collective action.

Overall, the findings from both the interviews and the visual content analysis suggest that the Zero Waste project successfully integrated environmental education with active, hands-on participation, fostering a strong sense of personal responsibility and community involvement among students. This combination of education, action, and emotional engagement is key to cultivating a generation of environmentally conscious and proactive individuals.

Discussion

Summary of Major Findings

The present fully integrated arts-based mixed methods case study explored the perceptions and engagement of primary school students with the Zero Waste initiative using a novel and comprehensive mixed methods research approach—namely, a fully integrated arts-based mixed methods case study. The data were derived from four sources: semi-structured interviews, nonverbal communication observations, demographic data, a visual content analysis

of photographs taken during the project. The findings from the interviews revealed four major meta-themes: Environmental Awareness, Proposed Solutions and Initiatives, Personal Responsibility and Emotional Connection, and Education and Community Involvement. In contrast, the photographs revealed two major meta-themes: Sustainability Education and Active Participation. Despite the different methods of data collection, there was significant overlap between the themes derived from interviews and those observed in the photographs. Both data sources highlighted the importance of environmental education and active involvement in sustainability efforts, although the photographs emphasized more practical and community-based activities, whereas the interviews delved deeper into the students' cognitive processes and emotional connections to the environment.

Based on the interview data, the most prevalent meta-theme was "Environmental Awareness," with 13 out of the 15 students (86.67%) contributing to this theme. This high prevalence indicates that environmental consciousness is ingrained deeply among these students, which is crucial for the success of the Zero Waste Project because it forms the foundational understanding needed for effective waste management and sustainability initiatives. The most prevalent theme within this meta-theme was "Pollution and Its Impact," with 80% of students recognizing and discussing the detrimental effects of pollution. This theme's prevalence suggests that pollution is a primary concern among these students and highlights the need for educational programs to continue emphasizing the importance of pollution prevention and mitigation.

In contrast, the least prevalent meta-theme was "Proposed Solutions and Initiatives," with only 40% of the students contributing to it. Within this meta-theme, the least prevalent themes were "Role Modeling and Influence" and "Importance of Environmental Education," with only 26.67% of students addressing these aspects. The low prevalence of these themes implies that students in this class might not fully recognize the importance of role models and education in driving environmental change. This finding suggests that more emphasis should be placed on these areas in educational curricula to ensure that students not only understand environmental issues, but also see themselves as agents of change who can influence others through their actions and advocate for the importance of environmental education.

The correspondence analysis of both meta-themes and themes revealed several significant trends related to the five demographic characteristics: gender, birth order, academic achievement, economic status, and extracurricular involvement. The analysis indicated that the boys were associated more closely with themes such as "Community Engagement" and "Technological Innovations," whereas the girls were more aligned with "Role Modeling and Influence" and "Emotional Engagement." Birth order also played a role, with third-born children showing a stronger connection to the meta-theme of "Personal Responsibility and Emotional Connection." High-achieving students were linked to the meta-theme of "Education and Community Involvement," suggesting a relationship between academic success and community-oriented environmental activities. Economic status did not show significant differentiation in theme engagement, indicating broad inclusivity across socioeconomic backgrounds. Additionally, students involved in artistic activities were more likely to engage with themes requiring emotional and social responsibility, such as "Pollution and Its Impact."

The nonverbal communication findings from the study reveal a rich tapestry of emotional and behavioral cues that underscore the students' engagement with the Zero Waste project. Throughout the project, students exhibited a range of nonverbal behaviors, including facial expressions, gestures, and body language, that conveyed their emotional responses to environmental issues. These nonverbal cues were categorized into various emotional states such as pride, frustration, enthusiasm, and anxiety. The data indicated that students frequently displayed positive emotions, such as pride and satisfaction, particularly when discussing their

contributions to the project or when engaging in hands-on activities. Conversely, negative emotions, such as frustration or anxiety, were observed when students encountered challenges or when reflecting on environmental degradation. These findings suggest that nonverbal communication played a significant role in expressing students' deep emotional connections to the environmental issues addressed in the Zero Waste project.

The nonverbal communication findings underscore the importance of understanding students' emotional engagement in educational projects like Zero Waste. The range of emotions observed suggests that students not only are intellectually engaged with environmental issues, but also are emotionally invested in the outcomes of their actions. The frequent display of positive emotions, such as pride and enthusiasm, indicates that students derive a sense of accomplishment and fulfillment from their participation in the project. This emotional investment likely enhances their overall engagement and commitment to the principles of zero waste. On the other hand, the presence of negative emotions, such as frustration and anxiety, highlights the challenges that students face when grappling with complex environmental issues. These emotional responses suggest areas where additional support or guidance might be needed to help students navigate their concerns and maintain their motivation.

Interpretation of Findings

The findings suggest that the students' understanding of zero waste is well integrated with their actions. The significant overlap between the conceptual themes from the interviews and the practical themes observed in the photographs indicates that the students were able to translate their knowledge and attitudes towards environmental sustainability into concrete actions. However, the data also reveal some discrepancies. For example, the interviews emphasized technological innovations, a theme that was not directly observed in the photographs. This suggests that although students can envision advanced solutions, their real-world applications were more grounded in immediate, hands-on efforts. The unique themes of Creative Expression observed in the photographs further underscore the importance of diverse methods of engagement in environmental education.

When comparing the nonverbal communication findings with the data derived from interviews and photographs, a complementary relationship emerges. The interviews provided insight into the students' cognitive and emotional engagement with zero waste concepts, revealing their thoughts, ideas, and verbal expressions of responsibility and environmental concern. The photographs, on the other hand, captured the students in action, highlighting their participation in community-based activities and creative expressions. The nonverbal communication findings bridge these two data sources by offering a window into the students' unspoken emotional states, which often aligned with their verbalized thoughts in interviews and their actions depicted in the photographs. For instance, the pride expressed verbally in interviews was mirrored by confident and enthusiastic body language in the photographs and nonverbal data. Similarly, the anxiety about environmental challenges discussed in interviews was observable in the students' tense and apprehensive nonverbal cues during related activities.

Therefore, using Greene et al.'s (1989) typology, the collection, analysis, interpretation, and comparison of the verbal data, non-verbal data, and photographs allowed all five purposes for collecting multiple sources of data to be used, namely: *triangulation* (i.e., comparing findings from the different data sources), *complementarity* (i.e., elaborating, illustrating, enhancing, and clarifying the findings from the different data sources), *development* (i.e., using the results from one analytical strand to help inform the other analytical strands), *initiation* (i.e., discovering paradoxes and contradictions that emerged when findings from the different data sources were compared), and *expansion* (i.e., expanding the breadth and range of the study by

using multiple analytical strands for different study phases). This comprehensive approach enriched the study's conclusions by offering a more robust and nuanced understanding of the students' engagement with the Zero Waste Project. By integrating multiple types of data, the researchers were able to uncover deeper insights and to capture the complexity of the students' experiences, which might have been overlooked if only a single data source had been used. Moreover, this methodological rigor not only strengthens the legitimation of the findings, but also provides a model for future research in environmental education and other interdisciplinary fields.

Contextualization with Existing Literature

These findings align with existing research on environmental education and children's role in promoting sustainability. Studies have shown that early education plays a crucial role in shaping lifelong attitudes and behaviors towards the environment (Bulut, 2020). The emphasis on education and community involvement observed in both the interviews and photographs supports the notion that integrating sustainability into the curriculum can foster a culture of environmental responsibility among young students (Ayçin & Kayapinar Kaya, 2021). However, the emphasis on practical, community-based activities in the photographs, as opposed to the more futuristic technological solutions discussed in interviews, highlights the gap between theoretical knowledge and practical application, a common challenge noted in environmental education literature (Pietzsch et al., 2017).

Contextualization with Philosophical Framework

The study's findings can be contextualized within the framework of the critical dialectical pluralistic (CDP) approach (Onwuegbuzie et al., 2024), which emphasizes social justice, inclusion, diversity, equity, and social responsibility, as well as the integration of diverse methodological perspectives. The overlap between the meta-themes derived from different data sources reflects the comprehensive nature of the CDP approach, wherein both qualitative and quantitative data contributed to a holistic understanding of the students' engagement with zero waste. The identification of themes such as Personal Responsibility and Emotional Connection aligns with the CDP's focus on social justice and equity, highlighting the students' sense of duty towards environmental protection and their emotional investment in the outcomes of their actions.

The CDP framework, which emphasizes the integration of diverse perspectives and the consideration of social justice in research, provides a valuable lens for interpreting the nonverbal communication findings. CDP advocates for a holistic understanding of participants' experiences, recognizing the importance of both verbal and nonverbal forms of expression in capturing the full spectrum of human experience. The inclusion of nonverbal communication data in this study aligns with the CDP's emphasis on inclusivity and equity because it acknowledges that students might express their thoughts and feelings in ways that go beyond spoken words. By capturing these nonverbal cues, the study honors the diverse ways in which students engage with and express their understanding of environmental issues, thereby contributing to a more comprehensive and socially just interpretation of their experiences.

Methodological Contributions of the Article

Contribution to the Mixed Methods Research Field
This article contributes to the mixed methods research field by introducing a fully

integrated arts-based mixed methods case study, which involves the systematic combination of both qualitative and quantitative data at every stage of the research process. This approach, referred to as the *1 + 1 = 1 integration approach* (Hitchcock & Onwuegbuzie, 2022; Natesan et al., 2019; Newman et al., 2015; Onwuegbuzie, 2017, 2022, 2023; Onwuegbuzie & Hitchcock, 2019a, 2022; Onwuegbuzie et al., 2018), emphasizes the synthesis of data to produce a deeper, more nuanced understanding that transcends the individual contributions of each method. This methodology enhances the rigor, transparency, and replicability of mixed methods research, providing a comprehensive exploration of complex phenomena such as environmental education and student engagement.

Contribution to the Arts-Based Research Field

This article also makes a significant contribution to the arts-based research field by incorporating visual content analysis of photographs as a central method of data collection and analysis. This approach not only documents the activities within the Zero Waste Project, but also serves as a tool for raising awareness, for engaging the community, and for enhancing the educational value of the project. The use of visual storytelling demonstrates how arts-based methods can be effectively integrated into educational research to make abstract concepts more relatable and memorable.

Contribution to the Arts-Based Mixed Methods Research Field

This article advances the arts-based mixed methods research field (cf. Archibald, 2018, 2022; Archibald & Blines, 2021; Archibald et al., 2014, 2024; Archibald & Clark, 2018; Archibald & Gerber, 2018; Slaughter et al., 2018) by transforming a traditional mixed methods case study into a fully integrated arts-based mixed methods case study. This transformation is achieved through the systematic use of photographs and other visual materials, which are analyzed alongside qualitative and quantitative data. The integration of arts-based elements enriches the interpretative process, supports a more holistic understanding of the research outcomes, and demonstrates the versatility and cross-disciplinary potential of mixed methods research when combined with creative approaches.

Contribution to the Case Study Field

In the case study field, this article contributes by demonstrating the application of a fully integrated mixed methods case study within a real-life educational context. The study explores the effectiveness of a Zero Waste Project in a primary school setting, providing insights into how various factors (e.g., demographic characteristics, nonverbal communication) interact within the case. The methodological rigor, particularly the use of quantitizing and qualitizing processes, provides a compelling example of how case studies can be conducted in a more structured and systematic manner, ensuring that findings are both contextually grounded and methodologically robust.

Overall Methodological Contribution

These methodological contributions highlight the article's role in pushing the boundaries of traditional research methodologies by integrating arts-based and mixed methods approaches in a way that is innovative, rigorous, and applicable across different fields of study. By demonstrating how visual data can be systematically analyzed alongside verbal and nonverbal data, the article provides a robust framework for researchers aiming to explore complex phenomena from multiple perspectives. This integration not only enhances the depth and richness of the findings, but also broadens the scope of inquiry, making it relevant for diverse contexts and disciplines. Furthermore, the article exemplifies how arts-based methods

can be used to foster greater engagement and creativity in research, paving the way for more dynamic and participatory forms of data collection and analysis.

Limitations

The study has two limitations. First, the photographs used for the visual content analysis might not have represented the full range of activities and behaviors associated with the Zero Waste initiative because they are subject to the photographer's selection and framing. Second, due to the study's focus on a single school and a relatively small sample of 15 students, the findings might not be generalizable to other contexts, such as different schools, age groups, cultural settings, or even countries outside Turkey. Also, the specific environmental education practices at this school might not reflect those used elsewhere.

Implications of the Findings

Despite these limitations, the findings have important implications for environmental education. They suggest that integrating sustainability into the curriculum and encouraging active participation in community-based activities effectively can engage students in environmental initiatives. The emphasis on creative expression observed in the photographs also indicates that incorporating arts and crafts into environmental education can enhance students' emotional connection to environmental issues, making the learning experience more personal and impactful.

Furthermore, the findings highlight the importance of addressing both the cognitive and emotional dimensions of environmental education. The observed nonverbal cues, such as pride and frustration, suggest that students' emotional experiences significantly influence their engagement with sustainability initiatives. By recognizing and nurturing these emotional connections, educators can create a more holistic learning environment that resonates deeply with students, fostering long-term commitment to environmental stewardship. This approach not only enhances the effectiveness of environmental education, but also contributes to the development of a generation that is emotionally invested in the well-being of the planet, which is crucial for driving meaningful and sustained environmental action.

These demographic-related findings suggest that environmental education programs could be more effective if tailored to address the specific interests and strengths associated with different demographic groups. For instance, integrating technological elements could engage male students more deeply, whereas activities fostering leadership and emotional expression might resonate more with female students. Recognizing the influence of birth order can help educators design programs that leverage the leadership tendencies of later-born children. The connection between academic achievement and community involvement implies that integrating environmental education into academic curricula might enhance student engagement. Lastly, the inclusivity across economic backgrounds highlights the need for accessible environmental education that reaches students regardless of socioeconomic status, while incorporating creative arts could enhance further emotional and social engagement with environmental issues.

Implications of Findings in the Turkish Context

The findings from this study, involving the verbal, non-verbal, pictorial, and demographic data of 15 primary school students, offer valuable insights into students' attitudes towards zero waste within the broader Turkish context. The students' deep emotional

engagement, as evidenced by both their verbal expressions and non-verbal cues, suggests that environmental education programs in Turkey could benefit from an approach that taps into students' emotions and personal experiences. The emphasis on community involvement and practical action, highlighted by both the photographs and the verbal data, reflects a cultural value of collective responsibility and communal effort, which is deeply rooted in Turkish society (Baban, 2013). This suggests that zero waste initiatives in Turkey should continue to promote community-based activities, fostering a sense of collective responsibility that resonates with cultural norms.

Moreover, the study highlights the importance of creative expression in engaging students with environmental issues. The significant role of artistic activities in this primary school class indicates that incorporating arts and crafts into environmental education could be a particularly effective strategy within the Turkish education system. This approach not only appeals to students' creativity, but also helps them internalize and express environmental values in ways that are personally meaningful. Such a strategy aligns with Turkey's educational emphasis on holistic development, which includes fostering creativity alongside academic achievement (Yige, 2017).

Implications of Findings in the Konya Context

In the context of Konya, a city known for its strong community ties and traditional values (Kutlu, 2007; Rumelili & Çakmaklı, 2017), the findings underscore the importance of aligning environmental education with local cultural and social dynamics. The students' strong association with themes of personal responsibility, community engagement, and emotional connection to the environment suggests that the Zero Waste project was effective in fostering attitudes that are compatible with Konya's cultural emphasis on responsibility and collective action. The fact that students from various economic backgrounds engaged similarly with the project highlights the inclusivity of the Zero Waste initiative, suggesting that it resonated across different socioeconomic strata within the community.

Given Konya's sociocultural landscape, the findings imply that future zero waste initiatives in the region could enhance further their effectiveness by leveraging local values such as community involvement and shared responsibility. Programs that emphasize collective action, such as neighborhood clean-up events and community-driven recycling efforts, are likely to be well-received and impactful. Additionally, the role of creativity in this study suggests that integrating local arts and crafts traditions into environmental education could provide a culturally relevant and engaging way to promote zero waste principles among students. This approach not only aligns with the traditional craft heritage of Konya (Nas, 2012), but also serves to deepen students' emotional and cultural connections to environmental stewardship.

Overall, these findings indicate that the Zero Waste project successfully has integrated environmental education with local cultural values, fostering a generation of students who are both intellectually and emotionally invested in sustainable practices. Because these students represent the future of Konya, their engagement with zero waste principles bodes well for the city's long-term environmental sustainability efforts.

Recommendations for Future Practice

In the Turkish cultural context, particularly in a city like Konya known for its deep-rooted traditions and strong community values (e.g., Okka et al., 2016), educators should consider embracing a more holistic approach to environmental education that resonates with

both the cognitive and emotional dimensions of learning. This approach should seamlessly blend theoretical knowledge with practical, hands-on activities that are culturally relevant and locally meaningful. By incorporating creative expression into the curriculum—whether through traditional Turkish arts and crafts or modern artistic methods—students can explore and express their environmental values in ways that are both personally and culturally significant. This not only deepens their understanding of sustainability, but also strengthens their emotional connection to the natural world, which is a vital aspect of Turkish cultural heritage (Çiftçi & Kunt, 2018).

Moreover, schools in Konya should prioritize opportunities for students to engage in community-based activities that reflect the city's strong tradition of collective action and social responsibility (Aydın et al., 2015; Küçüktığlı, 2019). These activities can serve to reinforce the importance of working together to promote sustainability, a value that aligns well with the communal ethos prevalent in Konya (Karakul, 2023). Educators can draw on the city's cultural practices, such as neighborhood collaboration and community gatherings, to organize environmental initiatives that foster a sense of shared responsibility and mutual support.

Based on the nonverbal communication findings from this study, it is also recommended that educators in Konya and across Turkey consider integrating strategies that address both the emotional and cognitive aspects of environmental education. Creating a classroom environment that encourages the expression of emotions—through discussions, reflective activities, or creative projects—can help students process and articulate their feelings about environmental issues. This approach particularly is relevant in a cultural context wherein emotional expression and community bonds are highly valued (Küçüktığlı, 2019; Nas, 2012). Additionally, training educators to recognize and to interpret nonverbal cues can enable them better to support students who might be struggling with feelings of frustration or anxiety, ensuring that the learning environment remains emotionally supportive. By fostering such an environment, educators can help students build resilience and maintain their engagement with challenging environmental topics, which is crucial for sustaining long-term interest and commitment to environmental stewardship in Konya and beyond.

Recommendations for Future Research

In the Turkish cultural context, particularly within the sociocultural framework of Konya, future research should explore the long-term impact of environmental education programs on students' attitudes and behaviors towards sustainability. Given the importance of collective responsibility and community involvement in Turkish society, studies that investigate how these cultural values influence students' sustained engagement with environmental issues would be particularly valuable. Larger studies with more diverse samples from various regions of Turkey, including both urban and rural areas, are needed to validate the findings and to examine how different educational strategies—such as those incorporating traditional arts, local customs, and technological tools—affect students' commitment to sustainability. Furthermore, research should investigate the role of technological innovations in environmental education, particularly how students' ideas about integrating technology with traditional practices can be applied in practical, culturally relevant ways within their communities.

Additionally, future research in Turkey should explore further the role of nonverbal communication in environmental education, especially with respect to how it interacts with verbal and behavioral expressions of engagement within the classroom and community settings. Longitudinal studies could be conducted to investigate how students' nonverbal cues evolve over time, particularly in the context of Turkey's strong emphasis on emotional expression and community bonds (Küçüktığlı, 2019; Nas, 2012), and whether these cues correlate with long-

term changes in environmental attitudes and behaviors. Researchers also could examine the impact of specific educational interventions—such as those rooted in mindfulness practices, arts-based approaches, or community-driven projects—on students' nonverbal communication and overall learning outcomes. Finally, researchers should explore the cultural dimensions of nonverbal communication in environmental education, focusing on how the unique cultural contexts of different regions in Turkey, including Konya, influence the ways in which students express their emotions and engage with sustainability issues. This would provide deeper insights into how cultural factors shape the effectiveness of environmental education programs in fostering long-lasting environmental stewardship among students.

Conclusions

The verbal and nonverbal communication findings from this study offer valuable insights into the emotional dimensions of students' engagement with the Zero Waste project, particularly within the Turkish cultural context and more specifically in Konya. These findings reveal that students are deeply emotionally invested in environmental issues, with their nonverbal cues reflecting both the challenges and rewards of participating in sustainability initiatives. In a cultural context wherein emotional expression and community bonds are highly valued (Küçüktığlı, 2019; Nas, 2012), these insights are particularly meaningful. The integration of nonverbal communication analysis into the study provides a more nuanced understanding of how students in this Konya school experience and internalize environmental education, complementing the rich perspectives gained from interviews and visual content analysis. This study underscores the importance of addressing the emotional aspects of environmental education, especially in a setting like Konya, where fostering a sense of community and collective responsibility is integral (Çiftçi & Kunt, 2018). It highlights the need for educators to create supportive and responsive learning environments that recognize and nurture the full range of students' emotional and cognitive experiences.

Overall, the study demonstrates that the Zero Waste project in this Konya school— Selçuklu Belediyesi Primary School—successfully integrated environmental education with active, hands-on participation, fostering a strong sense of personal responsibility and community involvement among students. This approach aligns well with Konya's cultural emphasis on collective action and social responsibility (Aydın et al., 2015; Küçüktığlı, 2019). The combination of education, action, and emotional engagement observed in this study is key to cultivating a generation of environmentally conscious and proactive individuals, ready to contribute to their communities. By addressing both the theoretical and practical aspects of sustainability, educators in Konya and across Turkey can create a more comprehensive and impactful learning experience that prepares students to tackle environmental challenges in the future, rooted in both their cognitive understanding and emotional commitment to environmental stewardship.

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