

**Stewards of Tomorrow:
Best Practices for Transformative
Environmental Education
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Table of Contents

Abstract	2
Introduction	2
Overview of Environmental Education (EE)	2
The Urgency of EE Implementation	5
Curricula	7
Background Context	7
Logistics	7
Methodologies	8
Interdisciplinary Approaches	8
Advocacy	9
Traditional Versus Non-Traditional Approaches	11
Challenges	13
The Role of Educators	14
Background Context	14
Teachers As Activists	15
Educator-Scientist Collaboration	15
Professional Development	16
Outcomes and Recommendations	19
Concluding Thoughts	23
Works Cited	25

Abstract

This paper examines effective and comprehensive strategies for promoting environmental education (EE). It begins by emphasizing the critical role of intrinsic motivation alongside collective engagement for EE best practices. Following this exploration, a pervasive sense of urgency surrounding environmental issues is discussed that can spur EE participants to immediate action. Upon addressing these dimensions, this paper offers insights into how EE curricula can be effectively implemented. In the process, it analyzes key background information about EE curricula, logistics, educational methodologies, interdisciplinary modalities, advocacy, traditional as opposed to non-traditional approaches, and related challenges. In turn, this paper then discusses the critical roles that educators play when implementing effective EE curricula. This section includes the importance of teachers understanding themselves as environmental activists and engaging in effective EE-rooted professional development initiatives. Based on all of the aforementioned insights, a number of outcomes and recommendations are revealed that promote transformative EE and forge a lasting global culture of environmental stewardship.

Introduction

Overview of Environmental Education

The Environmental Protection Agency (EPA) characterizes environmental stewardship as “...the responsibility for environmental quality shared by all those whose actions affect the environment” (EPA Staff). This paper explores one manifestation of such stewardship in the form of environmental education (EE). Effective EE is intricately linked to positive behavior change. Throughout this bidirectional process, environmental educators can consider implementing a holistic curriculum that focuses on climate science in tandem with environmental stewardship. This dual approach not only equips students with requisite content, but also fosters their motivation to create change and become stewards of tomorrow.

In many contemporary K-12 schools, however, EE predominantly emphasizes basic practices such as recycling. While such focused behaviors are well

intentioned, they may not sufficiently engender a more widespread sense of civic responsibility for the environment. These limited initiatives tend to neglect more impactful paradigms including fostering a shift in values towards sustainable development (Walker et al.). To this end, The Great Smoky Mountains Institute at Tremont (The GSMIT) asserts that EE should encompass the following four vital factors: (1) experiential engagement with nature, (2) understanding biodiversity, (3) fostering stewardship, and (4) developing life skills (Jenkins). When incorporated into EE curricula, these elements can deepen students' awareness of how their individual actions can enrich the environment.

Engaging with nature through hands-on programming tends to encourage students to value environmental conservation. Coupled with discussions on life skills and stewardship, this strategy fosters environmental compassion and can lead to related, positive behaviors (Walker et al.). In fact, when implemented at The GSMIT, these strategies "...revealed significant positive short-term effects and retention of gains in environmental stewardship and awareness 3-months after the student experience" (Walker et al.). This observation suggests that EE can be effective when it incorporates the aforementioned characteristics.

When developing curricula for EE, it is imperative to include instruction on the multiplicity of Earth's systems, biodiversity, and the capacity of humans to irrevocably alter these natural processes. By learning about factors such as human-caused pollution and excessive fishing (among other related topics of concern) students can discover that their actions may have a direct impact on the environment. In the process, they may come to a greater understanding that people and nature are interdependent. Indeed, "...human well-being is tied to environmental quality and...humans and the systems created by humans – societies, political systems, economies, religions, cultures, technologies – impact, and are impacted by, the total environment" (Simmons). Adopting lifestyle changes such as living without a car and consuming a vegetarian diet can honor this symbiotic relationship by significantly reducing carbon dioxide emissions (Thor and Karlsudd). Realizations such as this can inspire students to modify their behaviors in positive ways that contribute to environmental preservation.

Furthermore, EE should guide students towards embodying environmental stewardship. Environmental stewardship entails not merely protecting these

natural systems, but also learning about them in holistic ways (Walker et al.). From this lens, stewardship promotes the fact that humans are global citizens with an obligation to conserve their planet. “Becoming an environmental citizen means one takes upon oneself the challenge as an individual of making changes in one’s daily life in favor of a better environment” (Thor and Karlsudd). With this definition in mind, a related experiment was designed to test a method of teaching environmental stewardship to elementary school children. The experiment incentivized sustainable behaviors by granting tokens to the children who completed environmental-oriented tasks. For instance, the peddler token encouraged students to bike to school and spare fossil fuel emissions, while the chomper token urged them to limit food waste (Thor and Karlsudd).

Despite the surface-level gains derived from this experiment, several EE teachers were somewhat skeptical of its seemingly positive outcomes. They questioned the extent to which the students’ behaviors derived from a genuine concern about the environment, as opposed to being solely motivated by acquiring tokens. From this vantage point, the experiment could prioritize a superficial reward system over cultivating an authentic duty towards the planet beyond short-term gains. The experiment thereby resulted in a valuable lesson that can be applied to future forays into EE. Going forward, the focal point of EE should be to nurture an intrinsic connection with the natural world and motivate students to independently seek environmental solutions. In fact, when students gain hands-on experience by learning in nature, they are more likely to feel connected to the environment – and form a sense of responsibility to protect it.

To this end, The GSMIT found that the most meaningful component of an outdoor, EE experience was the development of curiosity for the natural world and a related sense of discovery (Walker et al.). When students have the opportunity to become intrinsically fascinated by nature, they are more likely to develop a profoundly personal connection with natural systems that is vital to environmental stewardship. In turn, educators can empower students to act on their curiosity and appreciation for protecting the environment. The value of “protection” effectively primes people to recognize environmental conservation as an essential and universally shared responsibility (Moyer et al.). It is important to note, however, that students should also be discouraged from adopting unhelpful misconceptions about safeguarding the environment. One of these problematic notions is that nature will

fix itself (Moyer et al.). Once the aforementioned values regarding protection have been established alongside curiosity for the natural world, students can more effectively advocate for the environment and limit environmentally disruptive behaviors.

Another key component of EE is to cultivate an environmentally literate populace equipped with advanced capabilities for addressing related challenges (Simmons). That is why it is important for students to not only feel committed to environmental stewardship but also to possess practical skills that can further pro-environmental agendas. These skills can include community organizing, public speaking, and writing. Environmental educators have a duty to guide students in applying such skills in ways that address issues that negatively impact the environment (Ardoin et al.). Furthermore, incorporating advocacy training within EE is crucial. This empowers students with confidence to champion environmentalist causes on local and national scales (Thor and Karlsudd).

The aforementioned perspectives suggest that EE should foster civic engagement. In so doing, students can be equipped with tools to implement sustainable environmental transformations. Throughout this process, it is vital to embed EE and related advocacy within core curricula. This step can help ensure that students gain a comprehensive understanding of environmentalism. This approach is thereby pivotal for fostering sustainable, life-long practices to safeguard the future of our planet.

The Urgency of EE Implementation

Unfortunately, there is a tendency to overlook EE as an essential strategy to combating important environmental issues such as climate change. The United Nations Educational, Scientific, and Cultural Organization (UNESCO) found that “...only 21 percent of the new or updated plans submitted by 95 countries as their Paris Agreement goals mentioned climate change education; none of them presented it as a climate strategy” (Cho). This suggests that the power of EE can be underestimated. In addition, there is much debate over the effectiveness of current EE programming. This can lead skeptical school administrators to continue not making EE available to students. In fact, when graded by the National Center for Science Education and the Texas Freedom Network Education Fund, the majority of

states in the U.S. scored a C+ or lower on the assessment for climate education – with 10 states receiving D's. As will be discussed later in this paper, a more well-rounded EE experience that exposes students to hands-on activities and outdoor explorations can begin to address this problem (University of Rochester Staff).

Another explanation for failed EE implementation is regional politics. In many parts of the U.S., certain individuals are more likely to disbelieve the reality of the climate crisis. The quality of EE in these regions can therefore vary. Although EE-related issues such as climate change are urgent, some people view them as controversial and are hesitant to engage in them. Indeed, states that are not politically aligned with pro-climate action typically invest fewer resources into EE (University of Rochester Staff). Consequently, EE has failed to become widely adopted. This can create a sense of climate anxiety around unpreparedness for the future (Cho).

Climate anxiety is typically characterized by feelings of distress and hopelessness about climate change or a perceived impact of it (Pihkala). To date, there has been over a 565 percent increase in searches for the phrase “climate anxiety” (Tamez-Robledo). One reason for this sense of anxiety is due to the United Nations’ assertion that “[u]nless action is taken soon, some major cities will be under water.” In a study conducted on young people (aged 16-25) across ten countries, scholars attempted to assess general opinions and feelings about climate change and government responses. The study reported that more than 50% of students felt sad, anxious, angry, powerless, helpless, and/or guilty about climate change, and 75% said that “...they think the future is frightening” (Hickman et al.). This is compared to only 7% of American adults who experience such anxiety, a Yale study found (Uppalapati et al.). It is not unreasonable that young people feel significantly more climate anxiety than older generations. “Climate change has important implications for the health and futures of children and young people, yet they have little power to limit its harm, making them vulnerable to climate anxiety” (Hickman et al.).

A common, related issue is that young people are likely to blame authority figures for climate change and adopt a false impression that there is limited opportunity to engage in environmental activism outside of protesting. In light of

this, the potential for EE to empower youth to make a difference is especially important. By providing youth with the means to make an impact on their own communities, EE can reduce climate anxiety. However, a curriculum that is overly focussed on urgency and disaster can fuel debilitating anxiety and may not be sustainable. Instead, EE should seek to inspire students to take informed, collective action toward significant and achievable goals.

Curricula

Background Context

Effective EE curricular approaches nurture environmental values and actions across age groups in a collaborative environment (Ardoin et al.). Furthermore, EE curricular content reflects a journey that unfolds throughout an individual's life. This continuous process ensures that pro-environmental initiatives permeate multiple levels of one's education and society at large (Thor and Karlsudd). At its best, EE curricula cultivates a culture of responsibility and sustained engagement with environmental issues.

Logistics

It is vital to finance robust, collaborative, and long-lasting partnerships in the logistical process of EE curriculum development. These attributes can ensure that stakeholders are well-equipped with the content knowledge to deliver and learn integrated EE content effectively. Wheeler et al. underscore the importance of financial support for alliances between colleges and school districts that fuel environmental sustainability.

Furthermore, these curricula can range from single-day initiatives conducted by external institution members to multi-year endeavors. In turn, complex logistical efforts are often required to prepare teachers and students for thorough EE engagement across different timelines. It is important to note that Wheeler et al. emphasize the superiority of long-term curricula over their short-term counterparts. This outlook suggests that sustained engagement yields a more profound impact on students and educators. To this end, Wheeler et al. advocate for prioritizing extended educational programs that integrate environmental and

sustainability concepts into national curricula.

Methodologies

The comprehensive methodologies of EE curricula span an array of topics including, but not limited to, habitat protection, water quality, energy conservation, and climate change. When combined, these topics address the urgent need for a complete understanding of environmental issues (Ardoin et al.). The richness of EE curricula lies not only in their subject matter but also in their pedagogical approaches. Monroe et al. note that some of the most effective EE techniques aim to make environmental concepts personally relevant to learners. The emphasis on personal relevance in EE curricula is crucial in fostering a deeper understanding of environmental challenges. It also encourages learners to translate EE content knowledge into action.

Furthermore, the incorporation of educational methodologies such as gamification, digital activities, and educational drama represents a significant evolution in teaching practices. Thor and Karlsudd hold that these strategies underscore the importance of a pluralistic approach to EE in which students' reflections and personal experiences are paramount. For example, EE-based theater has the potential to stimulate students to process new ideas in an active setting. This aligns with broader curricular goals of preparing students to engage with complex environmental issues in creative ways. Moreover, the use of role-plays and simulations to understand diverse perspectives about EE exemplify the potential of interactive learning experiences to deepen students' comprehension (Monroe et al.). Yet Edge Research Staff points out that challenges remain to ensure that EE content is integrated across curricula and not isolated within science subjects.

Interdisciplinary Approaches

It is also critical to adopt an interdisciplinary approach to EE curricula. Reid et al. demonstrate that EE-related issues transcend the scientific community to encompass the humanities, arts, social sciences, and broader society. Multidisciplinary engagement can also facilitate the process of meeting the United Nations' mandate to integrate EE into the curricula of all educational systems by

2025. Reid et al. emphasize the importance of fostering shared creative insights across academic subjects. This can help learners, teachers, and administrators implement comprehensive curricular integration. This collective vision is crucial for inspiring EE-rooted innovation across academic departments and bolstering environmental stewardship.

Another key component of interdisciplinary EE approaches entails embracing extracurricular activities and community engagement (Reid et al.). These aspects can include nature-based tourism and environmental community networking. As a whole, these additional outlets may offer a broader spectrum of learning opportunities. Numerous studies also found that these approaches tend to have a significant positive educational impact on children and adolescents (Reid et al.). Additionally, the establishment of partnerships with various stakeholders across different areas of expertise can enrich EE curricula. Ardoin et al. cite The Alaska Rural Systemic Initiative to exemplify this phenomenon. The multidisciplinary EE curriculum underlying this initiative integrates knowledge and practices from Native Americans. Such approaches have been shown to promote a deep understanding of environmental issues and thoroughly prepare students to engage with them.

Advocacy

Advancing pro-environmental behaviors is a critical goal of EE curriculum development. Unfortunately, students have often reported difficulty in perceiving the substantial impact that environmental issues have on their daily lives (Thor and Karlsudd). This disconnect underscores the need for EE curricula that bridge the gap between environmental concerns and personal relevance. Meyer's research supports the efficacy of such curricula that include promoting behaviors such as engaging in environmentally-friendly travel methods and reducing energy consumption. This perspective suggests that when individuals are informed and engaged through EE curricula, they can significantly contribute to environmental advocacy efforts through their daily choices.

In addition, EE curricula can also champion the active involvement of communities in conservation efforts. In fact, Wheeler et al. emphasize the symbiotic relationship between education, community engagement, and

environmental stewardship. When integrated into EE curricula, these efforts do not merely provide practical solutions to local environmental issues. They also foster a sense of empowerment among participants and fuel lasting pro-environmental behaviors (Cordero et al.).

Another way in which EE curricula can catalyze related advocacy is by instilling empathetic perspectives towards nature, in-depth knowledge about environmental issues, personal connection, and a sense of agency (Hungerford and Volk). The remarkable influence of this approach is evidenced by the outcomes that teachers and students have reported. Upon engaging with such advocacy-oriented EE curricula, these participants adopted various conservation actions such as recycling and purchasing energy-efficient appliances (Hungerford and Volk). These practical applications underscore the transformative potential of well-structured EE curricula in shaping sustainable behaviors.

Furthermore, the interrelationship between personal beliefs, experiences, and actions concerning environmental degradation plays a pivotal role in shaping advocacy efforts. Cordero et al. illuminate the significant influence of personal conviction and experiential learning on carbon emissions reduction advocacy. Individuals who perceive global warming as a direct threat to themselves or future generations exhibit a more substantial commitment to reducing their carbon footprint. This correlation is further evidenced by the notable difference in carbon emissions reductions between those who have personally felt the effects of global warming and those who have not. The former group reduced their emissions by an average of 3.7 tons of CO₂ per year, compared to 2.9 annual tons for the latter (Cordero et al.). This finding underscores the need for EE to foster a personal connection between its subject matter and participants.

The incorporation of environmental documentaries into EE curricula also fosters advocacy (Ahn). This approach results in significant learning gains among pre-service teachers. It suggests that visual and narrative elements can profoundly impact learners' engagement with climate issues (Monroe et al.). Similarly, an energy efficiency education program empowered students to not only adopt energy-conserving practices but also to influence their families' actions in this regard. This finding aligns with the fact that education should connect with learners' lives to be effective. In turn, people begin to recognize the ubiquity of

environmental degradation in daily decisions. This perspective can ultimately lead to active engagement and advocacy in related mitigation efforts.

When EE is presented with respect to broader societal contexts, it may also fuel advocacy. This is especially true regarding community health and lifestyle choices that impact the environment. For example, EE that links communal health with individual decisions related to climate change has been shown to result in robust advocacy initiatives (Moyer et al.). When EE focuses on healthy communities as a product of lifestyle choices, societal action around environmental issues often emerges.

By making EE personally relevant and actionable, individuals tend to feel empowered to contribute to related societal goals. This approach shows the transformative power of EE as a tool for environmental advocacy. It also reinforces the need for a concerted, society-wide effort to address environmental issues effectively. This type of EE not only fosters individual agency but also cultivates a generation of informed citizens equipped to tackle urgent environmental challenges.

Traditional Versus Non-Traditional Approaches

The typical structure of STEM curricula that is used in schools may not be effective for EE implementation. This is partly because such traditional approaches often fail to engage students and develop their profound appreciation for environmental causes. Indeed, sustainability, ecology, and citizen responsibility can be just as important as academic learning in this regard. This lens underscores the critical nature of a balanced approach that incorporates both STEM curricular content and hands-on learning (Walker et al.).

Unfortunately, EE is usually presented in ways that fall short of delivering a holistic and effective curriculum. This problem is primarily due to a failure to incorporate outdoor components into EE, which are essential for promoting a deeper and more tangible connection with the environment. In fact, this issue may originate from decades of STEM curricula which caters to standardized and state tests while neglecting real-world engagement.

When trying to fit EE into such a strict classroom structure, many schools often fail to address outdoor-based learning strategies. These schools tend to adopt a hierarchy in which learning that takes place outside the classroom is considered supplemental rather than essential. Thus, outdoor activities related to EE are more likely to be considered unnecessary and are discarded. In reality, a more “formal” style of EE implementation can undermine the fact that physical interaction with the environment tends to enhance student learning (Moyer et al.). In light of this realization, schools should be inclined to adopt a more “informal” approach. This type of curriculum can include goals that embrace nature-based settings.

The evolving paradigms of EE increasingly incorporate less traditional characteristics. These traits include conducting classes outdoors and engaging students in activities beyond conventional classroom settings. Fostering an engaged citizenry equipped to address the environmental and social challenges of our time necessitates the integration of field trips, hands-on science lessons, and other outdoor activities into EE curricula (Moyer et al.). These immersive experiences not only enrich participants’ interaction with their environment but also boost their eagerness to partake in proactive environmental stewardship. In studies that explore participants’ perceptions of EE, researchers have uncovered the significance of developing a personal connection with nature and the joy derived from outdoor experiences (Walker et al.). These findings suggest that students often derive a profound sense of educational value from engaging EE-based outdoor activities. “Just like a root system supplies nourishment to a plant to help it flourish, [outdoor] environmental education provides kids with enriching experiences and supportive relationships that foster lifelong stability and continual growth” (Moyer et al.).

Furthermore, many effective EE classes encourage students to participate in extracurricular activities to improve the environment. These initiatives can include, but are not limited to, tree planting, clean-up drives, and recycling campaigns. Many students find these outdoor activities to be engaging and positive experiences (Cho). This finding suggests that schools which provide opportunities for – and encourage – students to participate in environmental extracurricular activities can greatly advance the impact of EE.

While many teachers have expressed skepticism about this untraditional

style of learning, the value of school-promoted environmental community projects can be substantial. Some teachers claim that this strategy seems ineffective, as they assume that environmental lesson plans will only be of interest to students “...who are ‘outdoorsy,’ or who ‘love animals,’ leading to stereotypes about who environmental education would most benefit” (Moyer et al.). This perspective is not necessarily accurate since all students can benefit from EE-rooted outdoor initiatives in many ways – including the development of important social and leadership skills. These “...opportunities nurture growth in areas like self-efficacy, social and political awareness, and commitment to civic action, allowing them to blossom in adulthood” (Moyer et al.). Moreover, students can leverage these initiatives to showcase creativity and problem-solving skills as they work on projects that benefit the environment. These projects also strengthen bonds by allowing students to spend quality time with their peers and mentors in collaborative settings.

Overall, non-traditional approaches to EE can have a variety of immense benefits. By interacting with the environment, students can gain an understanding of how natural systems work in more direct and effective ways than through traditional classroom learning. This can foster a sense of active learning as opposed to passive knowledge regurgitation. Throughout this process, students are continually challenged to apply theoretical concepts to real-world problems. In turn, the lasting impact of such innovative approaches to EE can yield lifelong benefits that influence career choices and daily environmental sustainability habits. These significant benefits can ultimately transcend the traditional confines of EE in holistic and effective ways.

Challenges

There are a number of formidable challenges to implementing effective EE curricula. Many of these obstacles are rooted in systemic issues such as fatalism and the perceived robustness of nature’s resilience. These views can dampen enthusiasm for systemic reform and undermine the urgency of addressing environmental issues. Moyer et al. discuss the crippling effects of fatalism, which sows seeds of doubt about the capacity of education to drive meaningful change. This lens can stall efforts to support policies that fortify communities against climate-related adversities through targeted educational initiatives.

Another challenge is a general trend toward marginalizing EE within K-12 curricula. For example, UNESCO reports an overall lack of focus on climate change within educational policies on a global scale. Moreover, in the U.S., “...most middle- and high-school teachers incorporate only an hour or two of instruction about climate change over the course of an entire academic year. Thirty percent of teachers devoted less than an hour” (Larson). This finding reveals a disconcerting gap between the acknowledged importance of environmental themes and the depth of related engagement in educational settings. This discrepancy is further amplified by Edge Research Staff’s insights into common barriers faced by educators. These impediments often include a lack of formal EE curricula and a pervasive dearth of clarity about how to effectively present EE to students. In the U.S., for example, “...there is still no national consensus about the importance of climate education...Each state determines what its schools teach and this can vary greatly” (Cho). These challenges tend to significantly hamper the collective action essential for environmental stewardship.

The Role of Educators

Background Context

The growing consensus about the importance of EE reflects a shared concern among both educators and parents. For example, an overwhelming majority of teachers (86%) and parents (84%) throughout the U.S. support the inclusion of topics related to EE such as climate change in school curricula (Cho). This finding underscores the widespread recognition of EE as a critical issue that can impact the future well-being of humanity. It also highlights a collective understanding that EE can play a critical role in preparing younger generations to address environmental concerns.

Nevertheless, the discrepancy between growing support for EE and its actual implementation in schools by educators is problematic. This challenge is particularly true with respect to climate change education. Although school administrators generally acknowledge the need for climate change education, teachers’ overall confidence in addressing this topic with students tends to be comparably low (Edge Research Staff). In fact, the readiness of educators to teach

climate change is often hindered by a lack of preparation. Indeed, less than half of educators on a nationwide scale have reported feeling “prepared” to educate their students about this critical subject (Edge Research Staff). Some educators fear that focusing on climate change might undermine their standing and effectiveness. As a result, they may tend to avoid the topic altogether (Monroe et al.).

Teachers As Activists

Despite the aforementioned issues, there tends to be a widespread genuine concern among teachers who recognize the urgency of addressing environmental degradation. Moreover, students often initiate conversations with their teachers about climate change and anxieties about the future of the environment. This student interest can present an opportunity for educators to guide discussions in a way that fosters proactive engagement with this topic. In so doing, teachers can serve as powerful environmental activists.

In addition, many educators are hesitant to describe themselves as environmental activists. “This [is] due, in part, to their belief that society paints activists as extreme or radical” (Barrett and Campigotto). This was particularly true in the case of an educator named Smith. Smith held a rather extreme view of environmental activism. For example, Smith defined such activists as “the people ...who are chaining themselves to trees...” (Barrett and Campigotto). In contrast to an extreme understanding of activism, this paper adheres to a broader and more flexible definition of the term that more closely aligns with that of an educator named Diana. She expressed that an activist “live[s] for the cause’...she reflected on her lifestyle choices...[and] decided that ‘choosing to eat healthy and not litter, and being conscious of your decisions’ was not something she would have considered activism, but she now recognized it could be defined as such...” (Barrett and Campigotto). In turn, Diana’s personal environmental activism can translate into her classroom instruction and influence her students.

Educator-Scientist Collaboration

It can be advantageous for educators and scientists to work alongside each other when developing and implementing EE programs. As Monroe et al. observe, teachers who participated as collaborators with scientists in program creation

gained confidence in facilitating student exploration of EE. The educator-scientist partnership also ensures that content is both accurate and accessible. In turn, it enables educators to successfully guide students through complex environmental issues. This collaboration can ultimately result in a deeper appreciation among students for related subject matter.

EE programs that were created by collaborations between educators and scientists tend to have a track record of success. This is especially true when their projects pertain to climate change. According to Ardoin et al., these effective programs often focus on local issues or locally relevant dimensions of broader climate-related challenges. This approach helps ensure that the content is relevant to students. Furthermore, these programs empower students to engage with environmental issues directly from a science-driven perspective.

Ardoin et al. have further demonstrated that teacher-scientist collaboration can often bridge the gap between theoretical knowledge about EE and practical applications of such information. This phenomenon is illustrated by Riordan and Klein's account of teachers, scientists, and students engaging in book clubs to analyze texts about pressing environmental issues such as water scarcity and sustainability. Following their engagement with these texts, students embarked on fieldwork projects such as testing local water sources in collaboration with teachers and scientists. These projects eventually culminated in the creation of public service campaigns and demonstrated how teacher-scientist educational programs can translate into tangible environmental activism that enhances students' understanding of such critical issues. Overall, these findings suggest that synergy between educators and scientists can create a dynamic learning environment in which students actively participate in addressing environmental issues and become agents of change.

Professional Development

To improve the quality of EE, it is vital for teachers to engage in related and effective professional development initiatives. Riordan and Klein understand the essential characteristics of professional development in terms of emphasizing hands-on tasks, the importance of collaboration, and the connection of activities to student learning. This perspective also emphasizes the necessity of ongoing

support and coaching. Overall, this approach advocates for “...professional development that emphasizes active teaching and learning” (Riordan and Klein). This type of professional development is ultimately rooted in a commitment to engage teachers in the same manner that they are expected to engage their students.

Unfortunately, there are often significant issues in current EE-based professional development implementation. The observation that many teachers tend to be unprepared to engage in EE activities and use related instructional strategies are critical concerns (Simmons). These deficiencies underscore the need for professional development programs to not only focus on content knowledge but also on effective pedagogical skills. Simmons’ critique of pre-service EE programs illuminates these shortcomings. Their focus on outdoor and nature education – though important – frequently neglects teaching educators instructional strategies that can best disseminate such information to students in accessible ways. In response, Riordan and Klein’s model for professional development introduces a two-pronged approach. It endeavors to integrate an expert in environmental-related content as an instructional guide as well as a pedagogical specialist to foster effective teaching methods. The presence of these on-site coaches can provide ongoing support.

Another issue that must be addressed to foster effective professional development relates to the discomfort that many teachers may feel towards field investigations (Riordan and Klein). These educators’ sense of inadequacy is often rooted in their limited exposure to real-world EE experiences. This underscores the importance of experiential learning – both for students and teachers. It can thereby be helpful to advocate for professional development programs that offer teachers on-the-ground experience with field investigations and environmental studies. These experiences can build their confidence with respect to integrating EE into curricula and ultimately enrich students’ learning experiences.

In light of this need, Expeditionary Learning (EL) presents a blueprint for supporting teachers in bridging the gap between theoretical knowledge and practical application. By facilitating out-of-classroom initiatives, EL not only enhances the educational experience for students but also serves as a powerful form of professional development for teachers. This hands-on approach to learning

and teaching facilitates active engagement that can help bring EE subject matter to life for both teachers and students.

In the process, Riordan and Klein's observation that teachers oscillate between being students and educators during professional development experiences underscores the fluid nature of learning. This dual role facilitates deep engagement with science content and can help teachers directly apply their learning into their specific classroom contexts. By engaging teachers in experiences that mirror the ones that they are in the process of creating for their students, a deeper understanding of EE can be achieved. This approach encourages teachers to engage students in critical thinking about environmental issues. It also fosters a sense of responsibility and cultivates engaged citizens who are capable of making thoughtful decisions about environmental issues.

Moreover, Simmons highlights that it is pivotal for educators to continually access peers who have successfully integrated EE into their curricula. Such networking is crucial for sharing strategies and resources that can enhance teacher effectiveness. Furthermore, connecting educators-in-training with K-12 teachers who exemplify effective EE teaching practices can help ensure that the next generation of teachers is prepared to address critical environmental issues.

In addition, there are a number of ways for professional development programs to reinforce EE content in a subtle fashion. "Modeling sustainable practices, such as recycling, zero food waste, and weather data collection, and reflecting upon the experiences and activities, can impact students and connect them to larger issues with the environment" (Walker et al.). By embedding implicit instruction into daily routines, teachers can enhance students' scientific and environmental literacy with minimal impact on instructional time. This approach to professional development acknowledges that small, practical changes on a daily basis can contribute to larger environmental solutions.

It is vital to note that the aforementioned types of EE professional development are not static. Indeed, educators must be actively involved in the ongoing process of learning and adaptation. This allows for a flexible approach to teaching and assessment that can evolve in response to new content-based research as well as pedagogical strategies. By continually exploring and integrating

such cutting-edge approaches to professional development, an environment of continuous improvement and innovation can emerge.

Outcomes and Recommendations

When EE is effectively implemented, a number of positive outcomes arise. Indeed, “...there are multiple possible pro-environmental behaviors that can be nurtured by advocacy-driven environmental education” (Meyer). These behaviors range from daily conservation efforts to long-term sustainable practices. By fostering an understanding of environmental stewardship, EE empowers individuals to make informed decisions that benefit both the planet and society. Moreover, this educational approach inspires a sense of agency that enables people to become active participants in a global effort to mitigate environmental challenges.

Effective EE triggers a significant transformation in both daily habits and attitudes. In fact, a significant number of students who were exposed to EE self-reported such positive behaviors (Ardoin et al.). An evaluation of changes in participants’ pre- and post-EE behaviors demonstrates an increased engagement in environmentally-friendly practices such as turning off lights and reducing water waste. Remarkably, this shift was noted to persist for months following the participants’ EE exposure. Similarly, effective EE water conservation programming further reinforces these findings. As a result of such initiatives, high school students exhibited a higher frequency of recommended water conservation behaviors compared to their counterparts in schools without such programs (Ardoin et al.). These instances show the critical role that EE plays in fostering a proactive attitude towards conservation and sustainability.

EE can also yield a number of critical projects that contribute to ecological restoration and conservation. These actions tend to primarily focus on ameliorating degraded environmental conditions. The specific processes that are often implemented include reforestation efforts and the eradication of invasive species (Ardoin et al.). Many of these projects began as singular EE-related events such as participating in a beach cleanup or planting trees during Arbor Week. Yet they often evolved into ongoing endeavors.

One example of this process occurred when a group of students began an EE project to develop small tree nurseries. Over time, this initiative blossomed into planting over 5,000 native seedlings (Ardoïn et al.). This aided in the restoration of damaged land and fortified the natural buffer around a national park. Similarly, a different group of students who were involved in their school's EE curriculum conducted a thorough investigation of land use within their local watershed and uncovered multiple pollution sources. Their subsequent recommendations led to significant local government actions such as the construction of a salt storage shed designed to mitigate runoff into waterways (Ardoïn et al.).

In addition, there are a number of other community-based EE initiatives that led to habitat restoration. These projects entailed the rejuvenation of a natural wetland along with nearby rice paddies and revitalizing dragonfly ponds aimed at bolstering habitat preservation. Ardoïn et al. demonstrate that the outcomes of these programs include "...increases in improved habitat (e.g., more roosting sites)..." and the proliferation of waterfowl and butterflies. Through such well-structured EE programs, students are not only informed about the challenges facing their environment but are also empowered to help solve them.

Moreover, EE can play a pivotal role in enhancing community capacity-building initiatives. This phenomenon is often achieved through a variety of channels. They may include, but are not limited to, the fortification of relationships and communication among different stakeholder groups, amplifying community engagement in conservation efforts, the formation of local environmental groups, and the advancement of both formal and informal educators' skills. One example of an EE project that resulted in a notable degree of community cohesion occurred through a program targeted at the dairy-farming sector. This initiative not only yielded a deeper understanding among dairy farmers. In fact, it facilitated collaboration between the local shellfish industry and government entities as well. United by their mutual environmental goals, these groups engaged in joint community leadership towards sustainable natural resource management (Ardoïn et al.). This example underscores the ability of EE to empower various communities to take collective action towards enhancing their natural environments.

EE does not merely promote sustainable practices. Indeed, it also plays a crucial role in personal and professional development. Wheeler et al. note the positive effects of EE programs on participants' self-esteem and engagement levels. To this end, there is a significant correlation between EE and enhanced academic achievement, particularly in STEM-related subjects (Van de Wetering et al.). The reinforcement of STEM proficiency not only augments students' knowledge but also prepares them for more rigorous academic challenges in related disciplines. Furthermore, Wheeler et al. analyzed the influence of EE on career trajectories. They found that many professionals in environmentalism-related fields attribute their career choices to nature-based outdoor opportunities and EE programs. This finding was not only valid for elementary and middle school students, but among high schoolers as well. EE can thereby ensure a continuous influx of passionate individuals committed to addressing environmental challenges.

In light of this, effective EE programs can offer participants the impetus to engage in related practical experiences for years after the educational initiatives have ended. This long-lasting dimension of EE is instrumental in equipping students with the tools needed to launch environmental careers. By fostering a strong foundation of passion for the environment, EE may play a pivotal role in shaping future professionals in the field. The combined effect of EE on personal development, academic achievement, and career orientation truly solidifies its importance to cultivating environmental stewardship.

In order to sustain these noteworthy outcomes, inclusive design principles and robust support for educators are critical. They are particularly important because there is a significant global public concern about addressing climate change and demand for transformative EE reform (Thor and Karlsudd). Such widespread support reveals the necessity for integrating EE into national curricular standards. This strategy can help ensure that students are not only well-informed about environmental issues but also equipped to actively engage with sustainable solutions. In addition, it is vital that such curricula is grounded in comprehensive support for educators. When enacted, this approach may cultivate a generation of students adept at addressing environmental challenges.

Financial investment is another recommended strategy that has been demonstrated to enhance EE (Randell and Gray). It plays a crucial role in the

advancement and dissemination of related educational resources across school districts. Reid et al. emphasize the need for governments and other entities to invest more monetary resources into EE innovation throughout both K-12 and higher education. This call for increased funding is echoed by Wheeler et al., who advocate for integrated project-based learning opportunities for students through avenues such as the Sustainable Design Project. This initiative underscores the power of public-private partnerships in fostering exceptional EE programming.

In addition, it is vital to provide funding for longitudinal studies to assess the long-term impacts of EE programs on student outcomes and career choices (Wheeler et al.). By implementing these funding goals, EE can more effectively encourage the development of informed, environmentally conscious citizens. Ardoin et al. further recommend developing evaluation systems to track environmental quality outcomes more effectively. From this lens, it is important to fund processes that properly evaluate the impact of EE.

EE can also benefit from a solid foundation of research-based strategies to inform and enrich teaching practices. Wheeler et al. propose the creation of a centralized repository for EE research. They suggest that organizations such as the EPA can compile and disseminate the results of such research to schools and other educational institutions. This recommendation can make new data readily available to educators and the public. In turn, the latest findings from universities, non-profit organizations, and other research institutions can be organized and shared. The continuous accumulation of such research would empower educators to incorporate the most current environmental knowledge and pedagogical strategies into their teaching practices.

Moreover, Wheeler et al. highlight the need for conducting additional studies in under-researched areas of EE. They recommend focusing on the efficacy of various teaching strategies and their impact on student outcomes such as achievement and graduation rates. This call for research is echoed by Meyer, who acknowledges that different EE interventions – both within and outside of the traditional educational system – can promote pro-environmental behaviors throughout society. These perspectives can encourage a wider array of EE interventions that better prepare learners to contribute positively to environmental conservation efforts.

Concluding Thoughts

This paper has rigorously examined the role and impact of EE as a pivotal aspect of environmental stewardship. Throughout this process, a critical need for both educational and professional development focused on environmental themes has continually surfaced. By integrating changes in EE that impact the “...head, heart, and hands...” (Reid et al.), a comprehensive educational approach emerges. It helps to ensure that both students and educators are not only knowledgeable about environmental stewardship but also genuinely committed to its realization. This devotion is essential to moving beyond superficial engagement to foster lasting action towards environmental sustainability.

Further expanding on the critical nature of EE, Reid et al. articulate a vision of transformative learning to facilitate the survival of both humanity and the planet. This approach underscores the importance of learning and acting in favor of the environment. It ultimately suggests that EE is not just an educational priority, but a fundamental pillar for global survival. The declaration that “...the time to learn and act for our planet is now” (Reid et al.) stresses the urgency of this endeavor.

In turn, Saylan and Blumstein express an unwavering belief in the possibility of change through collective and individual efforts. They assert that change is within reach to the extent that global citizens act on the fundamental tenets of EE. Indeed, EE does not just belong to the domain of experts but embraces a collective responsibility that requires a fundamental shift in how all people engage with the environment. Collaborating on EE initiatives can thereby ensure that future generations inherit a world where environmental consciousness is a lived reality.

The effectiveness of EE in driving conservation efforts and improving environmental quality has been documented across various outcomes from habitat preservation to pollution mitigation. These results demonstrate the capacity of EE to engender change and underscore the necessity of integrating EE into all levels of education. By providing all students with access to meaningful and rigorous environmental learning, a more environmentally conscious and active generation can emerge.

This paper has also honored the fact that the journey towards achieving widespread and effective EE is filled with challenges. Moyer et al. highlight a critical barrier in the form of prevailing misconceptions about EE. The perception that EE is not a necessity can result in a society that is ill-prepared to engage with environmental issues. In turn, people may forego opportunities to foster a deeper connection with the natural world and fail to work towards its preservation. It is therefore important to challenge these misconceptions by advocating for EE as an integral part of curricula on a global scale.

Furthermore, the quality of EE is just as critical as its scale. Cordero et al. assert that addressing environmental degradation effectively requires both mitigation and adaptation strategies that are supported by educated individuals. This necessitates an approach to EE that extends beyond traditional learning paradigms to embrace innovative, interdisciplinary, and interactive methods. When integrated into EE, these qualities can spark a shift in societal behaviors that promote environmentalism.

It is clear that EE is not merely an academic discipline. Rather, it represents a vital conduit through which human interaction with the Earth is taught and understood (Moyer et al.). In the process, comprehensive EE-rooted educational reforms emerge as a means to not just survive but thrive. Living in this world inherently means impacting it – both positively and negatively. As such, effective EE represents a crucial way of life for everyone. Its blend of individual and collective action on a global scale champions life-long environmental stewardship.

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