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Evaluating Teachers' Use of Technological Processes and Resources in Promoting Environmental Awareness in Foundation Phase Learners

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Abstract

In South Africa, introducing environmental education (EE) in the Foundation Phase is important for helping young children develop an early understanding of environmental issues. Although the Curriculum and Assessment Policy Statement (CAPS) supports the inclusion of EE, many teachers struggle to use technology effectively to promote environmental awareness. This study examines how Foundation Phase teachers use technological tools and processes to support EE in the classroom. It looks at how teachers apply technology to teach environmental topics, which tools are most helpful, what challenges they face, and how technology affects learners' attitudes and understanding of environmental sustainability. The study is based on an interpretivist approach to understand teachers' views and experiences. A qualitative case study design was used, with data collected through semi-structured interviews and classroom observations. Ten Foundation Phase teachers from different suburban schools in Vhembe District, Limpopo Province were selected using purposive sampling. Thematic analysis was used to examine the data. The study focused only on urban schools and did not include rural areas. The results show that teachers mostly use simple technological tools, such as educational videos and interactive whiteboards, to introduce environmental topics. However, a lack of access to more advanced technology and limited training opportunities make it difficult for teachers to fully integrate technology into environmental lessons. Based on the findings, the study recommends providing professional development programs to help teachers use technology more effectively in EE. It also suggests investing in appropriate and accessible technological resources for early childhood environmental education. To successfully use technology in EE, schools must ensure that teachers are well-prepared and that the necessary resources are available.

Keywords: *Environmental education, Foundation phase, Technological integration, Sustainability awareness, Early childhood education*

1. Introduction and Background of the Study

Environmental challenges such as climate change, pollution, and resource depletion have become increasingly urgent, necessitating early educational interventions that nurture sustainable behaviours from a young age. Foundation Phase

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education plays a crucial role in shaping children's understanding of the natural environment and their responsibilities toward its protection. In South Africa, the Curriculum and Assessment Policy Statement (CAPS) emphasises the integration of Environmental Education (EE) across all subjects and grade levels to equip learners with the knowledge, values, and skills essential for sustainable living.

Although the policy framework supports EE, practical implementation within Foundation Phase classrooms remains limited and inconsistent. Factors such as insufficient teacher training, a lack of age-appropriate resources, and restricted access to educational technologies present significant challenges (Moseki and Mudzielwana, 2020). These barriers often hinder the effective teaching of environmental concepts during the early years of schooling.

Technology, however, offers promising opportunities to enhance EE delivery. Interactive digital tools, videos, and simulations can transform abstract environmental concepts into engaging, concrete learning experiences. When appropriately applied, such technologies not only support cognitive development but also improve learners' environmental literacy and curiosity (Ndlovu and Nyoni, 2022). According to Mhlongo and Mahlomaholo (2021), embedding EE in the early years sets the stage for lifelong environmental responsibility.

This study investigates how Foundation Phase teachers utilise technology to foster environmental awareness among young learners, exploring their instructional approaches, the challenges they face, and the impact of these practices on learners' attitudes toward sustainability.

Incorporating technology into EE has been identified as a promising approach to overcome some of these challenges. Technological tools can enhance learner engagement, simplify complex environmental concepts, and encourage interactive learning. Yet, many Foundation Phase teachers still lack the confidence and training to integrate digital resources into their teaching practice (Ramoroka and Mthombeni, 2023). A deeper understanding of how technology is currently being used in classrooms can help identify gaps and inform targeted interventions that strengthen the integration of EE at the foundational level.

Despite policy support, there is a gap between the intended integration of EE and its practical application using technology in Foundation Phase classrooms. This disconnect may impede the development of environmental consciousness among young learners.

2. Aim and Research Questions

To evaluate the utilisation of technological processes and resources by Foundation Phase teachers in promoting environmental awareness.

To achieve this, the article was guided by the following research questions:

- How do Foundation Phase teachers integrate technology to teach environmental concepts?
- What technological tools are most effective in promoting environmental awareness among young learners?
- What challenges do teachers face in implementing technology-based environmental education?
- How does the use of technology influence learners' understanding and attitudes toward environmental sustainability?

3. Theoretical Framework

This study is based on the Constructivist Learning Theory, which explains that learners build their knowledge through active experiences, interaction with others, and reflection (Piaget, 1952; Vygotsky, 1978). In environmental education, this means that young children learn best when they are involved in real-life situations, hands-on activities, and solving problems. This theory fits well with early childhood education, where learning through doing is very important.

Technology supports this kind of learning by offering tools that make lessons more interactive, interesting, and connected to real life. For example, videos, interactive whiteboards, and digital stories can help young learners understand environmental topics by showing them real-world situations in a way they can relate to (Jonassen, 1999). These tools allow learners to take part in the learning process rather than just listen to the teacher.

Vygotsky's idea of the Zone of Proximal Development (ZPD) also supports the use of technology in teaching. It suggests that children can learn more when they get help from someone else, like a teacher, a classmate, or even a digital tool (Vygotsky, 1978)). Technology can act as a guide to help learners understand environmental ideas that they would not be able to understand on their own.

In Foundation Phase classrooms, using technology in a constructivist way encourages learners to think, ask questions, and work together. These are important skills for building environmental awareness. When children use suitable

technology tools, they can better understand how their actions affect the environment and learn how to care for natural resources. Therefore, the Constructivist Learning Theory provides a useful foundation for studying how teachers use technology to teach environmental awareness in young children.

4. Conceptualizing Environmental Awareness

Environmental awareness is the understanding of environmental challenges and the importance of preserving natural resources, coupled with the motivation to engage in responsible behaviours that support environmental sustainability (Kaya and Elster, 2019). It involves not only knowledge about the environment but also attitudes, values, and skills that encourage learners to participate in actions that protect and improve the environment. In the context of education, environmental awareness is a foundational component of Environmental Education (EE), which aims to instil environmental values and problem-solving skills from an early age (UNESCO, 2020).

In early childhood education, cultivating environmental awareness is particularly important because young children are in a critical stage of forming habits and attitudes. Research shows that introducing environmental concepts at an early age helps children develop empathy for nature and a deeper connection with their surroundings (Ernst and Burcak, 2019). These early experiences shape how they view environmental responsibility throughout life. For example, when children participate in activities such as recycling, gardening, or exploring natural habitats, they begin to understand their role in caring for the planet.

Technology can enhance environmental awareness by offering interactive learning experiences that are both engaging and educational. Digital tools like videos, educational games, and simulations can make abstract environmental concepts more concrete and accessible to young learners (Hsu *et al.*, 2020). When integrated with constructivist approaches, technology helps learners visualise environmental processes, such as the water cycle or deforestation, and understand their real-world impacts.

Environmental awareness is not limited to understanding facts but includes developing the capacity to make informed choices and take meaningful action. This broader view aligns with the principles of Education for Sustainable Development (ESD), which promotes critical thinking, participation, and responsibility as essential components of environmental learning (Wals, 2022). Thus, environmental awareness in the Foundation Phase is about nurturing not only knowledge but also positive environmental attitudes and behaviours.

Therefore, environmental awareness is a multidimensional concept that integrates knowledge, values, and actions aimed at environmental protection. In early education, promoting environmental awareness lays the groundwork for future environmentally responsible citizens who can contribute to sustainable development.

5. Literature Review

The integration of technology in early childhood education has transformed how environmental education is delivered, offering new ways to engage young learners. This literature review explores the benefits, challenges, and teacher perceptions of using technology to support environmental awareness in the Foundation Phase.

5.1. Integration of technology in Early Childhood Education

The integration of technology in early childhood education has gained attention as teachers seek innovative ways to enhance learning experiences. Research suggests that technology, when used appropriately, can support the development of cognitive, social, and environmental understanding in young learners (Neumann, 2019). Tools such as interactive whiteboards, educational applications, digital storytelling, and multimedia presentations provide engaging opportunities for learners to explore concepts in dynamic and visually rich ways. These tools can also support differentiated instruction and inclusive education by accommodating diverse learning styles and needs.

Despite its potential, the effective integration of technology in early childhood classrooms faces numerous challenges. One significant barrier is the lack of access to adequate technological infrastructure, particularly in under-resourced schools. Teachers often struggle with outdated equipment, unreliable internet connections, and limited technical support (Chikodzi, 2021). Many early childhood teachers report insufficient training in using technology for pedagogical purposes, which affects their confidence and willingness to implement digital tools in the classroom (Donohue and Schomburg, 2020).

Another concern is the misconception that young children may not benefit from technology-based learning, leading some teachers to rely solely on traditional methods. However, recent studies show that when guided by developmentally appropriate practices, technology can enhance inquiry-based learning and environmental awareness. For example,

children who use digital simulations or watch videos on nature and sustainability demonstrate increased curiosity and engagement with environmental topics (Siraj-Blatchford *et al.,* 2021). These experiences not only foster conceptual understanding but also encourage positive attitudes toward the environment.

Integrating technology in early childhood education holds promise for enriching environmental education. However, successful implementation depends on addressing structural challenges such as resource availability and professional development, ensuring that teachers can effectively use digital tools to support young learners' environmental awareness.

5.2. Environmental Education in the Foundation Phase

Environmental Education (EE) in the Foundation Phase is vital for nurturing environmental consciousness and promoting sustainable habits from an early age. Young children are at a formative stage where values, attitudes, and behaviours are shaped, making early education a strategic platform for instilling respect for nature and a sense of environmental responsibility (Davis, 2020). EE at this level encourages learners to explore, observe, and reflect on their interactions with the natural world, thereby fostering critical thinking and problem-solving skills related to sustainability.

Despite its importance, the implementation of EE in the Foundation Phase is often inconsistent and superficial. Many schools treat environmental content as an add-on rather than integrating it meaningfully across the curriculum (Mnguni and Abrie, 2019). Teachers may struggle to align EE with prescribed learning outcomes or lack clarity on how to embed environmental themes into daily classroom activities. This results in fragmented exposure to environmental issues, limiting learners' opportunities to build a coherent understanding of sustainability.

One contributing factor is the limited training and professional development opportunities available for teachers in EE. Without a strong background in environmental issues and pedagogical strategies, teachers may lack confidence in delivering content effectively (Lotz-Sisitka *et al.*, 2021). Teaching materials and resources that support age-appropriate EE are often scarce, particularly in under-resourced schools. These gaps affect not only the depth of EE delivery but also the ability to link environmental knowledge with practical, real-world applications.

Research also shows that EE in the Foundation Phase is more impactful when it involves experiential and place-based learning, such as nature walks, gardening, and recycling projects (Boeve-de Pauw *et al.,* 2022). Such activities engage learners emotionally and physically, making learning more meaningful and memorable. However, logistical and safety concerns, coupled with rigid curricular demands, often prevent these approaches from being widely adopted.

To strengthen EE in the Foundation Phase, there is a need for better teacher support, resource provision, and curriculum integration. A more holistic and practical approach will not only enhance learners' understanding of environmental issues but also cultivate lifelong sustainable practices.

5.3. Teachers' Perceptions and Attitudes Toward Technology

Teachers' perceptions and attitudes play a critical role in determining how effectively technology is integrated into classroom practices. When teachers view technology as beneficial to teaching and learning, they are more likely to adopt and utilise digital tools confidently and creatively (Hatlevik and Hatlevik, 2020). Positive attitudes toward technology often result in increased motivation to experiment with new methods, promote learner engagement, and improve instructional quality.

In early childhood education, however, perceptions vary widely. Some Foundation Phase teachers embrace technology as a tool for enriching learning environments, while others express concerns about its appropriateness and effectiveness for young learners (Neumann, 2020). These mixed attitudes are shaped by factors such as prior exposure to digital tools, professional development opportunities, and institutional support. Teachers who feel inadequately trained or unsupported may resist incorporating technology, regardless of its potential benefits.

Studies suggest that confidence in using technology, often referred to as technological self-efficacy, is a key determinant of integration (Koehler *et al.,* 2019). Teachers who believe in their ability to effectively use digital tools are more likely to incorporate them into their pedagogical practices. Conversely, a lack of confidence may result in minimal or superficial use of technology, which does not fully exploit its interactive and learner-centred capabilities.

Cultural and contextual factors also shape teachers' attitudes. In many South African classrooms, particularly in under-resourced schools, limited access to functional technological infrastructure can lead to frustration and scepticism about the value of digital learning (Naidoo and Bhorat, 2021). These structural limitations may reinforce negative attitudes, even among teachers who are theoretically open to integrating technology.

Understanding teachers' perceptions is therefore essential for the successful implementation of technology-enhanced education. Addressing their concerns through ongoing training, access to resources, and peer support networks can foster more positive attitudes and better integration outcomes.

5.4. Challenges in Implementing Technology-based Environmental Education (EE)

Despite the recognised benefits of using technology in education, several barriers hinder its effective integration in environmental education (EE), particularly in the Foundation Phase. One major challenge is the lack of sufficient teacher training. Many teachers do not receive adequate professional development focused on using technology for EE, resulting in low confidence and limited pedagogical strategies for integrating digital tools meaningfully into their teaching (Tse *et al.*, 2021). Without targeted training, technology use often remains superficial and fails to support the development of environmental awareness effectively.

Resource constraints also pose significant limitations. In many South African schools, especially those in under-resourced communities, access to essential technological infrastructure such as tablets, internet connectivity, and interactive whiteboards is limited or inconsistent (Naidoo and Bhorat, 2021). These resource deficits widen the digital divide and make it difficult for teachers to implement technology-based EE lessons that require multimedia tools, simulations, or online learning platforms.

Curriculum constraints further complicate the integration of technology into EE. While the South African Curriculum and Assessment Policy Statement (CAPS) emphasises the inclusion of EE across subjects, it does not always provide explicit guidelines or time allocations for its implementation in the Foundation Phase (Govender and Hugo, 2020). This often leads teachers to prioritise core literacy and numeracy outcomes over environmental content, leaving little room for the meaningful use of technology in EE.

There is a concern about age-appropriateness and screen time when using technology with young children. Some teachers and parents worry that digital tools might not align with developmentally appropriate practices or that excessive use could negatively impact children's social and cognitive development (Neumann, 2020). This scepticism may lead to resistance or caution in adopting technology-based EE, even where resources are available.

To address these challenges, there is a need for well-structured training programs, increased investment in digital infrastructure, and clearer curriculum guidance to support teachers in effectively integrating technology into environmental education for young learners.

5.5. Effective Technological Tools for Environmental Education (EE)

The integration of effective technological tools into Environmental Education (EE) offers new and engaging ways to foster environmental awareness in young learners. Interactive applications, multimedia resources, and virtual simulations have shown considerable promise in supporting children's understanding of ecological concepts. These tools not only provide visual and experiential learning but also allow learners to engage with abstract environmental issues in developmentally appropriate ways.

Interactive educational applications tailored for young children often include games and storytelling elements that teach sustainability concepts, such as recycling, water conservation, and biodiversity. According to Alldred and Cullen (2020), apps that incorporate visual storytelling and problem-solving tasks enhance children's environmental knowledge and encourage pro-environmental behaviours. By simulating real-life environmental scenarios, these applications make learning both enjoyable and meaningful for early learners.

Multimedia resources, including animated videos, songs, and e-books, are also widely used to enrich EE in the Foundation Phase. These resources provide multimodal content that appeals to young children's sensory engagement and learning styles. Neumann and Neumann (2021) found that children exposed to multimedia materials demonstrated improved comprehension of environmental topics, such as the importance of trees and the impact of pollution.

Virtual simulations and digital games offer immersive learning environments where children can explore natural ecosystems, experiment with environmental choices, and observe their outcomes. These tools promote systems thinking and ecological literacy. Research by Chien *et al.* (2019) highlights how digital simulations in early education help children visualise complex processes like the water cycle or climate change in simplified formats suited to their cognitive levels.

Augmented reality (AR) applications are emerging as effective tools in early EE by blending real-world experiences with virtual content. These tools allow children to engage with their physical environment while receiving digital

information layered onto real-world objects (Barma *et al.*, 2021). For instance, scanning a leaf or a tree using an AR app might present the learner with information about plant growth, photosynthesis, or habitat roles, making learning contextual and memorable.

Overall, when thoughtfully selected and used alongside teacher guidance, technological tools can significantly enhance environmental learning in early childhood by making it interactive, engaging, and age-appropriate.

While technology offers meaningful opportunities for enhancing environmental education, its effective use in the Foundation Phase depends on teacher support, infrastructure, and curriculum alignment. Addressing these factors can promote more impactful and inclusive learning experiences for young children.

6. Methodology

The study adopts an interpretivist paradigm to understand and interpret the experiences and perceptions of Foundation Phase teachers regarding the integration of technology in environmental education (EE). This approach is well-suited for exploring the subjective meanings and complex realities experienced by teachers in their teaching contexts (Creswell and Poth, 2018). A qualitative case study design was chosen to enable an in-depth exploration of how technology is employed for EE in a specific real-world setting, allowing the researcher to generate rich, contextual insights (Yin, 2018).

Data were collected through semi-structured interviews and classroom observations, which allowed for flexibility while maintaining a focus on the study's core themes. This combination of methods provided both spoken narratives and practical evidence of classroom practices, offering a holistic understanding of the phenomena under study (Merriam and Tisdell, 2016). The study targeted Foundation Phase teachers working in suburban schools within the Vhembe District of Limpopo Province, South Africa. A purposive sampling strategy was employed to select ten participants who possessed relevant experience and demonstrated an interest in EE and the use of educational technology.

Thematic analysis was used to examine the data, following Braun and Clarke's (2019) framework for identifying, analysing, and reporting patterns across the dataset. This method enabled the researcher to uncover themes that reflect teachers' challenges, strategies, and perceptions related to technology-based EE. Delimiting the study to urban schools means that the findings may not be generalizable to rural or peri-urban contexts, where access to technology and support structures may differ significantly.

Trustworthiness was ensured through methodological triangulation, combining interviews and observations, as well as member checking, where participants reviewed the findings to confirm their accuracy. An audit trail documenting decisions throughout the research process further enhanced transparency and credibility. Ethical considerations were rigorously upheld, including obtaining informed consent from participants, assuring confidentiality, and complying with institutional ethical standards to protect participants' rights and well-being throughout the study.

7. Presentation of Findings and Discussion

This section presents and discusses the key findings of the study, which aimed to evaluate how Foundation Phase teachers use technological processes and resources to promote environmental awareness. The findings are organised into four main themes derived from the data, highlighting current practices, perceived benefits, challenges, and the impact on learner outcomes.

7.1. Theme 1: Current use of Technology in Environmental Education (EE)

Findings from the semi-structured interviews and classroom observations revealed that Foundation Phase teachers in suburban schools of Vhembe District primarily use basic technological tools such as videos, pictures, and PowerPoint presentations to introduce environmental topics. These tools are mostly used to supplement teaching by providing visual context and stimulating interest in environmental content.

One participant noted, *"I usually show short videos about pollution or recycling so that learners can see real-life examples. They enjoy the visuals, and it helps them remember what we discussed."* This comment reflects a common practice among participants, where digital media is used as a support mechanism rather than as a platform for interactive or learner-driven exploration. Another teacher shared, *"I use images and slides to teach about nature, like animals and trees. The children relate better when they can see things instead of just hearing about them."*

This reliance on passive technological tools indicates a limited integration of more dynamic or constructivist-aligned digital resources, such as simulations or interactive games. According to Constructivist Learning Theory, learners construct knowledge actively through experiences that are meaningful and contextually relevant. The teachers' current

use of videos and images aligns partially with this theory, especially in creating relevance and activating prior knowledge, but falls short in engaging learners in constructing their own understanding through exploration or problem-solving.

The constructivist emphasis on active participation suggests a need for more student-centred technological tools in EE. For example, interactive environmental games or virtual field trips could provide opportunities for learners to engage in inquiry-based learning, aligning more closely with the theory's principles. One teacher acknowledged this gap: *"I wish we had access to those interactive programs or games that let children explore forests or oceans. It would make learning more exciting and hands-on."*

This finding supports previous literature, which highlights that while teachers recognise the potential of technology in EE, the actual classroom use is often limited to teacher-directed content delivery (Naidoo and Bhorat, 2021). It also underscores the importance of professional development and resource support to shift from passive consumption to active construction of knowledge through technology.

The observed practices show that although teachers are making efforts to integrate digital tools, these efforts are constrained by a lack of training and access to diverse resources, reaffirming the relevance of the constructivist call for learner-centred environments (Tse *et al*., 2021). As Neumann (2020) argues, meaningful integration of technology in early childhood settings requires not just access but also pedagogical strategies that promote exploration, experimentation, and reflection, which are key aspects of constructivist learning.

While teachers in this study use technology to introduce environmental concepts effectively, their practices remain mostly transmissive rather than transformative. To deepen learners' environmental awareness in alignment with Constructivist Learning Theory, future efforts should focus on equipping teachers with both the tools and strategies necessary for fostering more interactive, inquiry-based technological experiences.

7.2. Theme 2: Perceived Benefits of Technology Integration

Findings from the interviews and classroom observations reveal that Foundation Phase teachers perceive significant benefits in using technology to support Environmental Education (EE). Teachers consistently highlighted that when technology is integrated effectively, it enhances learner engagement and improves comprehension of environmental concepts. This aligns with the principles of Constructivist Learning Theory, which posits that learners construct knowledge more effectively when they are actively engaged in the learning process through relevant and meaningful experiences (Fosnot, 2013).

One participant remarked, *"When I show a video about how pollution affects the ocean, the learners become curious and start asking questions. They're more attentive than when I just explain it on the board."* This comment illustrates how visual and interactive technologies stimulate interest and foster a deeper cognitive connection to the topic. Another teacher observed, *"Using tablets for interactive quizzes or games helps them remember things better. They feel like they're playing, but they are also learning."* This supports the idea that technology, when used as a tool for exploration and participation, enhances motivation and retention, key elements in constructivist classrooms.

Teachers also noted that digital tools help bridge the gap between abstract environmental concepts and learners' real-world experiences. For instance, one participant shared, *"It's hard to explain deforestation to six-year-olds, but when they watch a short animation, they start to understand the consequences. It becomes real to them."* These examples indicate that technology can mediate understanding by making complex issues more accessible and relatable to young learners. This process of making meaning through interaction and context is at the heart of the constructivist approach to education.

Observations during technology-integrated lessons confirmed that learners were more engaged, participated actively, and displayed better recall of environmental terms and practices compared to lessons delivered through traditional methods. This affirms studies such as Neumann (2020), who found that digital technologies support early learners in constructing knowledge more effectively when used in developmentally appropriate ways. Govender and Hugo (2020) emphasise that the use of multimedia and digital storytelling in EE can enrich the learning environment and promote a deeper understanding of sustainability issues.

However, it is important to note that while the perceived benefits are evident, the success of such integration heavily depends on the teacher's ability to select and use appropriate digital tools. Constructivist learning environments require thoughtful design and intentional use of resources that encourage inquiry, critical thinking, and problem-solving (Jonassen and Land, 2019). Thus, while technology has great potential, its effectiveness in EE is closely linked to how it is implemented pedagogically.

Teachers recognise the value of technology in enhancing environmental learning by increasing engagement and improving understanding. These benefits, as observed in this study, align well with Constructivist Learning Theory, reinforcing the importance of active, experiential learning supported by well-integrated digital tools.

7.3. Theme 3: Challenges Faced by Teachers

While participants acknowledged the potential benefits of integrating technology into Environmental Education (EE), they also identified several significant challenges that hinder effective implementation. These challenges have limited access to advanced technology, a lack of training, and restrictive curriculum demands, which were consistently cited across interviews and observed in classroom practices. From a constructivist perspective, these barriers directly impact teachers' ability to create learner-centered environments where knowledge construction is supported through interactive and context-rich digital experiences (Fosnot, 2013).

One participant expressed frustration with limited resources: *"We only have one projector and it's shared among five teachers. Sometimes I plan a digital lesson, but I have to cancel because the equipment is not available."* This reflects the infrastructural disparities that many South African schools, particularly those in suburban or under-resourced areas, face. Access to technology is foundational to creating constructivist learning settings, where learners can engage in authentic exploration and active knowledge-building (Jonassen and Land, 2019).

A second major challenge was insufficient professional development. Several teachers reported not having received adequate training on how to effectively use technology for EE. One teacher noted, *"We are expected to use technology, but no one shows us how to use it for environmental lessons. I just end up using it the same way I teach other subjects."* Without targeted training, teachers often resort to surface-level use of technology, which undermines its potential to support inquiry-based, learner-centred pedagogy which is a key tenet of Constructivist Learning Theory. As noted by Msimanga and Mahlangu (2021), professional development that is both relevant and ongoing is essential for fostering teachers' confidence and pedagogical innovation in using educational technologies.

Time constraints within the curriculum further complicate efforts to integrate technology into EE meaningfully. Teachers described the pressure to meet assessment deadlines and cover required content in literacy and numeracy, leaving minimal time for in-depth environmental topics. One teacher shared, *"There's hardly time for EE. We are so focused on reading and math that I just touch on environmental issues quickly, usually without using technology because it takes time to set up."* This challenge illustrates how structural and policy limitations can prevent teachers from implementing the kind of experiential, technology-enhanced learning that constructivist theory advocates.

Although teachers are aware of the educational value of technology, their ability to integrate it into EE is hindered by systemic constraints. From a constructivist lens, these barriers limit opportunities for learners to engage in meaningful, contextualized, and active learning experiences. Addressing these challenges requires targeted investment in digital infrastructure, comprehensive training programs, and curricular reforms that prioritise EE alongside core academic subjects.

7.4. Theme 4: Impact on Learner Outcomes

The integration of technology in Environmental Education (EE) has had a marked positive impact on student learning outcomes, as reflected in the teachers' observations and classroom interactions. Teachers reported that learners exposed to technology-enhanced EE demonstrated better retention of environmental concepts and exhibited increased enthusiasm for sustainability practices. This finding is in line with the principles of Constructivist Learning Theory, which suggests that learners construct knowledge more effectively when they are actively engaged in interactive, meaningful learning experiences that challenge their existing understanding (Piaget, 1952; Vygotsky, 1978).

One teacher remarked, *"When I use digital resources, the children remember the lessons longer. They keep talking about the videos we watched on recycling, and they start picking up trash outside the school."* This suggests that the interactive nature of technology, such as videos, simulations, and interactive games, enhances student engagement and fosters deeper cognitive processing of environmental topics. The vivid and relatable nature of multimedia resources can bridge the gap between abstract environmental issues and students' everyday experiences, leading to a stronger emotional connection and a more sustainable understanding (Jonassen, 1999). Constructivist theory highlights the importance of creating an environment in which learners can engage in authentic experiences that help them apply and reflect on their learning, and technology facilitates such opportunities.

Teachers also observed increased enthusiasm toward sustainability practices among learners who had access to technology-based EE. One participant explained, *"After we watched a video on how pollution affects animals, my*

students wanted to start a garden in the classroom to help the environment. They came up with the idea and started it themselves." This statement reflects the transformative impact of technology on learners' attitudes and behavior. Technology enables students to see the real-world implications of environmental issues, which, in turn, motivates them to take initiative and adopt sustainable practices. Such hands-on, self-directed projects align with the constructivist idea that learners are not passive recipients of knowledge but active participants in their learning processes (Fosnot, 2013).

Teachers noted that students were more enthusiastic and motivated to engage with environmental topics when technology was part of the lesson. One teacher shared, *"They love using the tablets to research animals or environmental issues. It's like they feel more connected to the topic when they can explore it on their own."* This aligns with the constructivist notion that learning is most effective when students have the opportunity to explore, discover, and build on their own knowledge, supported by technological tools that provide personalised, interactive experiences (Vygotsky, 1978).

The use of technology in EE not only improves the retention of environmental concepts among young learners but also fosters a sense of enthusiasm and personal responsibility toward sustainability. These outcomes highlight the importance of integrating technology to enhance the construction of knowledge, particularly in the context of environmental education, where real-world applications and active learning are crucial. Technology serves as a powerful tool for promoting constructivist learning, helping students to engage with, reflect on, and apply the knowledge they acquire.

The findings reveal that while teachers recognise the value of technology in enhancing environmental education, their efforts are often hindered by limited resources and support. Nonetheless, when technology is effectively integrated, it significantly improves learner engagement and understanding of environmental issues. These insights highlight the need for targeted support and training to fully realise the potential of technology in fostering environmental awareness in young learners.

8. Recommendations

Based on the findings of this study, several recommendations can be made to improve the integration of technology into Environmental Education (EE) in the Foundation Phase. One key recommendation is the implementation of comprehensive professional development programs specifically focused on equipping teachers with the skills and knowledge necessary to integrate technology into their EE practices. These programs should provide teachers with hands-on training on how to effectively use digital tools and multimedia resources to support environmental learning. This would enhance their confidence and competence in using technology in ways that align with pedagogical best practices. Such professional development should be ongoing, allowing teachers to continually update their skills and stay informed about new technological advancements that could benefit EE.

It is essential to allocate adequate resources to ensure that classrooms are equipped with the necessary technological tools and support materials for effective EE delivery. Many schools, especially those in under-resourced areas, struggle with limited access to devices such as tablets, interactive whiteboards, and reliable internet connections. To overcome these challenges, governments and educational stakeholders must prioritise funding and support for infrastructure development in schools. This would help bridge the digital divide and provide all teachers and students with equal access to technology that can enhance the learning experience. Providing teachers with access to ready-to-use digital resources, such as environmental education apps, videos, and simulations, would make it easier for them to implement technology effectively in their classrooms.

To support these recommendations, it is also crucial that educational policies emphasise the importance of integrating technology in EE and provide clear guidelines on how it can be incorporated into the curriculum. By ensuring that both teachers and students have the appropriate training, resources, and support, we can maximise the benefits of technology in environmental education and foster a generation of learners who are not only knowledgeable about environmental issues but also empowered to take action in their communities.

9. Conclusion

The integration of technology into environmental education (EE) in the Foundation Phase presents a promising approach to fostering early environmental consciousness among young learners. As the study highlights, using technological tools such as videos, simulations, and interactive applications can significantly enhance the engagement of students

with environmental topics, helping them better understand and retain key concepts related to sustainability and the natural world. Through these technologies, learners are not only exposed to environmental issues but also provided with opportunities to engage actively in problem-solving, exploration, and critical thinking, all of which are central to the development of environmental awareness.

However, the realisation of this potential is contingent upon addressing several key challenges. Resource availability remains a significant barrier in many schools, particularly in under-resourced areas where access to technology and internet connectivity is limited. Without adequate infrastructure, the integration of technology into the curriculum remains superficial and ineffective. Teacher preparedness is another crucial factor that can hinder the successful implementation of technology-based EE. Many teachers lack the necessary training and support to confidently and competently incorporate digital tools into their teaching practices. This gap in professional development can result in missed opportunities to use technology in ways that align with constructivist principles, which emphasise active learning and student engagement.

To fully realise the potential of technology in promoting environmental education, it is essential to prioritise the provision of resources, professional development, and ongoing support for teachers. Educational stakeholders must work together to ensure that schools are equipped with the necessary tools and that teachers receive the training they need to effectively integrate technology into their teaching practices. Only by addressing these challenges can we create an environment where young learners are empowered with the knowledge, skills, and values needed to become responsible, environmentally conscious citizens.

While the integration of technology into environmental education in the Foundation Phase holds great promise, it is crucial to recognise the need for strategic investment in resources and teacher development. By overcoming these challenges, we can support the development of a generation that is not only aware of environmental issues but also motivated to take action in preserving and improving the environment for future generations.

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