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A Sustainable Kindergarten Participatory Action Research for Addressing Environmental Challenges in Ulaanbaatar's Ger Neighborhoods

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ABSTRACT

Recognizing the urgency of addressing environmental concerns and aiming to support child development, this participatory action research (PAR) focuses on initiating actions for a greener and safer environment for young children in the marginalized ger neighborhoods in Ulaanbaatar the Capital City of Mongolia. In collaboration with parents and involving 311 children aged two to five across 11 groups, this action research has been conducted since September 2021 with the goal of enhancing children's cognitive, emotional, and social development, fostering increased environmental awareness, improving problem-solving skills, and a sense of responsibility. Research findings show that the attitudes and habits towards air pollution, ecological safety, rational water use, and creating a green environment have significantly improved among the participants.

Keywords: environmental challenges, sustainable kindergarten, action.

INTRODUCTION

The Ulaanbaatar capital city of Mongolia has experienced rapid urbanization in recent decades. The urban population has surged from approximately 600,000 in the early 1990s to over 1.7 million by 2023, primarily due to rural-urban migration (National Statistics Office of Mongolia, 2023). This influx has resulted in overpopulation, significantly straining urban infrastructure, public services, and the environment (Murphy, 2017; Guttikunda & Khaliquzzaman, 2014). A notable consequence of this rapid growth is the expansion of informal settlement areas, particularly large ger neighborhoods, which lack essential infrastructure such as central heating, sewage systems, and a reliable water supply (World Bank, 2018).

The main challenges faced by Ulaanbaatar's neighborhoods are manifold:

First, Ulaanbaatar is the fifth most polluted city in the world with urban air pollution levels ten times higher than those set by the World Health Organization (2019), posing a severe risk to public health (Allen et al., 2013). Rapid urbanization has led to overcrowding, reduced green spaces, and significant environmental issues, including water supply (Batsaikhan, Lee, Nemer, & Woo, 2018; Dalai, Dambaravjaa, & Purevjav, 2018), soil pollution (Kasimov et al., 2011), and alarming levels of air pollution (Allen et al., 2013). Ulaanbaatar city ranks among the most polluted cities globally, primarily due to air pollution from heating practices in low-income traditional housing areas known as ger neighborhoods consisting of gers (traditional Mongolian yurts). The widespread use of coal-burning stoves in households emits large amounts of particulate matter (PM2.5), sulfur dioxide (SO2), and nitrogen oxides (NOx), severely degrading urban air quality (Warburton et al., 2018). For instance, PM2.5 levels can reach 200 μg/m3 in winter (IQAir, 2018). Over half of Ulaanbaatar's population lives in these neighborhoods. The remaining residents live in apartments that receive electricity and heat from the city's coal-fired power plants.

Second, rapid population growth and industrial activity are straining Ulaanbaatar's water resources. Excessive groundwater extraction, the primary source of drinking

water, is causing water levels to decline (Batmunkh et al., 2017). Establishing and maintaining a sustainable and clean water supply is a critical future challenge for Ulaanbaatar (Javzandulam et al., 2018).

Third, soil pollution is a significant issue in Ulaanbaatar. Improper disposal of hazardous chemicals, heavy metals, and industrial waste pollutes the soil, posing risks to human health and the environment (Kasimov et al., 2011). This pollution affects agricultural productivity and food security, worsening the urban environment (Batjargal et al., 2006). Additionally, many parks and open spaces in the city have been replaced by buildings and infrastructure, reducing residents' access to recreational areas (Brueggemann, 2020). The lack of green space and proper land use planning exacerbates environmental challenges and hinders sustainable urban development (United Nations, 2019).

Compared to other cities worldwide, Ulaanbaatar faces some of the most severe environmental challenges due to rapid urbanization and urban sprawl. Issues such as air and water pollution, soil contamination, and waste management significantly impact public health and quality of life (Warburton et al., 2018). Addressing these environmental issues is crucial to improving public health outcomes and ensuring sustainable urban development (Allen et al., 2013). The environmental degradation in Ulaanbaatar also affects the natural ecosystem, endangering the ecological balance and the well-being of citizens, and has led to the deterioration of green structures (Brueggemann, 2020). Therefore, the implementation of effective environmental management and sustainable practices is essential to ensure the city's long-term development and sustainability.

Adverse effects of environmental problems on public health in Ulaanbaatar

The rise in respiratory and cardiovascular diseases in Mongolia is closely linked to air pollution in Ulaanbaatar. Studies have demonstrated that exposure to high levels of particulate matter (PM2.5) leads to chronic obstructive pulmonary disease (COPD), asthma, lung cancer, and ischemic heart disease (Warburton et al., 2018). Children and the elderly are particularly vulnerable to these health impacts, resulting in increased morbidity and mortality rates (Guttikunda & Khaliquzzaman, 2014). In rural areas, water-borne diseases such as hepatitis A and cholera are prevalent due to the contamination of drinking water sources (Batmunkh et al., 2017). Additionally, respiratory infections are common, stemming from poor indoor air quality and environmental conditions (Murphy, 2017).

The stressful lifestyle in Ulaanbaatar, characterized by overcrowding, pollution, and economic insecurity, significantly affects the mental health of its citizens including young children. High rates of anxiety, depression, and stress-related disorders have been observed, particularly among residents of ger districts (Davies et al., 2019). The lack of green spaces and recreational areas exacerbates mental health issues and limits opportunities for recreation and social interaction (Sternberg, 2017). Air pollution, environmental degradation, and poor living conditions in Ulaanbaatar adversely impact children's growth and development, leading to cognitive impairments, reduced lung function, and developmental delays (Allen et al., 2013; Heinrich & Slama, 2007). The mortality rate due to air pollution among children under five in the city is significantly higher than in neighboring countries. The absence of safe and green environments for play and physical activity also negatively affects children's physical and social development (Guttikunda & Khaliquzzaman, 2014). Moreover, there is evidence that air pollution impairs neurodevelopment, causing cognitive deficits, behavioral problems, and learning delays (Perera et al., 2014).

Impact of environmental education on young children

Numerous studies have confirmed the significant impact of environmental education on children's cognitive, emotional, and social development, emphasizing its importance in early childhood education. Childhood is an ideal period to instill lifelong habits and attitudes towards the environment (UNESCO, 2019). By incorporating environmental education into the kindergarten curriculum, young children can become more aware and responsible citizens, laying the foundation for positive and healthy behaviors in future generations (Davis, 2009). For instance, a longitudinal study by Wells and Lekies (2006) found that early childhood experiences with nature and environmental education have a lasting positive effect on environmental attitudes and behaviors in adulthood.

Research has shown that environmental education greatly benefits children's cognitive development. Sobel (2004) noted that environmental education helps children learn and understand complex ecological concepts in a practical, real-life context, making it more effective than traditional classroom teaching. Furthermore, children who participated in environmental and sustainable development education programs demonstrated improved critical thinking skills, a better understanding of environmental issues, and acquired good habits and attitudes compared to their peers who did not receive such education (Ernst & Monroe, 2004; Elliott & Davis, 2009). Engaging in sustainable development education also helps young children develop critical thinking and problem-solving skills, as well as a deeper sense of belonging to the Earth (UNESCO, 2017).

Environmental education also plays a crucial role in the

emotional and social development of young children. According to Jensen (2016), children who study environmental and sustainable development education develop empathy, an appreciation for cultural diversity, and a better understanding of social justice. Chawla (2009) found that interacting with nature through environmental education fosters feelings of wonder, empathy, and connection to the Earth, which later leads to environmentally friendly behaviors. A study by Evans (2007) revealed that children who participated in environmental education programs were more likely to engage in environmentally friendly practices, such as recycling and conserving water at school and at home. This change in behavior is often associated with increased environmental awareness and responsibility through participation in these programs (Eagle & Demar, 1999).

Playing and learning in outdoor environments or nature has positive effects on children's physical and mental health. Faber Taylor and Kuo (2009) found that symptoms of attention deficit hyperactivity disorder (ADHD) decreased and cognitive performance improved when children spent time in nature. Louv (2008) introduced the term "nature-deficit disorder" to describe the significant negative impact of restricted outdoor play on children's well-being, highlighting the importance of incorporating nature-based activities into early childhood education. Environmental education is essential for fostering cognitive, emotional, and social development in young children. By integrating it into early childhood education, we can promote lifelong environmental awareness, responsibility, and healthy behaviors, ultimately contributing to the well-being of future generations and the planet.

Sustainable development education in early childhood education

As highlighted, numerous studies demonstrate that educating children about environmental sustainability from an early age can develop environmentally conscious and socially responsible citizens who are well-prepared to address future environmental challenges. This research aims to create an environmentally friendly and sustainable kindergarten education model that can be implemented in other urban areas facing similar environmental issues through its participatory and action-oriented approach. Furthermore, this research aligns with the Sustainable Development Goals (SDGs) of the United Nations, particularly Goal 4, which aims to provide accessible and quality education for all, and Goal 11, which focuses on making cities and human settlements inclusive, safe, resilient, and sustainable (United Nations, 2015).

To implement sustainable development education in kindergarten teaching and activities, it is crucial to integrate the concept of sustainable development into the curriculum and daily routines. This can be achieved through topics such as sustainable water use, waste recycling, and biodiversity (Davis & Elliott, 2014). Additionally, outdoor or nature-based activities are essential components of education for sustainable development (ESD) because they allow children to experience and connect with the natural world (Sobel, 2013). Teachers play a pivotal role in ESD by modeling positive behavior and creating a learning environment that nurtures children's curiosity and cognitive development (Cutter-Mackenzie & Edwards, 2013).

While there are significant benefits to introducing ESD in kindergartens, several challenges exist. One major challenge is the complexity of the content. The SDGs are complex, interrelated, and multidisciplinary concepts that are difficult to convey to young children (UNESCO, 2017). Additionally, integrating sustainable development education into existing curricula is challenging due to existing educational priorities and standardized models (Ferreira et al., 2015). Implementing the SDGs in kindergarten teaching and activities requires teachers who have extensive knowledge of the SDGs and the skills to teach them. Hägglund and Samuelsson (2009) found that a lack of sustainable development knowledge and resources is a major obstacle for many teachers, leaving them insufficiently prepared to teach these concepts.

Children in urban environments have limited opportunities to learn and play in nature (Duhn, 2012). Moreover, a lack of resources and support hinders the implementation of sustainable development education in preschools. Schools and kindergartens often face financial difficulties in acquiring materials for sustainable development education, and without adequate support, sustainability efforts are negatively impacted. While early childhood education in sustainability presents challenges, its integration is vital for fostering environmentally responsible future generations. Addressing these challenges requires comprehensive support for teachers, the incorporation of nature-based activities, and sufficient resources to develop a robust and effective ESD curriculum.

Participatory Action Research Methodology

The purpose of this study is to develop a kindergarten education model that is both sustainable and environmentally friendly by using a participative and action-oriented approach. Participatory Action Research (PAR) is a collaborative research approach that emphasizes active participation and collaboration among researchers and community members to address issues of mutual concern. PAR is characterized by its cyclical process of planning, action, observation, and reflection,

aiming to improve practices and generate knowledge through active participation (Reason & Bradbury, 2001). The methodology is grounded in principles of collaboration, empowerment, and reflexivity, which are crucial for addressing environmental challenges that directly impact communities (Greenwood & Levin, 2007).In this study, PAR was employed to develop sustainable and feasible responses tailored to the specific needs and contexts of urban residents by involving children, parents, teachers, and other stakeholders in the research process. This methodology was chosen because it fosters active collaboration between researchers and the community members or stakeholders directly affected by the research topic. It aims to bring about positive social change by empowering participants and addressing real-life issues and challenges.

Unlike traditional research methods where researchers act as detached observers, PAR emphasizes the active involvement and participation of the people being studied in all stages of the research process (McTaggart, 1997, cited in Borda, Reason & Bradbury, 2006). Participants are treated as competent and reflexive agents capable of engaging in all aspects of the research process. By involving those directly impacted by environmental issues, PAR ensures that the research is relevant, context-specific, and geared towards practical, actionable outcomes. This approach not only enhances the validity and applicability of the research findings but also promotes a sense of ownership and empowerment among community members, thereby fostering sustainable environmental practices and solutions.

Since 2018, 167th Public Kindergarten has been implementing sustainable development education activities in the 9th khoroo of Bayanzurkh district, where 96.5% of the 7,355 residents live in ger district.

From September 2021 to December 2023, a participatory action research (PAR) project was conducted with parents and the local community, initiated by the kindergarten to drive environmental changes. Monthly meetings were organized, involving parents, kindergarten teachers, and the local community including smallest local government administrations Horoo's director and social worker and local community family hospital's doctors.

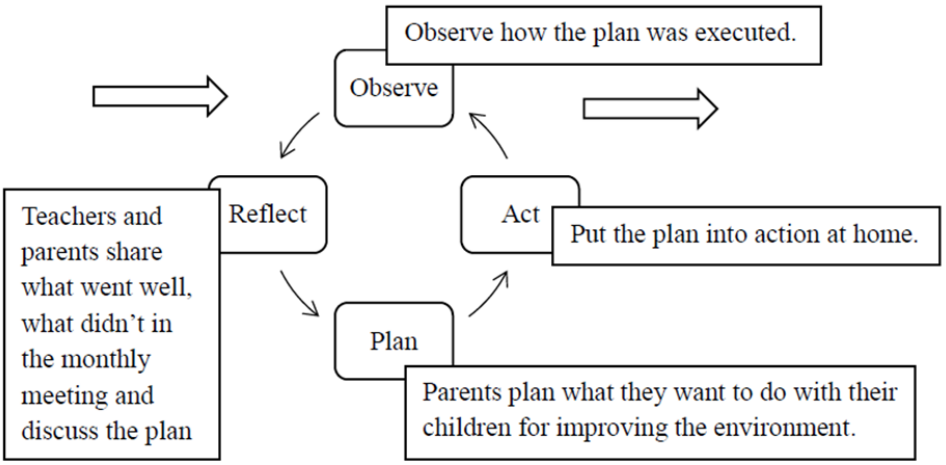

Figure 1: Participatory Action Research Monthly Cycle

Parents' Participation

Through the participatory action program, parents took ownership of all activities, with the local kindergarten initiating the idea to empower parents through PAR. The program aimed to explore pollution in the selected areas and motivate actions for positive social changes in young children's learning and development. Parents planned, implemented, and shared their positive experiences to support their children in the home environment (Figure 1). The kindergarten professionals played a crucial role in connecting with parents and community members, ensuring participation from Ulaanbaatar citizens with preschool children in ger districts.

Parents were invited to join the learning group and could leave at any time. Despite busy schedules, all parents accepted the invitation, participated actively, and successfully completed the activities from November 2021 to December 2023. Two groups were initiated in marginalized areas of Bayanzurkh district with the following objectives:

- Promote sustainable development education in the ger district context
- Provide opportunities for parents to make decisions and plan their child's development and learning

- Enable parents to share their planning implementations and learn continuously from one another

To support learning communities of parents, the project established groups with the support of local kindergartens. Each community group consisted of 50 parents who met monthly with the project team for planning activities with their children at home. Besides face-to-face meetings, online conversations and discussions were held to share experiences of planned activities.Communication and Collaboration
The communication and collaboration process were democratic and based on parents' decisions, accommodating their family's conditions. From November 2021 to December 2023, communications and collaborations were organized through monthly in-person meetings, internet communication via Facebook group chat, and phone calls, depending on network availability. The Facebook group chat included all group members, facilitating learning from one another about implementing planned activities with their children. Consent and confidentiality were maintained, recognizing the importance of the relationship between researchers and participants (Mahbub, 2017).

Monthly Meetings

The primary purpose of the monthly meetings was to share their knowledge about environmental challenges and actions they did in the previous month with their young children at home, how it went and plan activities for the upcoming month (Figure 1). During these meetings, group members identified improvements to support their children at home and enhance communication with them. Discussion time was extensive, providing opportunities for reflection on children's real needs and daily responses. Based on these reflections, parents developed daily play and activity plans for their children. Each subsequent meeting followed the same cycle: sharing the past month's experiences, reflecting on the activities, and planning for the coming month. Through this collaborative and reflective process, the PAR project at 167th Public Kindergarten aimed to foster sustainable development education, empowering parents and supporting children's holistic development in the ger district of Bayanzurkh district. The monthly meetings were organized not only for sharing experiences and planning for next month's actions but also parents learn from one another and support each other. All of the actions planned and implmented were initiated, planned and implemented each parent.

Daily Learning Activities at Kindergarten

To achieve the objectives of sustainable development education, the training program for parents and young children at the 167th Public Kindergarten includes various skill-building activities. By incorporating these elements, the training program aims to develop a holistic understanding of sustainability in both parents and children, fostering an environment where sustainable practices become a natural part of everyday life. As a public kindergarten, it implemented national preschool education curriculum and all of the above activities enriched daily learning activities initiated by the teachers and parents based on their initiative for improving environment. Children practice their learning activities in class with peers and teachers as well as at home with their parents.
To find out positive changes for greener and safer environments for young children as the result of this participatory action research quantitative and qualitative data were gathered from parents and kindergarten teachers. For quantitative data, the McNemar test was used to assess whether there was a change in the participants' attitudes and actions, and 311 parents and caregivers were randomly selected based on the active participation. The McNemar test is used to test for statistically significant changes between two related nominal variables. It was chosen because the study aimed to determine the changes in the responses obtained from the same group of participants at two different time points (beginning (Pre) and the end (Post) of the study). For qualitative data, interviews were conducted with parents.

RESULTS

For quatitative data, statistically significant changes were found in six ecological habits and practices between the beginning (Pre) and the end (Post) of the study (Table 1). For example, the highest change was found in the attitude to use air purifiers (McNemar's $\chi^2 = 1.62.9$, $p < .001$). In addition, positive changes were found in the attitude to plant houseplants, plant trees, separate waste, save water, and use water purifiers. Here are basic explanations regarding Table 2:

1. The table 1 shows the number and percentage of participants who answered "No" or "Yes" at the beginning (Pre) and at the end (Post) of the study. It shows how the participants' living environment and daily habits changed from the beginning to the end of the study.
2. McNemar χ^2: This is a statistical value that calculates the difference in the number of participants who changed from Start=No→End=Yes and Start=Yes→End=No. The higher the value, the more likely it is that the difference between the beginning and end is not a random change, but a real change.
3. P-value: The probability level calculated from McNemar's χ^2. $p < .001$ indicates that the difference

between the beginning and end answers is statistically significant.

4. "Change" column: This briefly indicates that most participants changed from "No" to "Yes" at the end of the study. This positive change was observed across all six types of living environment and daily habits.

Table 1: Participants' habits and routines at the beginning and end of the study, and McNemar test results (N=311).

Question	At the beginning: No n (%)	At the beginning: Yes n (%)	At the end: No n (%)	At the end: Yes n (%)	McNemar χ^2	p-value	Change
Do you have an air purifier in your home?	227 (73%)	84 (27%)	75 (24%)	236 (76%)	115.1	< .001	No → Yes, it is
Do you have any houseplants?	184 (59%)	127 (41%)	96 (31%)	215 (69%)	46.7	< .001	No → Yes, it is
Have you planted a tree in your yard?	252 (81%)	59 (19%)	116 (37%)	195 (63%)	119.9	< .001	No → Yes, it is
Do you sort your garbage?	175 (56%)	136 (44%)	86 (28%)	225 (72%)	47.5	< .001	No → Yes, it is
Do you save water?	250 (80%)	61 (20%)	94 (30%)	217 (70%)	87.6	< .001	No → Yes, it is

This result shows that the attitudes and habits towards air pollution, ecological safety, rational water use, and creating a green environment have significantly improved among the participants. Also, the McNemar test values are $p < .001$ for all questions, and the Value is quite high (46.77–162.93), which is evidence that the difference between the initial and final test is not a coincidence, but a real change.

By organizing the learning activities in a more realistic way based on the environmental needs, the teacher acted only as a guide and used games, and real materials that the children made their own decisions. In this way, the tendency of children to become more self-confident and share their knowledge with others increased. Observing this, practical the activities supported the children's ability to speak. Also, it is a habit to turn off the lights in the classroom during nap time, and the children take turns to do this, which is a form of putting their knowledge to use. So, when the assessment was repeated in April 2024, the children's attitude showed more growth. This shows that the children have become more self-confident and become influencers and distributors to their friends and family. Looking at the results of the training, the ability of the children of the four- and five-years old groups to express their ideas freely, to tell and explain the meaning of pictures and symbols, and to learn to limit their use in the right way has increased. Children in the primary and middle groups have improved their cognitive abilities to use water, express themselves, understand rules, and stay away from dangerous things. 238 children who regularly attend our kindergarten and their families have started using a cup to brush their teeth. According to the first family survey, a family used at least 800 ml of water for oral hygiene at home, but now it is 300-400 ml. parents and children practiced to use natural light without turning on the lights during the day at home on weekends. Also, through the influence of children, parents are learning the good practice of disconnecting electricity that is not being used at home. The main results are shown in in outdoor and indoor environment improvement in young children's learning and living areas. In outdoor, from 2021 to 2024, a total of 348 trees were planted and distributed among children, parents, teachers, and workers and 77.2% of the planted trees were thriving by May 2024, contributing to the purification of 4.5 million cubic meters of air. In order to plant the tree parents changed their soils and fixed their living environment together with their children that provided them more opportunities to spend time with their young children. In the kindergartens fence, children participated in planting and harvesting vegetables in a $20m^2$ garden. A $25m^2$ greenhouse produced a variety of fruits and vegetables, including strawberries, peppers, pumpkins, cauliflower, and tomatoes that were used for their kindergarten daily food. In 2021-2023, totally 3486 flowers were distributed and exchanged among the participant families. At first each family prepare and grow their flowers at home. Once in three monthly meetings parents exchange their flowers and parents decorate their home with flowers. Parents and teachers' expressions how their attitude changed regarding making positive changes in their living

environment:

"I used to complain about my environment to horoo (smallest unit of local administration) and expect them to make changes in the environment. Now myself am contributing for living in much better and green environment." Parent 17

"Now I am mindful for all my consumption choices. I prefer to choose anything that is less harmful for natural environment. For example, when I buy grocery products, I think how I handle the trash from what I am buying. There can be glass bottles, plastic bags and vegetable trash that can be used for plant soil. Everything that We use must not worsen the environment we live. So, I became more mindful for my all consumptions and its effect to the earth." Parent 5

"This community participatory action research gave me opportunity to reflect how I can spend time with young children healthy and effectively. Taking care of the flowers with my daughter, I have enough time to talk with her. It gives me more time to spend meaningful time with my daughter." Parent 38

"Actually, this was not training that one to teach another. However, we discussed how to improve our environment and did some action during the monthly meetings. Everyone was doing certain action based on their possibility and own decision and it was supportive learning community of parents with young children. For me, we planted over 20 trees with my children such as spruce, black cherry tree, and pine tree. Our ger neighborhood is dousty and smoky most of the time. We believe that our tree will contribute our polluted environment positively. Parent 22

The kindergarten's integrated approach to environmental education not only enhances children's cognitive and practical skills but also fosters a community-wide commitment to sustainable living. By blending practical experiences with educational initiatives, the participant parents are nurturing a generation of environmentally conscious citizens who value and protect nature. 167th kindergarten's environmental education initiatives have not only fostered a deeper understanding of sustainability among children but also influenced their families to adopt environmentally friendly practices. The projects and activities have led to significant improvements in children's cognitive, ability, and attitudinal development, contributing to a greener and more sustainable future for the community.

CONCLUSION

Adopting proper consumption habits, such as in food, electricity, water, air, and medicine, is crucial for our health and that of our children. Consistently using natural resources correctly fosters a positive impact on our future and promotes environmental friendliness. The kindergarten has enhanced its curriculum by integrating sustainable development education with aims of equipping community, parents and children with knowledge and practical skills applicable beyond the kindergarten environment. Observing the outcomes of this educational approach, parents and children gained awareness of environmental issues, understand their interconnectedness, and develop problem-solving abilities essential for social engagement. A significant outcome of the participatory action research is that parents and children are more effectively engaged when learning through hands-on experiences with materials used in everyday life, enabling them to make decisions independently. Based on our research findings, we propose the following recommendations for implementing sustainable development concepts in kindergartens:

- Integrate sustainable development practical activities into the curriculum using appropriate methodologies
- Enhance policy coordination and ensure effective management.
- Foster opportunities for developing learning and implementation capabilities.
- Support teachers in acquiring knowledge and skills for sustainable development education.
- Increase parental involvement to stimulate children's natural curiosity, fostering their appreciation for nature, ecological education, and sustainable habits.
- Create a conducive learning environment with educational materials and technology-based play.

Adapting and being mindful to the natural environment is seen as a key solution to climate change. Therefore, it is crucial to provide sustainable development education to children from preschool through all levels of schooling. This education aims to develop knowledgeable citizens who are motivated to sustainably develop their families, communities, countries, and the planet. Emphasizing sustainable development from an early age prepares children to address and mitigate environmental challenges, promoting a sustainable future for all. By addressing these key areas, the educational program aims to instill essential knowledge and habits in children, empowering them to make positive environmental and sustainable choices throughout their lives.

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