Empowering Ghanaian Youth: Integrating Local Ecological Knowledge in Environmental Education

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Abstract

In the face of transboundary environmental crises, moving away from education systems with colonial legacies would empower Ghanaians to lead adaptation and resilience efforts in their communities. Nuanced, culturally relevant, place-based education can fight the entwined threats of climate change, biodiversity loss, and the rise of infectious diseases. This article delves into the environmental education landscape in Ghana, finding that integrating informal, cultural learning with formal curricula is a strong pedagogical strategy. Ghana is the focus because it is a lower-middle-income country whose formal schooling was introduced by the British colonial power. Many other formerly colonized countries face a disproportionate environmental burden, so lessons from Ghana can be helpful elsewhere. This article contributes to the ongoing discourse on preparing the next generation for the new planetary conditions, offering a roadmap for a more integrated, holistic approach that harnesses the strengths of cultural knowledge and communication.

Keywords

Environmental Education; Ghana; Informal Education; Formal Education; Traditional Ecological Knowledge; Local Knowledge; Climate Change Pedagogy; Traditional African Education

Introduction

Opuni-Frimpong et al. note that under the threats of environmental disaster posed by climate change and the biodiversity crisis, formal "education is the most powerful tool for engaging teenagers and preparing them for jobs in greener economies" (2). I have chosen to focus on environmental education in Ghana because of its role as an African country with a strong economy, a culture of communalism, and a plethora of environmental threats that students must be prepared to address. Additionally, I lived and studied in Accra from August 2022 to May 2023. I completed an internship with the Centre for National Distance and Digital Learning under the Ministry of Education, through which I was introduced to the current state of formal education in Ghana. I also witnessed firsthand the effects of climate change, including heat waves, flooding, coastal erosion, pollution, and infectious diseases. While my personal experience inspired me to choose Ghana as my main area of study, I do not assume that this has given me enough insight into living in Ghana as a native person to prescribe any absolutes. Instead, I hope to amplify the voices of African researchers whose work already exists in the literature and synthesize their findings to create new recommendations. While this article focuses on one country, improving environmental education is an imperative for every community worldwide as our planet continues to change.

Formal Education

The United Nations Educational, Scientific, and Cultural Organization (UNESCO) defines formal education as that which is "institutionalized, intentional and planned through public organizations and recognized private bodies" ("Formal Education"). All public education in Ghana is organized, supervised, and implemented by the Ministry of Education (MoE) at the national level, with little work being delegated to district governments ("About Us"). Districts can range from containing 75,000 residents to over 250,000 ("District Assemblies"). There are also private

schools run by individuals and non-governmental organizations that are supervised by the MoE. This article will focus on public schools because the literature suggests that there is an observable "private school effect" in Ghana, meaning that private school children have notably superior learning outcomes compared to public school children (Adu Boahen 1277). Therefore, this article focuses on the population that needs research support to find pathways to improve learning outcomes.

The Ministry of Education in Ghana oversees 18 agencies to realize its vision of a highly educated and skilled nation, setting educational standards, distributing funds, and promoting informal education ("About Us"). Schooling is structured into primary, secondary, and tertiary levels, with free compulsory education up to year nine ("Education in Ghana"). Public high schools, mostly boarding and highly competitive, admit only a fraction of the over 500,000 annual applicants, leaving others to pursue vocational schools or end their academic journey ("Education in Ghana"). Rural schools face significant challenges, including under-resourcing and high dropout rates, with the majority of underperforming students attending these schools (Baah-Boateng; Education Sector Analysis). The legacy of colonial-era, single-gender boarding schools persists, with limited access historically determined by race and elite status, though expansion since independence has greatly increased enrollment (Adzahlie-Mensah and Dunne). Increased access and quality, particularly beyond the boarding system, are necessary for further educational improvements.

Modern formal education in Ghana incorporates Piaget's theories of cognitive development and constructivism, as outlined by Athman and Monroe, and others (Athman and Monroe; Pinto; Piaget and Rosin). Piaget's developmental stages: sensorimotor, preoperational, concrete operational, and formal operational, align with Ghana's school progression: primary school covers the active and intuitive stages, while junior and senior high include the practical and

reflective stages (Piaget, 1977; Pinto; Thompson). Constructivism, central to Ghanaian pedagogy, emphasizes building on prior knowledge and encourages experiential learning, where students actively engage with material through discussion and hands-on activities (Athman and Monroe; Piaget and Rosin; Jakobsson et al.). For example, Ghana's science curriculum includes group projects such as concept maps and Future's Wheels to foster cooperation, critical thinking, and the application of knowledge (Science Curriculum). Despite these strengths, classrooms still face challenges in meeting diverse student needs and equipping teachers.

Informal and nonformal education refer to what people of all ages learn through activities that do not have the explicit intent of teaching and learning those subjects ("Formal, Non-Formal and Informal Learning"). It can take place in an organized setting, such as reading groups or debate clubs, or through individual efforts, such as learning to play the guitar by listening to others and experimenting. Much of informal education is based on cultural knowledge, rooted in local cultures, histories, and experiences (Dei). Cultural knowledge belongs to a culturally united people living in one area, often one to which they are indigenous. It is dynamic and responds to the pressures of time and cultural change. It is also crucial for the survival of the society to which it belongs, as without this knowledge, the people may lose their sense of unity. It pervades many aspects of a people's cultural entities, including stories, proverbs, farming technologies, belief systems, and the organization of kin groups, among others. When the people to whom this knowledge belongs are indigenous to their land, and the knowledge arises from human interactions with nonhuman and nonliving beings, it can be classified as Indigenous knowledge. Consequently, the existence of this knowledge can speak to the history of Western colonization and hegemony, which operated under a different conception of knowledge (Dei). The passage of knowledge from one generation to another opens the door to much informal education. Often, older members of a Ghanaian community teach the youth how to live as members of their society (Dei). Most of this

teaching is done by parents, guardians, adults, and Elders of a community. Also, this form of education does not have a graduation date and is seen as a lifelong process for all, regardless of profession or academic level. The lessons passed on may include morals, social and civic responsibility, and harmonious interaction with the natural world. Local vernaculars are almost exclusively used to communicate this knowledge because the lessons are completely interwoven into everyday activities, such as completing chores or spending time with loved ones. In Ghanaian society, it is commonly understood that the accumulation of this knowledge is what makes a person educated, while their progression through the school system makes them schooled (Dei). This knowledge is part of Ghanaians' cultural heritage, and receiving it is an integral part of living within the community that helps define their identity. Therefore, informal education in Ghana demonstrates strength through its perseverance in the face of colonial pressures.

Before moving on to environmental education in Ghana, it is essential to understand local environmental issues in the context of global threats. Why is it the fundamental duty of a student's education system to provide them with a practical, thorough, place-based, and just lens through which they can assess these threats? Globally, environmental threats stem from habitat loss, invasive species, pollution, human population growth, and overharvesting, forming the acronym HIPPO, modified for local situations (Wilson). The consequences of these threats can be modeled using the IPAT framework, which holds that the *impact* of environmental threats is a function of *population*, *affluence*, and *technology*. As the population and its affluence grow, the impact of threats will also grow. New technology can have a positive or negative effect on the environment, depending on how it is used, and environmental justice and infectious diseases are also important to consider.

In 2019, Ghana imported around 215,000 metric tons of electronic waste (e-waste) from countries such as the United States, the United Kingdom, and other Western European countries

("Shaping Sustainable Paths"). In fact, 39% of those imported in 2021 were treated in Agbogbloshie, a single landfill next to a densely populated neighborhood of Accra, the capital city (Njoku et al. 1). The chemicals released during the burning of e-waste can cause lethal health problems that affect the most vulnerable members of Ghanaian society. Resource-restricted Ghanaians are feeling the ramifications of the intense use of electronics in developed countries, while those who produce and enjoy these products can avoid the burden of their long-term effects.

Beyond waste, Ghana faces habitat loss, which can be classified into three categories: destruction, degradation, and fragmentation. Destruction means the land is left completely inhospitable to native organisms, often through the filling in of wetlands or the clearing of forests. Degradation can involve pollution or invasive species that harm ecosystems to the point that they no longer function. Finally, fragmentation refers to when habitat is cut up by roads or dams so that populations may not have access to a large enough area to mate or find food ("Habitat Loss"). Ghana's Ministry of Environment, Science, Technology, and Innovation (MESTI) reported that agriculture is the main driver of land use change because many farmers prepare the land for cultivation through slash-and-burn clearing techniques, which are time and cost-efficient but leave the ground vulnerable to erosion ("CBD Fifth National Report"). Pesticides are also commonly used, negatively affecting pollinators and contributing to habitat loss and pollution ("CBD Fifth National Report"). Agricultural runoff of pesticides, herbicides, and fertilizers is just one form of pollution that causes habitat loss. The runoff from mining is another polluting threat to biodiversity: mineral mining operations, known colloquially as "Galamsey", involve clearing forests and digging deep pits to access mineral deposits ("CBD Fifth National Report"). In the absence of restoration efforts, the original biodiversity of these areas often cannot return once operations move on to other areas, leaving many species without habitat. These species are also limited in where they can move to, because of habitat damage and loss. Infrastructure development,

such as hydroelectric dams, flood land, and lead to the displacement of thousands of organisms and human communities as well ("CBD Fifth National Report"). Along the coast, development near estuaries has destroyed wetlands and contaminated the water with chemicals and materials that harm extant populations, contributing to a devastating drop in fish and bird populations.

On top of this, many areas suffer from invasive species such as the water hyacinth (*Eichhornia crassipes)*, originally native to South America ("CBD Fifth"; "Common Water-Hyacinth"). These marine plants spread rapidly over the surface of bodies of water, crowding out native plant species that cannot compete for sunlight and nutrients. When these plants die, they decompose, releasing carbon dioxide into the water, which can suffocate other organisms, and they become sediment at the bottom of the river, blocking water flow and leading to dry river beds. Fishermen are seeing declines in their catches due to water hyacinth, affecting the economy and access to nutrition. Moreover, chemicals released from factories and farms reduce the ability of native species to survive, reproduce, and fight off disease ("CBD Fifth National Report").

Another element of pollution in Ghana is plastic. Many essential products in Ghana are sold in plastic bags, including drinking water (Erinosho). These single-use bags are then disposed of haphazardly, often ending up in waterways and drainage systems. These plastic pollutants also emit greenhouse gases into the atmosphere, contributing to global climate change. 8% of Ghana's greenhouse gas emissions from 2016 came from its plastics production (Erinosho). The effects of these emissions and those produced around the globe are apparent in Ghana, where climate change is drastically affecting temperature and rainfall patterns (Erinosho).

Another environmental justice issue facing Ghana is the imbalance between the threats posed by climate change and Ghana's contribution to global greenhouse gas (GHG) emissions. Many environmental threats explained above interact with climate change, such as pollution, deforestation, and coastal erosion. Together, these threats can lead to positive feedback loops,

where the deterioration of ecosystems exacerbates itself. Ghana is experiencing the effects of these destructive systems, but it has contributed very little to GHG emissions relative to countries that have been highly industrialized for decades. For instance, from 1800 to 2022, the United States contributed 427 billion metric tons of GHG emissions into the atmosphere ("U.S. Historical"). In comparison, from 1950 to 2022, Ghana produced only 388.54 metric tons (Ritchie et al.). It is unjust that while Ghana had little to do with the creation of climate change, its people, infrastructure, and future must suffer just as much, if not more, than others. Education is a crucial element for empowering Ghanaians, despite these injustices, to create opportunities in their communities and build a better future for the land, water, animals, and themselves.

The burden of climate change is an issue that highlights the transboundary nature of environmental justice issues in Ghana, which should be emphasized in national environmental education. Many Ghanaian lessons that address the causes of climate change fail to acknowledge the global nature of the causes (Boakye). This knowledge gap could mean that students will not demand enough from the international community in terms of changing their practices and assisting with climate resilience and adaptation.

Formal Environmental Education

The Tbilisi Declaration is the international standard for environmental education (Unesco). It was produced at the 1977 Intergovernmental Conference in Tbilisi, Georgia, then a Soviet Republic. The conference was organized by UNESCO and the United Nations Environment Programme (UNEP) with the aims of discussing the role of education in solving major environmental problems, analyzing current national and international environmental education programs, and devising strategies for the improvement of education as an environmental tool (Unesco). The conference declaration strongly advocated incorporating environmental education

to increase access to "the necessary knowledge, understanding, values, and skills needed by the general public in devising solutions to environmental problems" (22).

The declaration also acknowledged the interdisciplinary nature of environmental education and the importance of "learning from the environment as well as about the environment" (Unesco 12). An understanding of subjects such as economics, policy, biology, chemistry, history, and computer science is required to contribute to environmental studies, making it a multidisciplinary field. As an extension of the recognition of this field as complex, ever-changing, and diverse, the declaration called for reforms to the methods and content of environmental education so that it can be better used by professionals in related fields and by all people to better understand the planet. One area in which the traditions of environmental education can be reformed is by creating a better understanding of what drives pro-environment changes in behavior, once one has learned of their impact.

The Tbilisi Declaration relies on the concept that increasing access to and the quality of education are meaningful drivers of behavior change. Nonetheless, most research on this topic finds that increasing awareness alone does not correlate to improved environmental consciousness or eco-friendly behavior (Kollmuss and Agyeman, Moya et al., Sousa et al.). While knowing about the environment, its problems, and human impacts is crucial, other factors can also influence whether someone engages in pro-environmental behaviors. Such factors include whether people have learned about environmental problems directly through firsthand experience or indirectly through lessons, and normative influences such as whether the dominant culture promotes pro-environmental behaviors. While it may be impossible to create a model that explains the gap between awareness of environmental problems and pro-environmental behavior, Kollmuss and Agyeman recommend studying connected attitudes and behaviors together. For instance, a verbal commitment to a specific pro-environmental action should be studied alongside engagement in

that behavior. Data should also be collected consistently and in short intervals to closely monitor how people's attitudes change over time.

The broadest environmental document that touches on environmental education is the Ghana National Climate Change Policy, published in 2013 by MESTI. There are only a few mentions of education in this policy, suggesting that the government of Ghana did not place much value on education in its efforts to combat climate change in 2013. Some references to education include the role of universities in producing new research on the state of the environment and as a function of civil society organizations (*Ghana National Climate Change Policy*). Additional mentions include proposed methods of mitigating other problem areas, such as hygiene and waste disposal. Educational inequities among rural and urban, migrant and non-migrant, and other communities are listed as challenges to improving environmental improvement efforts (*Ghana National Climate Change Policy*). There is very little educational support for migrants because they are often not accounted for by the Ministry of Education. Their lack of education often leads to under- or unemployment, demonstrating the consequences of neglect in the education system (Ewulley et al.). The most substantial inclusion of education comes in the section titled "Information, Communication, and Education," which concentrates on how to engage stakeholders on climate change (*Ghana National Climate Change Policy*). The suggestions listed here include educational initiatives targeting multiple levels of society, including public servants, school-age students, and environmental educators. The foci of these initiatives include energy-efficient refrigerators and stoves, disaster preparedness, and local impacts of climate change (*Ghana National Climate Change Policy*). There is a lack of any type of reference to reforming the education system to strengthen its environmental subjects anywhere in this document.

The "Actions for Immediate Implementation" in the Ghana National Climate Change and

Green Economy Learning Strategy of 2016 include integrating environmental lessons into all levels of schooling, from pre-school to tertiary, due to the need to start children's environmental education early to affect their beliefs (*Ghana National Climate Change and Green Economy Learning Strategy*). They also mention lessons that need to be developed and distributed to adults and professionals, such as clinical health workers who need to learn how to treat climate change-related health issues, and policymakers who must incorporate environmental concerns into their economic policy. While this document mentions the need to engage stakeholders, the communities in which new climate change policies were to be implemented were not included in this group. Informal education was generally mentioned as something to be addressed, but no further details were provided (*Ghana National Climate Change and Green Economy Learning Strategy*). So, how have these efforts affected Ghanaian students' learning outcomes? A 2017 study titled "The State of Disaster Risk Reduction Mainstreaming in Pre-Tertiary Education in Ghana: An Exploratory Study" found that teaching and learning in pre-tertiary schools was below standard, with more teacher respondents reporting that they were working with inadequate training, time, teaching and learning materials, and student appreciation for the topics (Saito). The teacher respondents suggested that climate risk reduction, including topics such as fire risk and flooding protocols, be made into an independent subject so that it receives sufficient time and materials. Another study, "Climate Change Education: The Role of Pre-Tertiary Science Curricula in Ghana," found that climate change education was nonexistent in basic schools (Boakye). The authors conclude that integrating climate change into science curricula across all school levels left room for improvement in building connections to other aspects of their lessons and in encouraging students to take action (Boakye).

Formal school can be the only routine, organized, and monitored activity a child does in their day. It is recognized for providing a space for students to develop their social and emotional

selves, especially in communities experiencing extreme poverty, conflict, or displacement. Therefore, it can have significant effects on children's lives and well-being, and should operate at the highest level possible. Teachers in formal schooling settings often lead their classes in didactic exercises in which students use symbols in meaningful contexts to learn, rather than by handling real objects (Hatano and Takahashi). This is important for the development of students' abstract thinking skills and their ability to process symbolic information, especially during the formal operational stage above the age of 11. Because teachers have so much control over students' progress, they must usually be accredited by a government body, which in Ghana is the National Accreditation Board of the Ministry of Education. The accreditation signifies that they understand their material and pedagogical methods ("About Us"). Formal schooling is now one of the main ways young people acquire the media and computer literacy necessary to succeed in the digital age (Hatano and Takahashi). Environmental literacy is another skill that is now mainly taught through formal school and forms the basis for environmental behavior change, providing an awareness of the environment and its problems. These attitudes allow those who are concerned for the environment to be motivated enough to participate in its improvement actively, and skills to identify and solve environmental problems (Athman and Monroe).

Many of the strengths of formal environmental education in Ghana stem from Ghana's education system as a whole. The opportunities and structures within the system that make it integral to the country's functioning apply specifically to aspects of environmental education. For instance, in their article "Cultural Diversity, Human Development, and Education," Hatano and Takahashi explain that literacy is not entirely critical for cognitive development, but it will always remain a mainstay of primary schools because of the access it affords students in other areas of study. Before students can read and write, they must learn through verbal and visual lessons. They have a more limited vocabulary and cannot store or synthesize information in writing. Similarly,

early environmental lessons teach vocabulary, connections, and main ideas in topics like ecology and hydrology, granting students access to classes and programs where they can apply these concepts. Without a structured introduction to environmental ideas, students would not have the skills or confidence to investigate further. Environmental literacy also allows students to learn without teachers having to instruct students on what to think. Students can use the building blocks of their lessons to innovate new questions and solutions on their own, without teachers focusing solely on their own interests (Hatano and Takahashi).

On the other hand, there are some instances in which teachers should be wary of students completely following their own thought paths. Misinformation and disinformation both refer to inaccurate information that is disseminated, with the difference being that disinformation is intentionally meant to mislead the audience while misinformation is not (Cook). Environmental literacy is a critical part of fighting misinformation among students because, with the ability to properly read and contextualize statistics, understand the connotations of vocabulary, and other skills, students can identify false information (Cook).

A final strength of Ghana's formal environmental education system is that the curricula that include information about environmental threats already incorporate pedagogical techniques that are thought to improve critical thinking and listening skills, and in general empower students to conceptualize the lesson material in terms of their personal experience. The Science Curriculum for Primary Schools, Strand 2, Sub-section 2, Earth Science, includes a lesson, B5.2.1.5.2, that builds on previous knowledge, student discussion, and analytical skills to teach about the common causes, symptoms, and prevention of cholera (*Science Curriculum*). This lesson helps students to recognize trustworthy sources of information by bringing in a public health expert, uses student discussion to synthesize previous knowledge with in-class learning, and culminates in a visual presentation. By examining the lessons the national government provides to instructors, it is clear

that Ghana is already leveraging the strengths of a formal school setting to develop environmentally competent and critical-thinking public basic school students. Nonetheless, there is potential for better learning outcomes.

However, Ghana's formal education system was introduced during colonial rule by the United Kingdom. Before colonization, education was provided by family members at home rather than at a separate school. Children were taught cultural knowledge and practical skills relevant to their community and landscape (Dei). By focusing on the school's spatial and organizational structures, the colonial hierarchies are evident, despite Ghana's postcolonial status. Every morning, the male prefects lead the student body in an assembly in which they stand in a military-style block formation outside, call the roll, and perform physical exercises. If a student speaks out of turn or breaks rank, they are punished, sometimes physically. The ranks are organized by height, except that the girls must be in the front, regardless of their height. This means that shorter boys cannot see over taller girls and may fail to perform the exercises, sometimes leading to their punishment (Adzahlie-Mensah and Dunne). The authors highlight that the gender segregation in these classrooms was inherited from the complete gender segregation of schools in prior decades. In the girls' schools, the subjects centered around home economics and the cult of femininity as crafted for the European woman. These schools were attempts at forming an "African woman" and molding her after the ideal white woman. The female prefect must defer to male prefects, further establishing female students as lower on the school's social hierarchy (Adzahlie-Mensah and Dunne). A 2018 report published by the Ministry of Education included nationwide learning outcomes statistics that align with Adzahlie-Mensah and Dunne's findings that gender is a significant factor in whether a student completes their education, especially when attending a rural school (*Education Sector Analysis*). Girls were not the only students at the school to feel pushed to the periphery of the institution, supposedly empowering them (Adzahlie-Mensah and Dunne).

Teachers were seen as the authority on everything simply because they were adults. Transmission pedagogy was the teaching style of choice, in which teachers received the curriculum from the Ministry of Education and passed it on to the students. Connections to prior or personal knowledge were not considered valid because they did not come from the authority figure. Students were not allowed to speak in class or object to anything presented in the lesson. English was the language of instruction for all classes, and the English class itself took up 25% of the teaching time in a week. Ghanaian languages were pushed aside, and with them, the knowledge the students had in those languages. English separates the students from their African identities and continues the epistemic violence of colonial education. This silencing robs the pupils of their power and ensures that the African child, in the authors' words, remains low in the hierarchy of their native society (Adzahlie-Mensah and Dunne).

Another major shortcoming of formal education is the unequal and insufficient distribution of resources in public schools nationwide. As evidenced by President Akufo-Addo's free senior high school program, expanding educational access has been a main focus of the government's educational policies over the past 50 years. Nonetheless, there is evidence that the expansion of access to this degree is leading to lower test scores (Armah). Specifically, there is a lack of "trained teachers, syllabi, and textbooks" for all subjects in free public schools (Armah 2). These inequalities exist along social and economic barriers, with worse education being provided to rural, adult, and out-of-school youth populations. Public junior high schools with higher low-income populations have failure rates as high as 40%, with students failing to score high enough on the Basic Education Certificate Examination to attend any senior high school. Almost half of those who pass the West African Secondary Schooling Certificate Examination (WASSCE) and qualify for tertiary education graduate from the top 20% of senior high schools (Armah).

A clear example of the sacrifice of quality for access is students taking turns going to

school, exacerbated by the COVID-19 pandemic (Nir). Because school infrastructure and the teaching workforce could not accommodate the large influx of students after all senior high schools became free, student bodies have been divided into two groups: one stays at home for 2 months while the other attends school (Nir). This harsh break in the education of all students can disrupt their learning and undermine the benefits provided by the increased access. The addition of the COVID-19 pandemic to this already-stressed system further undermined improvements from higher enrollment rates stemming from the 2017 expansion. Before schools were shut down for the pandemic, across all schools in the country, "16.9% of children between the ages of 5 and 11, 50.9% of children between 12 and 14 years old and 83.3% of children between 15 and 17 years old did not attend school, had two or more years behind in school or had not reached the appropriate level of schooling for their grade" (Agbogbo et al. 4). Students in remote regions of Ghana without access to the internet could not attend online classes and were forced to wait until the public health risk subsided enough that they could return to the classroom.

Another area in which education in Ghana could use improvement is teacher capacities. The teaching profession is generally underappreciated and is broadly perceived as a "passing job" that someone has until they get a better one (Agbogbo and Lorenzo 6). One way to increase the value of teachers' roles in Ghanaian society is to increase their representation in policy-making. Teachers are handed curricula and laws from their national and district governments, over which they have little to no say, which makes these policies feel distant and bureaucratic (Almeida). In addition, they are often written in English, while many teachers are more comfortable in their local language. Reforming the policy-making process to incorporate more teacher voices could empower teachers to excel in their work because they know their government cares about their success (Almeida). It will also be important to increase teachers' pay. One study found that 26.9% of Ghanaian teachers had a second job, compared to 14.9% other wage workers

(Evans et al.). Raising pay will allow teachers to spend more time and energy on their lessons and help establish teaching as a permanent profession. Informal education, including traditional ecological knowledge and oral histories, can counteract some of the negative effects of the colonial school system and offer alternative learning methods to the resource-deprived, understaffed formal education programs.

The superiority of Western knowledge over cultural knowledge, and the use of English, restricts cultural identity (Adzahlie-Mensah and Dunne). The marginalization of the student body's cultural identity contradicts the proposals of Athman and Monroe in their paper, "Elements of Effective Environmental Education Programs." They argue that the most effective environmental education programs are those that empower students through their relevance to students' lives, build practical skills for future careers or daily life, and are fun and enjoyable, completed outdoors (Athman and Monroe). The integration of Ghanaian methods of knowledge production and transmission, such as proverbs, into environmental lessons should help break down the existing power structure that teaches young Ghanaians to learn only from their textbooks, rather than from themselves, their peers, and the world around them (Dei).

Informal Environmental Education

Before the imposition of the British colonial school system, Ghanaians learned from what is now called Traditional African Education (TAE) (Atuguba). In Ghana, the diverse elements of TAE are underlined by the idea that people, the natural world, and the spiritual world are united. Living humans must take care of nature because that is the current home of their ancestors. Colonization did not completely eradicate these traditions, and some people still practice them in rural areas across the country. These philosophies are also present today in many of the songs, stories, and proverbs taught to most Ghanaians as they grow up (Atuguba). For instance, many

ethnic groups in Ghana hold certain animals as sacred and not to be eaten. They are called totem animals and reflect historical beliefs about the character of the ethnic group. The ban on eating these animals can also act as a method of environmental stewardship. One community holds the black-and-white colobus (*Colobus satanas*) and Lowe's mona (*Cercopithecus lowei*) monkeys as sacred and runs a monkey sanctuary to support their population (Atuguba). Taboos on eating these various animals have helped protect some species of hedgehogs, tortoises, parrots, eagles, and fish. This type of cultural knowledge and behavior not only helps maintain a close relationship between people and their food, water, and home but can also measurably improve their environment.

Another element of TAE that requires community participation is communal labor, including the construction and maintenance of spaces such as hospitals, schools, and footpaths (Atuguba). Community members are, therefore, constantly thinking of themselves as important members of a place-based community in which they hold a responsibility to the land and the people around them. People also learn about the trends, constants, and unexpected changes in the environment around their homes. They make observations and predictions daily, acting out community science. While many villages and families continue this practice today, the government has the legal and social duty to maintain Ghana's schools, markets, and other infrastructure. Local people are less incentivized or duty-bound to carry out these tasks than they were when their community relied on them directly (Atuguba).

Another element of informal environmental education, already partially at play in some classrooms, is teacher modeling and implicit instruction (Atuguba). These concepts refer to how the instructor structures and communicates lesson material to their students. As opposed to explicit or overt curriculum, which is deliberately written, implicit curriculum is conveyed through teachers' actions and inactions, school routines, and the nature of the lesson. Null curriculum is

another important aspect of this, referring to what students glean from what is excluded from the overt curriculum. Students are only exposed to topics included in the lesson plan as deemed valuable by the National Council for Curriculum and Assessment (NaCCA) and their instructors. Therefore, students may never know about subjects left out or may see them as less important than those included. This plays into the hierarchies of knowledge mentioned earlier, seeing as the exclusion of cultural knowledge from the classroom can lead students to see it as less important than topics influenced by TAE (Atuguba).

Teacher modeling is the specific element of implicit instruction that refers to how students learn from their teacher's behavior (Walker et al.). When a teacher demonstrates sustainable practices in front of their students, the class may begin to model their behavior. Some behaviors that can be effectively taught through teacher modeling include reducing food waste, recycling, and noting changes in the weather.

Ghanaians who learn about the vegetation and wildlife in their home region from their elders during childhood, through play or by learning to prepare meals, inherit a cultural understanding of these natural elements. Proverbs are short sayings that convey a life lesson and are very popular in Ghana, ~~of~~ten referring to plants and animals. For instance, one is "Knowledge is like a baobab tree; no one can encompass it with their hands" ("Proverbs from Ghana"). This saying implies that the baobab tree is large and cannot be and should not be controlled by human forces. Also, it creates a link between the baobab and knowledge, characterizing this tree as related to wisdom and understanding. As young Ghanaians learn these sayings throughout their youth, every part of the natural world around them becomes imbued with personifications and connections to life lessons. Their understanding of their surroundings is entirely woven into the pillars of their culture. Compared to formal education, which was originally imposed by a foreign power and established to control Ghanaians, informal education aligns with other aspects of young

people's lives (Adzahlie-Mensah and Dunne).

Because informal education rooted in Ghanaian culture is unique to its setting, youth are shown that elders are experts in their own location. No one knows the land under a village better than an Elder who has lived there for their entire life. Understanding the strength of Indigenous knowledge is crucial for young Ghanaians when they encounter people from other places who try to tell them about their own home country, no matter the foreigners' intentions. As global conversations around transboundary issues like pollution and infectious diseases increase, Ghanaians' confidence to stand up to global powers will partly derive from this form of education (Dei). Therefore, it is essential to keep this knowledge alive and to ensure its transmission.

Traditional African Education that interacts with environmental literacy shows a historical pattern of a communal understanding of the environment. Cultural methods of knowledge production, such as TAE, are not the only elements of communalism in Ghanaian culture, as it also appears in housing, town activities, and spirituality (Atuguba). Unlike other, more individualistic cultures, societies in Ghana are uniquely primed for teaching and learning about the environment beyond the formal curriculum. Not only will communalism help environmental learning, but environmental learning also benefits the community. For instance, environmentally focused lessons in towns that involve gardening or storytelling enrich the community visually and culturally. Students learn and are empowered through their gardening, and the town is left with a source of beauty, food, and a reminder of the students' labor. Education rooted in a community has been found to foster positive attitudes toward the material students learn and to increase their self-esteem, as they see themselves as stewards of their community (Takkouch and DeCoito). Additionally, implicit communication is an informal practice that, when done intentionally, can enrich environmental curricula. Teachers can practice these actions by doing what they have to do anyway—i.e., eating and waste habits—so this can be expanded in schools without additional

funding or explicit curriculum (Walker et al.). It also requires the instructor to be thoughtful in their behavior, which can help them think critically about their subject matter and become a more engaged educator. In general, harnessing implicit instruction to shape how students see themselves in their environment is an effective, scalable measure.

The nature of informal environmental education structures in Ghana may create a setting uniquely capable of fighting mis/disinformation. The rise of the internet, globalization, and social media has propelled the creation and spread of false information. Informal environmental education could leave students open to believing false non-facts because much of the information does not come from vetted sources. Nonetheless, Lee et al., in their paper "Community-based Strategies for Combating Misinformation: Learning from a Popular Culture Fandom", explore how strong communities may develop powerful strategies for fighting false information. While this study focuses on an online group of fans of an internationally popular musical group, its findings can apply to the Ghanaian educational setting because of its strong sense of communalism, shared identity, and the daily, inconspicuous nature of misinformation (Lee et al.). Some of the particular strategies used by the fan community highlighted by this research that could work in Ghanaian schools include: "asking others to correct or retract misinformation, wait[ing] for official sources, disengag[ing], divert[ing]" (Lee et al. 3). This could look like a student asking another to identify their source or clarify their logic. Waiting for official sources could look like referring to a formal school teacher or a school-provided resource that is known to be trustworthy. Diverting could be a student or leader reminding the group of the purpose of their activity to engage them critically with the truth of each statement. A strong community would be especially apt to display these behaviors because they are working toward shared goals and understand how to communicate effectively to keep the group on track. Each group of students can develop their particular strategies to counter false information, but they must be reminded of the importance of this work by each

other and their leaders, to not grow complacent. These informal environmental education strategies can meld with formal structures in Ghanaian classrooms to accentuate each arrangement's strengths and build upon each other.

Conclusion and Recommendations

A central pillar of the constructivist approach to education is that students should be able to independently display what they have learned (Athman and Monroe). Therefore, assignments that ask students to apply a skill learned in class are critical for teachers to monitor their students' progress. One assignment can be used to measure students' abilities against a common standard, and another, done later, can capture a student's advancement in that subject. Nonetheless, relying too heavily on assignments designed solely to measure students' progress in the curriculum can prohibit teachers from creating an environment where students can use their creativity and unique capacities. For instance, in her research on environmental education in Ghana, Atuguba interviewed several teachers about the frustrations that arise when students express a desire to learn something relevant to the topic not included in the lesson plan. One teacher respondent, Vera, wrote: "There are times students push for more, sometimes they even suggest we go on field trips to see what we are talking about, but we are restricted by the curriculum. Sometimes when I can make time, I try to but most of the time I stick to what is in the curriculum" (Atuguba 143). This poses a conflict in which teachers must try to adhere to the curriculum so students can pass national exams rather than follow their students' curiosity. One strategy to cope with this dilemma is to alter the nature of class assignments, if possible, given that assignments may also be bound by an exam-oriented curriculum.

Independent student work on environmental topics should also build on students' knowledge in other subject areas, given the interdisciplinary nature of environmental studies.

Therefore, a lesson would include an at-home component for the students to prepare before the class session. Junior high students would find a newspaper article, radio show, or television broadcast reporting on the environment, such as an unexpected weather pattern or a new law banning a form of pollution. The class would present their findings and discuss any connections to other lessons or events. A lesson like this would improve students' media literacy, reading comprehension, oral presentation, and critical listening skills. These are all listed as core competencies for primary school students (*Science Curriculum for Primary Schools (Basic 4-6)*). They would also be discovering current, relevant environmental news independently, which contributes to their empowerment.

Another example lesson that would incorporate local knowledge into environmental teaching would be to include a debrief of current environmental events in a local Ghanaian language. Many Ghanaian languages include vocabulary and idioms relating to specific climatic patterns in Ghana, such as the Harmattan. The Harmattan is the dusty, dry, cold wind that blows southward through Ghana from the Sahara from December to February ("Harmattan"). The English word Harmattan derives from the Akan word "haramata." In January, a science teacher could include a check-in question in Akan about how students are doing in the dry air of the Harmattan to engage them with environmental content, validate a local language as scientific and academic, and prompt students to conceptualize the Harmattan in a different linguistic framing, deepening their understanding. Or, a teacher in a class studying a local language could incorporate an entire unit on environmental vocabulary to improve students' language and scientific competencies.

Another strategy for incorporating more informal knowledge into the formal education system would be to start community gardens at schools. Participants in a vegetable or herb garden can keep produce from the garden to eat at home or share with the community. Gardens should be

designed by teachers or local leaders who have established knowledge of the native flora and fauna in the area. They can then choose vegetation that grows the best without the need for chemical fertilizers or pesticides, uses and replenishes nutrients in the soil, and has symbiotic relationships with pollinators and other animals (Takkouch and DeCoito). The leaders can explain their choices to the student gardeners as a way to open up many other ecological discussions, such as plant-pollinator relationships and the importance of the pH level of the soil. Students then understand the value of native organisms not only through a lecture but also by seeing the productivity of these relationships with their own eyes. All students gain a better understanding of where their food comes from and how it can affect their health, public health, and planetary health. Learning gardening skills could spark a student's passion and lead to careers in botany, farming, or landscaping. The community- and place-based nature of school gardens means that students can see how science interacts with local civic problems through the distribution of the food produced by the garden within the community. If certain community populations are experiencing food insecurity, a community garden can provide them with healthy, free, and reliable food. The demands of the garden for students to work as a team, communicate, and share ideas improve social skills that are useful for future careers and for life in general. Ghana's School Feeding Program, the national body charged with providing food in public schools, does run a School Gardening Program, but only 2% of enrolled schools have gardens. The main obstacles were funding, teacher professional development, and community members' understanding of the value of a school garden (Nalumu et al.). Hosting a garden in every school in Ghana could help students feel empowered in their communities and their academics.

The Tbilisi Declaration on Environmental Education constructs effective environmental education as a progression from "awareness to action", defining this type of teaching and learning as intrinsically oriented toward behavior change (Athman and Monroe 41). Therefore, one way to

measure the efficacy of an environmental education program is to track changes in students' knowledge of environmental threats and in how they respond to them, both in attitudes and in actions. It also means that these programs should be intentionally designed using pedagogical frameworks that empower students and teach practical skills they can use to accomplish achievable goals.

One pillar of a successful framework is to tailor the content and delivery to the audience. Athman and Monroe identify three elements of this tailoring: making the lesson relevant to the organization's mission, the individual listeners' educational objectives, and their everyday lives (Athman and Monroe). An overarching goal is essential in crafting the secondary goals and the actual materials, and justifies allocating funding to certain programs. It also means the program can remain consistent as it is passed on from one administration and teaching staff to another, and as it passes before many students' eyes (Athman and Monroe). Environmental education should also align clearly with students' educational objectives, such as national standards. Ghanaian students must pass both the Basic Education Certificate Examination and the West African Secondary School Certificate Examination to graduate from primary and secondary school, respectively. Students are aware of these looming examinations and should feel as though their classes are preparing them to graduate. Therefore, it is critical to find a balance between teachers' and students' personal interests and the requirements of the formal education system. That is why assignments such as those outlined in the previous section maintain the curriculum's learning goals while infusing environmental and local knowledge. Additionally, students should be taught using locally relevant concepts. For instance, lessons about biodiversity loss taught to students in Ghana should probably not center on Siberian tigers. Instead, the lesson should perhaps revolve around a monkey found in Ghanaian forests or a lizard seen on the streets in the students' town. This is due to students' need to understand the concrete before the abstract, and is very

helpful in creating fun, engaging lessons (Takkouch and DeCoito). Also, for the academic system in Ghana to further move away from colonial power structures, it is critical to have experts on Ghana be Ghanaians. In addition, students should clearly understand the purpose of their lessons in terms of their growth through clear learning objectives (Athman and Monroe). Once again, environmental programs like school gardens can achieve this through their hands-on approach and social skill-building through cooperation.

Lastly, successful environmental education that incorporates cultural knowledge must be delivered using the best possible teaching practices. Revisiting Piaget's theories of cognitive development and constructivism, teachers should always aim to build on students' prior knowledge, both in and out of the classroom. Incorporating common proverbs from the region that students are likely to have heard before, for example, into a classroom lesson can create linkages in their minds between something about which they feel confident in their understanding and new information. They are better equipped to place the new content in their mind about the proverb's context or meaning, allowing them to leapfrog over some connections. Teachers should always have these theories and strategies in mind when teaching and should stay current with the local culture of the surrounding community. Nonetheless, teachers should not be expected to know everything about their students' culture and prior knowledge without government support. Unfortunately, there is currently a lack of resources and attention for teachers, which hinders them from doing their best work.

Insufficient resources are allocated to paying teachers, developing their professional aptitudes, and providing them with satisfactory teaching and learning materials, as discussed above. These deficiencies mean that many internal and external to education view teaching as a temporary job on a person's way to a better, more respected career. This attitude could be part of why there is a lack of funding for environmental education research in Ghanaian universities, as

well as well-developed and widely distributed teaching and learning materials, and satisfactory teacher training (Opuni-Frimpong et al.). Without the support of these fundamentals, teachers will not have the flexibility in the course schedule to explore topics that pique students' interest or to facilitate discussions of the life lessons they have gained from their informal education. One recommendation that does not require funding would be to utilize better free online resources, such as the Network of Conservation Educators and Practitioners from the American Museum of Natural History. This is a multilingual resource that provides professional development materials and modules for teachers ("Network of Conservation"). Nonetheless, funding would allow the creation of localized materials incorporating teacher and student input. The way to increase funding for these areas is to convince those in power who allocate funds that these are essential expenses for a well-educated public.

Teachers are the first line of people working in formal environmental education, so they should feel and act as if it is critical work. While many teachers probably already understand the importance of teaching well about the planet, others' opinions may change through listening to their students' worries about biodiversity loss, climate change, etc., and to their fellow teachers. Once they do grasp the modeling, pro-environmental behavior will come more naturally and be a way for their class to get one step closer to acting for the well-being of the environment. Another critical group of stakeholders is those at the National Council for Curriculum and Assessment (NaCCA), which develops the curricula. Kollmuss and Agyeman explain how one crucial element of someone acting for the environment is that those behaviors are supported by the dominant culture. People, no matter who they are or where they are from, feel more comfortable changing their mindset or behavior when they feel supported by others around them. Enshrining the importance of informal environmental education into the official national curriculum would allow teachers and students to feel more comfortable in changing their ways.

The last group who must realize the importance of these shifts is the politicians who set the national agenda and have the power to reform the school system. Dei covers how political footballing, or the use of changes to the education system to exert power, was a major problem in Ghana in the 1980s and 1990s. Each new presidential administration changed the length of senior high school, added or removed social programs provided in schools, and reallocated resources. While these changes have settled down in recent years, this demonstrates the power high-level government officials have over how schools operate. Dei also highlights how leaders must limit the influence of foreign financial backers in this system. A tempting route to gain more funding could be to secure loans or other funding from international groups, which could lead to a reduction in Ghanaian control over these programs despite the additional resources. While it will be difficult to attract the attention of presidents and ministers to this issue, their power to improve teaching and learning could be monumental, providing sufficient resources and helping the general public understand why this is such a crucial area.

The importance of well-educated, engaged young people will only increase as the global human population grows, consumption increases, and the effects of planetary crises such as climate change and the biodiversity crisis are felt more intensely by more people. Media literacy and social skills developed through classroom lessons help defend students against misinformation and disinformation while preparing them for a productive career. Teachers have the power to influence their students through modeling eco-conscious behavior and validating Traditional African Knowledge. Finding a path forward in environmental education that centers on the generational, trusted information shared among family and community members is a strong way to ensure that future generations are grounded, passionate, and skilled.

Empowering students and deconstructing the hierarchies left by Ghana's colonial history can be aided by thoughtfully weaving this community knowledge into the existing school system.

School gardens and local language integration give students the responsibility to tend to the earth, teach and learn from each other, and their community. In the end, the skills students learn from this type of curriculum can enable them to innovate long-lasting, equitable solutions for environmental crises and, in general, leave the world a better place than they found it.

The vision of an ideal, straightforward path to preparing future generations is unfortunately highly unlikely. Parents, policymakers, potential future teachers, and curriculum developers must shift their attitudes toward place-based African education so they can use their power to ensure students engage with this type of knowledge. Improvement to environmental education can only happen if the issues in the education system at large are addressed, this includes: increasing teacher pay, better training, more funding to support the infrastructure, teaching, and learning materials from their schools, expanding the types of schools for different types of student learning needs, ensuring migrant children go to school, and addressing gender discrimination. If solving these issues are prioritized by every stakeholder, there is a great opportunity for the young people of Ghana to craft a future based on environmental justice, respect, and an understanding of their own power.

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