

## THE ROLE OF LEARNING TECHNOLOGIES IN FOSTERING SUSTAINABILITY AWARENESS AMONG PRIMARY SCHOOL LEARNERS IN RURAL PAKISTAN

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### **Abstract:**

*Learning technologies can foster sustainable development capabilities in primary school children in remote rural areas of Pakistan. This study aims to seek ways on how different technologies like interactive boards can help the students become more active and interested in the problems of the environment. Problem-Based Learning (PBL) methodology and advocacy perspectives like Children as Agents of Social Change (CASC) provide the basis for allowing interactions from the learners, where the learners depend on positively impacting the respective context. To this end, the proper use of these technologies depends on the active role of the community and the teachers' training based on the environmental education models. Suppose environmental sustainability principles are incorporated within the curriculum and equip learners with Information and communication technology. In that case, it is imperative that the learners will no longer be passive spectators but will be active participants in solving climate change injustices. The conclusions show that creating the solutions has to change the perception of investing more in digital communication and networks to create environmental citizens for both the global and local communities.*

**Keywords:** Learning Technologies, Sustainability Awareness, School Learners, Pakistan

### **1 Introduction**

The integration of learning technologies in primary education plays a crucial role in fostering sustainability awareness among learners in rural areas of Pakistan. Educational technology, particularly in developing regions, can significantly enhance learning outcomes by providing interactive and personalized experiences that engage students more effectively than traditional methods (Abdul Sattar et al., 2016). Learning technologies encompass a variety of

tools and platforms designed to facilitate educational processes, thereby improving student engagement and understanding of complex topics such as sustainability. By utilizing digital learning tools, educators can create a more dynamic learning environment that encourages students to explore sustainability issues relevant to their local context. This is particularly important in rural areas, where access to resources may be limited, and traditional teaching methods may not adequately address local environmental challenges (Deniz et al., 2012). One effective pedagogical approach that can be enhanced through learning technologies is Problem-Based Learning (PBL). This method engages students in active problem-solving activities related to local environmental issues, increasing their sustainability awareness (Heidi et al., 2011). For instance, by integrating local environmental problems into the curriculum, students can work collaboratively to devise solutions, fostering a sense of agency and responsibility towards their community and environment. The Children as Agents of Social Change (CASC) framework further supports this by promoting education about social issues, specifically aimed at enhancing sustainability awareness among learners. Moreover, teacher training programs are essential for equipping educators with the skills to effectively integrate these technologies and sustainability concepts into their teaching practices.

Professional development initiatives can help teachers understand how to utilize digital tools to create engaging lessons highlighting the importance of sustainability, thus ensuring that students are informed and motivated to act. Community engagement is another critical aspect of this educational approach. Involving local communities in the educational process enhances the relevance of sustainability initiatives and supports students in applying their learning to real-world situations (Nicola, 2019). This collaboration can lead to the development of curricula that reflect local sustainability challenges and practices, making education more meaningful for students. In conclusion, the role of learning technologies in creating sustainability awareness among primary school learners in rural Pakistan is multifaceted. By leveraging digital tools, employing innovative pedagogical frameworks like PBL and CASC, and fostering community involvement, educators can significantly enhance students' understanding and commitment to sustainability (Abdul Sattar et al., 2016; Agatha et al., 2009; Alan, 2011).

## **2 Literature review :**

### **2.1 Education and sustainability awareness**

Education for sustainability (EfS) among young children is a crucial and emerging field that seeks to integrate environmental awareness and sustainable practices into early childhood

education. This approach is essential as young children are the most vulnerable to the impacts of unsustainable living due to their physical and cognitive vulnerabilities. Yet, they also hold the potential to become informed and active citizens capable of contributing to sustainable living (Davis, 2010). The integration of sustainability into early childhood education is not only about imparting knowledge but also about fostering transformative education that builds the capabilities of young children as agents of change for sustainability (Davis, 2010). This involves embedding sustainability throughout all practices in early childhood settings, including management, curriculum, and community relationships, thereby providing numerous opportunities for children to act as change agents (Davis, 2008). Field experiences, such as forest adventures, are particularly effective as they offer direct engagement with nature, fostering knowledge, attitudes, and advocacy for environmental conservation among young children (Gambino et al., 2009).

Moreover, the use of funds of knowledge approach, which considers children's interests in popular culture, can help educators create an integrated curriculum that connects well-being, environmental education, and everyday choices, potentially impacting child weight and facilitating obesity prevention alongside environmental sustainability (Edwards et al., 2016). The Project Approach, which involves in-depth investigations and transformative practices, has enabled young children to think critically about environmental issues and create change in their local contexts, even taking on roles as educators to influence others' behaviours (Stuhmcke, 2012). Despite its importance, EfS in early childhood remains under-practised and under-resourced. However, there is a growing recognition of its significance as the early years are a critical period for influencing lifelong physical, neurological, and social development (Davis, 2008). Whole-centre approaches, action research, and systems thinking can help reorient early childhood education towards sustainability, ensuring that it becomes a systems-wide imperative rather than the initiative of individual teachers or centres. The literature suggests that early education can contribute significantly to sustainable living by promoting education for sustainability from birth to eight years, drawing on national and international initiatives like 'Sustainable Schools' and 'Health Promoting Schools' (Davis, 2010). This comprehensive approach addresses environmental issues and incorporates social and economic dimensions, preparing children to navigate and address the complex challenges of the future (Hirst, 2019). Overall, integrating sustainability into early childhood education is a transformative process that requires collaboration, inquiry, and a commitment to

embedding sustainable practices across all aspects of early childhood settings, ultimately empowering young children to become proactive stewards of the environment.

## **2.2 Role of digital learning in creating sustainability awareness**

Learning technologies are crucial in creating sustainability awareness among primary school learners in rural areas by providing innovative and accessible educational opportunities. Digital technologies, such as videoconferencing, mobile apps, and virtual and augmented realities, can engage students in environmental stewardship by allowing them to capture and share experiences of local and distant environments, collect data, and participate in citizen science projects, thus fostering globally minded, environmentally responsible behaviours (Buchanan et al., 2018). In developing countries, ICT-enhanced Problem-Based Learning (PBL) frameworks, like the Children as Agents of Social Change (CASC), have been implemented to address local environmental issues, such as forest fires in Tanzania, by connecting students with local experts through video-supported PBL activities, which have proven effective in promoting sustainability education (Roy et al., 2014) (Roy et al., 2012). Community factors, such as unbiased access to technology, using local languages, and equipping teachers with technological skills, are essential for successfully adopting ICTs in rural education, as demonstrated in rural India (Ale & Chib, 2011). Collaborative learning environments, supported by technologies like the Collaborative and Multimedia Interactive Learning Environment (CaMILE), enable students to work in multidisciplinary teams, enhancing their ability to recognize and address sustainability issues from various perspectives (Hmelo et al., 1995). Sustainable learning frameworks incorporating neurobiological mechanisms and value-based motivation can transform didactic learning into deep, sustained learning essential for adapting to environmental challenges (Schneider et al., 2013). Cloud computing technology allows rural educational institutions to provide digital resources, virtual laboratories, and interactive classes. However, challenges such as energy and security need to be addressed for sustainable e-learning (Odunaike et al., 2014). E-learning platforms, enhanced with gamification techniques, can engage students in sustainable development education by providing a collaborative and interactive learning environment (Donath et al., 2020). Educational technologies like open badges and blockchain can facilitate distance learning and empower geographically remote populations to engage with and highlight their traditional knowledge, thus supporting sustainable development in mountain and pastoralist societies (Gwin & Foggin, 2020). Learning technologies offer flexible, scalable, and contextually relevant solutions to promote sustainability awareness

among primary school learners in rural areas, enabling them to become informed and proactive citizens in addressing environmental challenges.

### 2.3 Integrating sustainability in early childhood education

Integrating sustainability awareness into early childhood education programs to foster environmentally responsible behaviours in young children requires a multifaceted approach that combines curriculum development, pedagogical strategies, and community involvement. Early childhood education for sustainability (ECEfS) should be transformative, building young children's capabilities as change agents for sustainability by embedding it into the curriculum and pedagogy (Davis, 2010). This can be achieved by incorporating sustainability as a core value within national curricula, such as New Zealand's Te Whāriki, ensuring it becomes part of everyday practice in early childhood centres (Prince, 2010). Programs should leverage children's natural connectedness with nature and instil sustainable living values through integrated learning experiences and modelling by teachers and parents (Prince, 2010). Practical, hands-on projects, such as biological surveys, reed planting, and turtle nest watch, have effectively engaged children meaningfully with sustainability issues, allowing them to take action in real-life contexts (Lewis et al., 2010).

Additionally, using arts-based pedagogies can deepen children's understanding of the natural world, enabling them to explore and reflect on their local environments creatively (Ward, 2013). The concept of the ecological footprint can be introduced to educate children, staff, and parents about the links between their daily activities, such as food consumption and transport, and their environmental impact, promoting infrastructure and cultural changes in early childhood settings (McNichol et al., 2011) (McNichol et al., 2011). Furthermore, early childhood education programs should draw on interdisciplinary research to identify opportunities for sustainability education, as demonstrated by the collaboration between engineers and educators in adapting the ecological footprint methodology for early learning centres (McNichol et al., 2011) (McNichol et al., 2011).

Source	Focus Area	Key Findings
Davis (2010)	Education for sustainability (EFS) in early childhood	EfS builds capabilities in young children as agents of sustainability.
Gambino et al. (2009)	Field experiences in fostering environmental education	Direct engagement with nature enhances environmental advocacy among children.
Edwards et al. (2016)	Integration of popular culture into	Popular culture interests can be leveraged for integrated curriculum

	sustainability education	promoting well-being and sustainability.
Roy et al. (2014)	ICT-enhanced Problem-Based Learning for sustainability	ICT-supported PBL helps address local environmental issues, fostering sustainability education.
Ale & Chib (2011)	Community factors in adopting ICT in rural education	Community involvement and teacher training are essential for ICT success in rural sustainability education.
Schneider et al. (2013)	Sustainable learning frameworks and deep learning mechanisms	Neurobiological and value-based motivation enhance deep learning and adaptability to sustainability challenges.
Prince (2010)	Sustainability as a core value in national curricula	Embedding sustainability as a core value helps make it part of everyday practice in early education.
Donath et al. (2020)	Gamification in sustainability education through e-learning	Gamified learning environments promote engagement in sustainable development.
McNichol et al. (2011)	Ecological footprint concept in early childhood education	Introducing ecological footprint helps young children understand their environmental impact.
Buchanan et al. (2018)	Use of digital technologies to foster global environmental awareness	Digital technologies engage students in global and local environmental issues.
Ward (2013)	Arts-based pedagogies for environmental engagement	Arts-based methods encourage creative reflection on local environments.
Lewis et al. (2010)	Practical, hands-on sustainability projects in education	Hands-on projects enable students to take real action on sustainability issues.

Programs should also engage with national and international initiatives like 'Sustainable Schools' and 'Child Friendly Cities' to promote education for sustainability from birth to eight years, as these initiatives provide a framework for linking early childhood education with broader sustainability goals (Davis, 2010). Educators can facilitate critical thinking and transformative practices by adopting a project-based approach, enabling children to become change agents who influence others' environmental behaviours (Stuhmcke, 2012). This approach aligns with the tradition of nature-based and child-centered pedagogy in early childhood education, emphasizing the co-construction of knowledge and transformative practices to create change (Stuhmcke, 2012). Finally, fostering a transnational dialogue on sustainability issues can enhance the global perspective of ECEfS, encouraging educators to



reflect on and adapt their practices to local and global sustainability challenges (Green, 2015). By integrating these strategies, early childhood education programs can effectively nurture environmentally responsible behaviours in young children, preparing them to contribute to a sustainable future.

#### **2.4 young children sustainability adaptive capacity**

The adaptive capacity of young children in the context of sustainability is a multifaceted concept that involves their ability to understand, engage with, and influence sustainability practices. Early childhood education for sustainability (ECEfS) plays a crucial role in developing this capacity by embedding sustainability into the curriculum and pedagogy, thereby equipping children with the knowledge and skills to act as agents of change (Davis, 2010) (Stuhmcke, 2012). The integration of sustainability in early education is essential as it aligns with the critical growth period in a child's life, influencing their physical, neurological, and social development, which are foundational for lifelong learning and adaptation (Davis, 2008). The concept of ecological footprint, when introduced in early learning settings, helps children, educators, and parents understand the environmental impact of daily activities, such as food consumption, transport, and energy use, fostering a culture of sustainability from a young age (McNichol et al., 2011). Moreover, participatory and whole-of-settings approaches in early childhood settings have been shown to effectively embed sustainability practices, allowing children to participate in sustainability initiatives actively and influence their communities (Davis, 2008). This approach is supported by action research and systems thinking, which help create a systemic change in early childhood education, making sustainability a central priority across all learning centre operations (Davis, 2010). The role of educators is pivotal in this process, as they are responsible for conceptualizing sustainability and implementing practice initiatives that go beyond the natural/environmental dimension to include social, economic, and political aspects (Hill et al., 2014). The transformative power of early education is further highlighted by studies showing that young children can critically engage with environmental issues and effect change in their local contexts, thereby enhancing their adaptive capacity for sustainability (Stuhmcke, 2012).

Additionally, integrating deep ecological insights and the concept of ecological habitus in early childhood education can foster moral agency and improve the life quality of young children, preparing them to meet future ecological challenges (Eriksen, 2013). The global context, marked by environmental, social, and economic crises, underscores the urgency of building resilience and capabilities in children through education, enabling them to contribute

to sustainable living now and in the future (Davis, 2010). The development of ECEfS practices is an emerging field, reflecting a growing awareness of the need for societies to respond to unsustainable living patterns, and educators and policymakers must continue expanding and refining these practices to fully realize the potential of young children as adaptive agents of sustainability (Hill et al., 2014). The case studies and research findings across various contexts demonstrate that with the right educational frameworks and support, young children can significantly contribute to sustainability efforts, highlighting the importance of early education in shaping a sustainable future (Davis, 2010) (Borg, 2017) (Peacock, 2011).

Education for sustainability (Efs) among young children is a crucial and emerging field that seeks to integrate environmental awareness and sustainable practices into early childhood education. This approach is essential as young children are the most vulnerable to the impacts of unsustainable living due to their physical and cognitive vulnerabilities. Yet, they also hold the potential to become informed and active citizens capable of contributing to sustainable living (Davis, 2010). The integration of sustainability in early childhood education is not only about imparting knowledge but also about fostering transformative education that builds the capabilities of young children as agents of change for sustainability (Davis, 2010). This involves embedding sustainability throughout all practices in early childhood settings, including management, curriculum, and community relationships, providing numerous opportunities for children to act as change agents (Davis, 2008) (Davis, 2008). Field experiences, such as forest adventures, are effective mediums for environmental education, allowing children to gain knowledge, change attitudes, and develop advocacy strategies for conservation efforts, as demonstrated in studies involving the Greater Bilby in Australia (Gambino et al., 2009).

Moreover, the interconnectedness of sustainability, well-being, and popular culture in early childhood education can be leveraged to create an integrated curriculum that impacts children's everyday choices and practices, potentially influencing child weight and facilitating obesity prevention alongside environmental sustainability (Edwards et al., 2016). The Project Approach, which involves in-depth investigations around topics of interest, has been effective in enabling young children to think critically about environmental issues, create change in their local contexts, and influence others' environmental behaviours (Stuhmcke, 2012). Whole-centre approaches to sustainability, which involve working across the entire operations of a centre, are recommended to reorient early childhood education towards



sustainability, supported by action research and systems thinking to create desired changes and leverage support for a systems-wide imperative (Davis, 2010). Despite its importance, education for sustainability in early childhood remains under-practiced and under-resourced, though there has been a growing interest and development of programs with a sustainability focus over the past decade (Davis, 2008) (Davis, 2008). The literature suggests that early childhood education for sustainability should be participatory and involve collaboration and inquiry through projects with children, fostering a shared understanding of sustainable development (Hirst, 2019). By drawing on national and international initiatives such as ‘Sustainable Schools’ and ‘Health Promoting Schools,’ early childhood education can contribute significantly to sustainable living from birth to eight years, promoting education for sustainability as a transformative force in young children's lives (Davis, 2010). Overall, integrating sustainability into early childhood education is about addressing immediate environmental challenges and preparing children to navigate and influence the complex social, economic, and environmental landscapes they will inherit (Peacock, 2011).

### 3 Discussion

#### 3.1 Sustainability Awareness Initiatives in Pakistan

In Pakistan, the integration of sustainability awareness into children's education is being approached through various initiatives, reflecting a growing recognition of the importance of sustainable development in educational settings. One significant initiative is the promotion of organic farming, which is seen as a sustainable practice that can be integrated into educational curricula to teach children about eco-friendly agricultural techniques and the importance of reducing environmental pollution. This approach supports sustainable livelihoods and educates children on the balance between human activities and ecological systems, fostering a sustainability mindset from a young age (Anjum et al., 2016). Additionally, higher education institutions in Pakistan are challenged to play a more active role in promoting education for sustainability. This involves critically examining and integrating sustainability considerations into existing courses, as highlighted by the National Conservation Strategy of Pakistan. The strategy emphasizes the need for educational reforms incorporating sustainability into the curriculum, thereby preparing future generations to address environmental, social, and economic challenges (Mughal et al., 2011).

Furthermore, the global perspective on early childhood education for sustainability underscores the importance of starting sustainability education early. This involves adopting whole-centre approaches that integrate sustainability into all aspects of educational

operations, from curriculum and pedagogy to community partnerships, as seen in initiatives in other countries like Australia and Korea (Davis, 2010) (Okjong & Stuhmcke, 2014). In early childhood settings, projects that engage children in sustainability practices, such as water conservation and waste reduction, are becoming more common. These projects are often driven by children's own ideas and concerns, which are used as a basis for developing sustainable practices within educational centres (Davis et al., 2005).

Theme	Key Insights	Potential Impact
Learning Technologies in Education	Digital tools enhance engagement and understanding of sustainability through interactive and personalized experiences.	Improved learning outcomes and greater interest in sustainability topics among students.
Problem-Based Learning (PBL)	Active involvement in solving local environmental problems promotes sustainability awareness and a sense of agency.	Increased student-led initiatives addressing local sustainability challenges.
Children as Agents of Social Change (CASC)	Framework supports children engagement with social and environmental issues, fostering responsibility.	Children actively contributing to environmental change in their communities.
Community Involvement	Involvement of local community members makes education more relevant and encourages real-world application of sustainability practices.	Enhanced community awareness and collaboration towards sustainable development.
Early Childhood Education for Sustainability (ECEfS)	Embedding sustainability values from an early age shapes children as future agents of environmental change.	Long-term cultivation of environmentally responsible citizens.
Long-term Benefits of Sustainability Education	Fosters critical thinking, collaboration, and sustainable actions within communities.	Creation of a generation equipped to tackle environmental, social, and economic challenges.

The role of educators is crucial in constructing a "sustainability frame of mind" among young children, which involves questioning current lifestyles and creatively thinking of ways to live more sustainably (Elliott, 2010). In addition, action research and systems thinking in early childhood education is advocated to create desired changes and leverage support for sustainability initiatives, ensuring that these efforts extend beyond individual teachers and become a systemic imperative (Davis, 2010). The challenges teachers face in integrating sustainability into the curriculum, such as lack of time and alignment with existing curricula, highlight the need for systemic curricular reform and the provision of resources like high-quality children's books and videos on sustainability topics (Merritt et al., 2018). Overall,

while significant efforts are underway in Pakistan to integrate sustainability awareness into children's education, these initiatives are part of a broader global movement that recognizes the essential role of education in fostering sustainable development and preparing future generations to live sustainably.

### **3.2 Potential long-term benefits of incorporating sustainability in education**

Incorporating sustainability education into Pakistan's school curriculum can yield numerous long-term benefits, fostering a generation equipped to tackle environmental, social, and economic challenges. Education for sustainability is crucial as it promotes a shift in mindset, encouraging individuals to question their lifestyles and their impacts on Earth's systems, ultimately fostering a "sustainability frame of mind" from an early age (Elliott, 2010). By embedding sustainability into the curriculum, children can develop resilience and capabilities to become informed citizens who contribute to sustainable living (Davis, 2010). This approach aligns with the global Sustainable Development Goals (SDGs), which aim to create safe, nurturing, and just societies, ensuring quality of life for future generations (MacDonald, 2015). Integrating sustainability education can also lead to a more profound understanding of the interconnectedness of human actions and the environment, promoting critical thinking, problem-solving, and collaboration among students (Bauermeister & Diefenbacher, 2015). Furthermore, adopting whole-school approaches to sustainability can foster communities of practice that encourage sustainable actions and lifestyles, contributing to societal change at a larger scale (Shallcross & Robinson, 2008). In Pakistan, linking higher education fields like Home Economics with Education for Sustainable Development (ESD) can provide the impetus needed to achieve SDGs, as these fields already incorporate the three pillars of ESD: environment, society, and economy (Syed, 2016). Experiential learning can further enhance this integration, which helps inculcate sustainable practices into students' daily routines (Syed, 2016). Additionally, early childhood education plays a pivotal role, as the early years are critical for physical and neurological development, influencing lifelong responses to sustainability issues (Davis, 2008). By embedding sustainability throughout educational practices, children can act as agents of change, promoting sustainable development from a young age (Davis, 2008). Moreover, sustainability education can lead to the development of a deeply sustainable society, where learning is an active process that continuously redefines what it means to live in harmony with nature (Foster, 2001). This holistic approach to education addresses environmental concerns and fosters a just and equitable society, preparing students to thrive in diverse and interconnected communities (Bauermeister &

Diefenbacher, 2015). By transforming didactic learning into sustained deep learning, incorporating neurobiological mechanisms, and fostering value-based motivation, sustainability education can ensure successful adaptation to environmental challenges (Schneider et al., 2013). Ultimately, the integration of sustainability education in Pakistan's school curriculum can cultivate a generation that is aware of sustainability issues and actively engaged in creating a more sustainable and equitable future for all.

#### **4 Conclusion**

In conclusion, integrating learning technologies in primary schools within rural areas of Pakistan plays a pivotal role in fostering sustainability awareness among young learners. By leveraging digital tools and resources, educators can enhance the learning experience, making complex sustainability concepts more accessible and engaging for students. Using interactive platforms and multimedia content not only captivates learners' attention but also encourages critical thinking and problem-solving skills essential for addressing environmental challenges. Furthermore, incorporating local context into digital learning materials ensures that students relate their learning to their immediate surroundings, reinforcing the importance of sustainable practices in their daily lives. As such, the effective implementation of learning technologies can significantly contribute to cultivating a generation of environmentally conscious individuals equipped with the knowledge and skills necessary to promote sustainable development in their communities. Continued investment and research into these educational technologies will be crucial in maximizing their impact and ensuring that sustainability becomes a fundamental aspect of the educational framework in rural Pakistan. Moreover, the potential of learning technologies extends beyond mere awareness; they can also catalyze community engagement and action. By facilitating collaborative projects involving students, teachers, and local stakeholders, these technologies can empower young learners to take initiative in addressing sustainability challenges within their communities. For instance, digital platforms could enable schools to partner with environmental organizations, providing students opportunities to participate in real-world conservation efforts, thus bridging the gap between theoretical knowledge and practical application. This approach enhances student learning and fosters a sense of responsibility and agency among youth, encouraging them to become active participants in sustainable development initiatives. As such, integrating community-based projects into the curriculum through technology may further reinforce sustainability principles and create lasting impacts on both individual and communal levels.

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