

Elementary School-Based Indigenous Knowledge Pedagogical Model on Native Tree Species for Environmental Sustainability Education in Ghana



FINAL REPORT

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Glossary of Terms

ESBIK Pedagogical Model- Elementary School-Based Indigenous Knowledge Pedagogical Model

IK- Indigenous Knowledge

EE- Environmental Education

ESE- Environmental Sustainability Education

Native Tree Species- Tree species that are originally grown in a particular locality or region.

Key Findings

1. The overarching purpose of the ESBIK pedagogical model give elementary school learners broader and richer knowledge of native tree species, inciting them to be stewards of native tree species in their respective local communities.
2. The learning objectives of the ESBIK pedagogical model are SMART (specific, measurable, achievable, reliable, and time-bound) and are well-adapted and linked to the purpose, content, and activities specified in the model.
3. Constructivism and pragmatism pedagogical philosophies proposed in the ESBIK model are aligned with the plant content in the Our World and Our People curriculum. Moreover, they prioritize hands-on and experimental learning that would imbibe sustainability consciousness and competence in elementary school learners. This would incite them to act positively in conserving native tree species. Also, these pedagogical philosophies would realign the perceptions of learners positively for them to gain social experiences about the native tree species required in exhibiting pro-environmental behaviour towards the conservation of native tree species.
4. The content in the ESBIK pedagogical model relies on the plant content in the Our World and Our People curriculum. Moreover, the content proposed decolonizes the curriculum from the Western-dominated content and exemplars with indigenous knowledge of native tree species to reflect the cultural realities and lived experiences of elementary school learners. Indigenous knowledge mediates the effective teaching of native tree species and the cultural heritage of local communities which learners must know. The content on native tree species in the ESBIK pedagogical model was very satisfactory because the content was based on the standard curriculum, only that it used native tree species in their local environment as exemplars and not Western plants. This made the content reflect the cultural realities and lived experiences of learners which made teaching and learning much easier. The indigenous knowledge as the main driver of the ESBIK pedagogical model was extremely satisfactory because it increased class engagement, learners gained new knowledge that the native tree species had spiritual dimensions and respected their interconnectedness with humanity, bolstering their resolve to conserve them.
5. The teaching methods in the ESBIK model align very well with the constructivism and pragmatism philosophies. Elementary school teachers in Ghana are familiar with them since they are those proposed in the curriculum by the Ministry of Education. Also, they promote practical teaching and offer elementary school teachers the flexibility in combining various teaching methods that would help to reach the hearts of the learners during the teaching and learning activities. The teaching methods in the ESBIK pedagogical model assisted the learners to be active and interactive in the teaching and learning activities. Also, they made the lessons on native tree species very practical and relatable to the learning experiences of learners.
6. The community elders who had rich indigenous knowledge of the native tree species filled this knowledge gap that was evident in the elementary school teachers. The elders made the learners feel at home and the learners viewed them as their grandparents. The high respect for the elders motivated the learners to listen keenly to

their instruction and the elders saw their responsibility as co-instructors as a spiritual duty that would be rewarded by the ancestors and deities.

7. The suggested activities for elementary school teachers and learners offer easy-to-follow exemplars that prioritize hands-on and participatory classroom and out-of-classroom activities that would help in the effective acquisition of core skills needed by learners to identify and conserve native tree species in Ghana. The teaching and learning activities such as field trips to nature reserves, nature walks in the local communities of the learners, and other interactive sessions provided the learners with real-world experiences, making them active participants in the lessons. Class discussions, individual and group projects, and participatory art activities motivated the learners to actively engage in the learning of the content on native tree species.

8. The assessment plan in the ESBK pedagogical model offers long-term learning because it is geared purposefully toward learning, especially for low-achieving learners. It prioritizes formative assessment strategies pegged around 70% of the entire assessment of the teaching and learning activities for the content on native tree species specified with 30% summative assessment. The emphasis on formative assessment that required assessing learners during the learning processes and not at the end of the learning processes helped greatly in improving the performance of the learners, especially those with learning difficulties who often trail behind during summative assessments of subjects in their schools. Learners were informed on what they were to do to get their grades via comprehensive and well-explained assessment rubrics. This put them on guard and motivated them to perform the required activities to succeed in the OWOP subject under which the content on native tree species was delivered. This was reflected positively in the summative and overall assessments of the learners for the native tree species education.

9. In terms of knowledge assessment, sustainability awareness, consciousness, and competence, the findings revealed that learners now have heightened awareness and knowledge about the native tree species including their domestic, cultural, religious, spiritual, medicinal, and economic significance. Parents, teachers, and school administrators have affirmed that the increased knowledge of native tree species has positively changed the careless attitude of learners toward tree species in their environment to a more caring attitude. This has resulted in high sustainability interest in native tree species among learners. Learners now encourage children in their neighbourhood to protect and care for tree species in their environment. Learners now have a much better understanding of the need to take sustainability actions toward native tree species in their environment such as planting and watering native tree seedlings, caring for gardens, and engaging in environmental campaigns among their colleagues on the need to live sustainably and engage in sustainable practices toward the native tree species in their environment. The native tree species education was carried out using well-designed posters with actionable inscriptions produced by the learners.

Abstract

Education on native tree species using indigenous knowledge systems is crucial in elementary school environmental education because it sensitizes learners on the significant roles played by the native trees and their interconnections with their culture and existence. Unfortunately in Ghana, there is no pedagogical model that would aid elementary school teachers in carrying out such education. This study was aimed at developing, implementing and evaluating an indigenous knowledge inspired pedagogical model for native tree education among elementary school learners in Ghana. The convergent parallel mixed methods design that aimed at collecting quantitative and qualitative datasets on the development and evaluation of the developed pedagogical model. The results show that the pedagogical model was deemed very satisfactory in all its aspects for native tree education among elementary school learners in Ghana. The model was able to assist in developing the sustainability consciousness and competence of elementary school learners toward caring for native trees through tree planting, making of nurseries and gardens, and engaging in native tree conservation campaigns. The study recommends that the Ministry of Education should adopt, improve and widely disseminate the pedagogical model and help in its broader implementation in various elementary schools across the country.

Keywords: environmental education; elementary education; ESBIK pedagogical model; native tree species; sustainability consciousness and competence; Ghana

Background

The conservation of native tree species as part of measures to protect the fast dwindling of native forest resources is an urgent global concern (Buyinka et al., 2015; Subiakto et al., 2016; Wang et al., 2020; Lopus et al., 2023). The cause of the high deteriorating and declining numbers of native tree species is attributed to human activities that have resulted in deforestation, changes in land use, forest fragmentation, unsustainable land management practices, destructive harvesting methods, introduction of invasive species, climate change and other atmospheric conditions (Buyinka et al., 2015; Woods et al., 2016; Wang et al., 2020). The need to conserve native tree species is indispensable due to their natural, aesthetic, cultural, historical and socio-economic values (Lopus et al., 2023). Their conservation is very important because they assist greatly in the restoration of ecosystems, supporting rural livelihoods and contributing to cleaner environments as they act as sequester for carbon (Byabashija et al., 2004). In the case of Ghana, approximately 906 native tree species exist but statistics show that over 120 out of the 725 native tree species that have been assessed using the IUCN Red List of Threatened Species categories and criteria as Critically Endangered (CR), Endangered (EN) or Vulnerable (VU) (BGCI and CPSG Report, 2023).

Hence, there is the need to map recovery pathways for the native tree species in Ghana. This would help decrease or eradicate the rate of deforestation, conserve the native tree species to restore degraded forest covers and engage in reforestation projects that target native tree species to prevent possible extinction of the native tree species in the country. In October 2022, the Botanic Gardens Conservation International (BGCI) and the Conservation Planning Specialist Group (CPSG)

collaborated with the Council for Scientific and Industrial Research (CSIR) of the Forest Research Institute of Ghana (FORIG) organized a four-day conservation planning workshop aimed at planning conservation action for Ghana's native threatened trees with a focus on thirty-eight endemic or near-endemic tree species (BGCI and CPSG Report, 2023). In the comprehensive report on 'Planning conservation action for Ghana's threatened tree species' that was later published in February 2023, one of the actionable objectives of the conservation strategy to recover Ghana's threatened native tree species was that by 2030 'Key stakeholders have increased awareness and a sense of responsibility for Ghana's threatened trees' (Objective 15, Planning conservation action for Ghana's threatened tree species, 2023). One of the conservation actions was aimed at engaging in massive biodiversity education in the country that focuses on the youth.¹ This is in tandem with the views expressed by many scholars in the literature that without a well-planned environmental education, efforts geared at conserving biodiversity will be impossible (Kostova & Atasoy, 2008; Morar & Peterlicean, 2012; Suryani et al. 2019; Adom, 2022).

The global call for the use of environmental education as an instrument for conserving biodiversity is not a recent development. The 19th principle of the United Nations Conference on the Human Environment, 1972 reiterated the need to prioritize biodiversity education among the youth when it said 'Education in environmental matters for the younger generation... giving due consideration to the underprivileged, is essential (UNESCO, 1977). Likewise, the National Curriculum Council (NCC) highlighted the need to engage children in environmental education stating that it assists them in understanding environmental issues, molding them to take part in the decision making processes regarding the use of the environment and its resources and more importantly, developing their intellectual and creative abilities to be responsible adults who make positive and constructive contributions toward biodiversity conservation (National Curriculum Council, 1990). Environmental education in recent times is seen as the principal and fundamental tool for preparing learners to be responsible adults who can exhibit pro-environmental behaviours (Dobson, 2010) necessary to protect the rich biological diversities including native tree species in their respective communities. It is not surprising that UNESCO during the World Conference on Education for Sustainable Development in Berlin, Germany called for an urgent introduction of environmental education as a core curriculum component in all countries by 2025 (UNESCO, 2020). Environmental education is recognised as a means for encouraging the active participation of learners toward sustainability (Hadjichambis & Reis, 2020), making them environmentally-literate learners. It informs people, especially young ones of the basic requirements for a harmonious human-nature relationship that incites them to live sustainably (Suryani et al. 2019). This education is crucial because a greater section of youth are losing touch of their native biodiversity which negatively impacts on their desire to protect biodiversity now and in the future (Hooykaas et al., 2019). In Ghana, the need to integrate environmental education into the curriculum for Ghanaian schools was first

¹15.6 Educate the youth: school conservation campaigns (e.g. clubs, competitions and debates) and influence the curriculum in junior high school and senior high school to cover biodiversity-linked subjects (Planning conservation action for Ghana's threatened tree species, 2023).

mentioned in the 2002 Ghana Education Review Committee's Report. The report concluded that the absence of a well-planned environmental education programme in Ghanaian schools is detrimental to the holistic development of students as they lack sustainability ideals that would make them exhibit pro-environmental behaviours. Today, environmental education has been formally introduced as an integrated programme in the Integrated Science curriculum for all levels of education in Ghana. However, the Environmental education (EE) programme in the country has been criticized as focusing on Western science and epistemology neglecting the indigenous knowledge systems that are community-based or place-based approaches efficient, impactful and sustainable for typical Ghanaian learners (Acharibasam & McVittie, 2022). While the BGCII and CPSG Report (2023) advocate education of the youth, it acknowledges the contributions and adoption of instructional pedagogies rooted in traditional/indigenous knowledge sharing modes.² Adom (2022) has recommended some pedagogical suggestions that hinge on indigenous knowledge systems that could be used to teach elementary school learners topics in environmental education. He avers that it is essential to target environmental education at the early developmental stages of children, what he refers to as 'catching them young'. He is not far from the truth because the early childhood stage is said to be the most critical stage where children could be assisted to connect to nature and its abounding biological diversities (Berry et al., 2020). After all, it is within the childhood stages that their individual personalities are formed (Bissoli, 2014). It is at this stage that the concepts of environmental protection and sustainable development need to be well constructed to ensure that they have the right awareness, knowledge, skills and attitudes to live sustainably as they grow into adulthood (Abass, 2020).

Elementary education on biodiversity conservation would help create the awareness of biodiversity conservation in children at their early years (Eshun, 2022). In the case of Ghana, Eshun (2011) explored how the Sankofa postcolonial methodology with emphasis on the use of interpretative poems based on traditional knowledge systems in Ghana could be used for environmental education. Similarly, Acharibasam and Mcvittie (2021) explored the potential of incorporating indigenous knowledge into the Western knowledge that has dominated environmental education in Ghana by introducing the two-eyed seeing methodology. This methodology for environmental education incorporates indigenous folk stories, elders as additional instructors for environmental education in classrooms and the linking of content on environmental education in the curriculum to the local cosmovision in Ghanaian communities. While these efforts by the previous researchers are commendable, their contributions were limited to offering ideas on how indigenous knowledge could impact positively on the methodology for environmental education in Ghana. There exists a lacuna in the development of effective pedagogical models from indigenous knowledge systems for environmental education in Ghana, especially those focused on raising the sustainability consciousness and competencies of elementary school learners on their native tree species. It is this gap in the studies on environmental education at the elementary school level in Ghana that this study addressed. In the implementation stage of the ESBIIK pedagogical model, five native tree species were used in

²15.2 Create interfaces for traditional/indigenous knowledge sharing under the Objective 15 of the Planning conservation action for Ghana's threatened tree species, 2023 report.

developing content for the native tree species education. These were *Pericopsis elata* (*Kokrodua*), *Ceiba Pendantra* (*Onyina*), *Alstonia boonei* (*Nyamedua*), *Newbouldia laevis* (*Sesemasa*) and *Blighia sapida* (*Ackee/Akyee*). The research objectives that underpin the study were to:

1. Find out existing pedagogical models based on indigenous knowledge systems that have been effectively used for environmental sustainability education among elementary school children
2. Develop a pedagogical model based on Ghanaian indigenous knowledge systems to be used for native tree education on native tree species in Ghana
3. Evaluate the impacts of the native tree education using the pedagogical model based on Ghanaian indigenous knowledge systems on the elementary school learners' sustainability consciousness and competence

Methods

Research Design

The convergent parallel mixed method research design was adopted for the study. The researchers assert that a triangulation of multiple data sets would enhance the rigor in the validation of the study's results (Bazeley & Kemp, 2012) when the two data sets (i.e. qualitative and quantitative data) converge and achieve complementarity for a broader scientific insight and interpretation of the elementary school learners sustainability consciousness and competencies in native tree species in Ghana. Specifically, phenomenology guided the qualitative aspect of the study. Long engagements with elementary school teachers and learners were carried out to garner rich qualitative data on the pedagogical model deployed for the teaching and learning activities on selected native tree species in Ghana. On the other hand, the quantitative aspect was carried out using the descriptive quantitative method. This was necessary to help measure the potential impacts and effectiveness of the developed pedagogical ESBIK model for native tree species education in the selected elementary schools.

Data Collection Instruments and Procedure

Adapted versions of the *SCQ-instrument for measuring Sustainability Consciousness* (Gerike et al., 2019) and the *Instrument for Measuring Student Sustainability Competencies* (Waltner et al. 2019) were used for ascertaining the levels of elementary school learners' sustainability consciousness and sustainability competencies after the implementation of the ESBIK pedagogical model (Appendix D & Appendix E). The theoretical constructs in the two instruments in relation to the key aspects of the ESBIK pedagogical model were used in developing a questionnaire that was used for soliciting the views of curriculum experts and elementary school teachers on the ESBIK pedagogical model before its implementation (Appendix F).

Also, the theoretical constructs in the two instruments guided the development of the semi-structured interview guide that were used for ascertaining the perspectives of the elementary school teachers and elementary school learners after the pedagogical model in the teaching of native tree species (Appendix G & Appendix H). A

classroom observation checklist (Appendix I) was designed to find out how well the ESBIK pedagogical model was implemented and to note other best practices used by the elementary school teachers in the classroom activities.

All the six developed instruments for the data collection activities were pretested before their eventual administration for the actual studies. Few aspects of the instruments were revised based on the suggestions that were garnered during the pre-testing phase of the instruments. The pre-implementation and post-implementation questionnaires were administered in-person to all the study participants. Eighteen (18) study participants consisting of three (3) curriculum experts and fifteen (15) elementary teachers filled the pre-implementation questionnaire for the ESBIK pedagogical model. The post-implementation questionnaire was answered by fourteen (14) elementary school teachers who took part in the implementation of the ESBIK pedagogical model.

Twenty (20) classroom observations of lessons using the ESBIK pedagogical model were carried out within three weeks. The trained research assistants with the assistance of the school administrators used the developed classroom observation guide in assessing the lessons on native tree species education.

The steps in Bowen (2009) *document analysis* methodology was applied in the review of existing pedagogical models for environmental education at the elementary school level based on traditional knowledge systems from the literature. The information garnered were arranged adapted using an adapted version of the keys in assessing best practices from various case studies on environmental education by Silva (2022). *Qualitative personal interviews* with fourteen (14) elementary school teachers who voluntarily wanted to share more detailed feedback after the implementation of the ESBIK pedagogical model in the two schools were interviewed. Similarly, *focus group discussions* with twenty (20) elementary school learners in the two elementary schools (5 in each FGD group) were conducted. In all the FGDs, local language (*Asante Twi*) was used to enable the learners to comprehend the questions and give accurate answers. These were transcribed into English Language by the researchers and vetted by two *Asante Twi* and English Language experts at the Kwame Nkrumah University of Science and Technology, Kumasi, Ghana.

Study Areas

Two elementary schools in the Ashanti region were selected as study sites for the implementation of the ESBIK pedagogical model. The two schools were selected from Akrofrom, a small town in the Afigya-Kwabre South district of the Ashanti Region, Ghana. These schools were selected because of convenience. One public elementary school and one private elementary school were selected to give a holistic evaluation of the ESBIK pedagogical model's implementation.

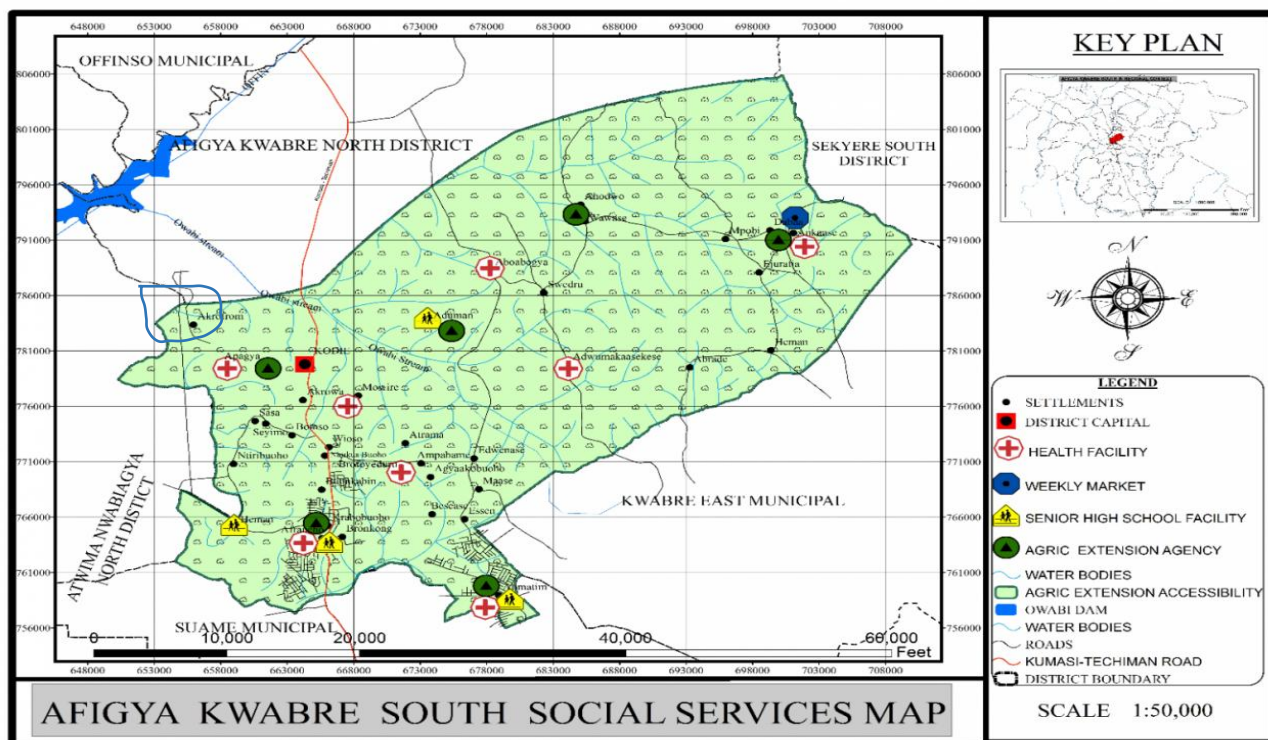


Figure 1: Map of Akrofrom, Afigya Kwabre South District, Ashanti Region, Ghana
 Source: Afigya Kwabre South District Assembly,
<https://aksda.gov.gh/index.php/profile/>

Population, Sampling Designs and Sampling Sizes

The population for the study primarily consisted of curriculum developers, school administrators, elementary school teachers, and elementary school learners. Elderly residents in the two communities who have experiential knowledge in indigenous knowledge systems related to native tree species were involved in the study to serve as co-instructors in the implementation of the ESBK pedagogical model. Stratified random sampling was used for selecting the sample for the study. Each stratum consisted of a population description (i.e. elementary school teachers, elementary school learners, school administrators, curriculum experts, elderly residents with expertise in IK on native tree species). Eight elementary school teachers were selected from each of the two elementary schools, one from each elementary grade level from Kindergarten one (1) to Basic School level six (6). Five (5) elementary school learners were selected from each elementary school grade level to enrol in the study. Therefore, forty (40) elementary school learners were selected from each elementary school. The two school administrators for the two selected schools were selected for the study. Also, three curriculum experts who were willing to participate in the study were recruited. Moreover, two elderly residents with experiential knowledge in indigenous knowledge on native tree species who voluntarily agreed to partake in the study as co-instructors in the implementation of the ESBK pedagogical model were also recruited.

Sample Description

<i>Population</i>	<i>Private School</i>	<i>Public School</i>	<i>Sample Size</i>
Elementary School Teachers	8	8	16
Elementary School Learners	40	40	80
School Administrators	1	1	2
Curriculum Experts			3
Elderly Residents with IK in native tree species			2
Total Sample Size	49	49	103

Ethical Procedures

A formal consent to conduct the study was sought from Kodie Education Unit at Afigya Kwabre South District, Ashanti Region of Ghana. The school administrators in the two selected elementary schools officially granted the permission to conduct the study. All the study participants were asked to complete and sign an informed consent form. All the parents of the elementary school learners who were selected for the study were invited to consent to the study by signing the informed consent form on behalf of their children.

Data Analysis Procedure

The data that were garnered from the pre-implementation and post-implementation questionnaires for the ESBIK pedagogical model administered were analyzed quantitatively in descriptive statistics (frequencies and percentages) using the SPSS for Windows Version 26.0. The level of satisfaction and importance of each of the specified aspects of the ESBIK pedagogical model before and after its implementation were measured. The qualitative data collected via personal interviews, focus group discussions and classroom observations were analysed based on the various themes/aspects of the ESBIK pedagogical model using the steps in qualitative thematic analysis (Dahlberg et al., 2008) and with the help of the NVivo 12 software.

Results and Discussion

Research Objective One

Find out existing pedagogical models based on indigenous knowledge systems that have been effectively used for environmental sustainability education among elementary school children

The study did not chance on a fully-fledged or developed pedagogical model based on indigenous knowledge systems. However, there were recommended teaching methods and best practices from various case studies on how to incorporate indigenous knowledge systems and local culture-driven methodologies in environmental education. These case studies have been reviewed and discussed in this section with the sole objective of picking essential lessons that could assist in the development of an elementary school-based indigenous knowledge pedagogical model on native tree species for environmental sustainability education in Ghana. Table 1 presents a

summary of the works consulted. The table adapted the keys in assessing best practices from various case studies on environmental education by Silva (2022). The researchers realised that the keys in the table would assist them best in extracting the lessons from the existing case studies that present best practices in incorporating indigenous knowledge in environmental education and/or time-tested methodologies for environmental education at the elementary school level. While her study focused on the use of problem-solving as an indispensable ingredient in environmental education, aspects in the table such as ‘problem question’ and ‘fundamental concepts’ were replaced with ‘TEK aspects highlighted’ and ‘teaching methods recommended’. Also, the section ‘Main resources’ in Silva (2022) was not used. These modifications were made to suit this study’s overarching goal of developing an elementary school-based pedagogical model based on indigenous knowledge.

The various aspects of the modified table for this study comprises ‘case study’, ‘school year/grade’, ‘IK aspect highlighted’, ‘Teaching methods recommended’, ‘Main examples of developed epistemic practices’ and ‘Main resources’. ‘Case study’ shows the reference of the study that presents best practices with lessons that could be adopted or modified in the development of the elementary school-based pedagogical model based on indigenous knowledge. ‘School year/grade’ indicates the academic level and students that were involved in the case study. ‘IK aspect highlighted’ presents the indigenous knowledge component recommended in the case study to be used for environmental education. Finally, ‘Main examples of developed epistemic practice’ describes how the indigenous knowledge aspect was used. The case studies that were reviewed were from Acharibasam and McVitte (2021), Eshun (2011), Adom (2022), Blanchet-Cohen and Reilly (2013), El Batri et al. (2022), Karwacki (2023) as well as Palmer and Neal (1994) (Table X).

Acharibasam and McVitte (2021) experimented with a two-eye methodology that incorporates indigenous knowledge with Western scientific knowledge for environmental education in Ghana. They investigated how the indigenous knowledge of the Kasenas residing in the Boania vicinity in Northern Region of Ghana could be effectively harnessed in environmental education. The teaching methods relied on the folktales and folklores, myths, cosmological belief systems and totemic practices related to plant and animal life in the region. Biodiversity resources that were known and ingrained in the lived experiences of pupils were used as basis for instruction by teachers. Child-centered approaches were used for the environmental education while field trips and local elders served as regular and auxiliary instructors in the classroom and out-of classroom activities. Overall, the tactful deployment of indigenous knowledge inspired content alongside the Western scientific knowledge resulted in a heightened awareness of environmental knowledge among the kindergarten learners who were the focus of the study.

Eshun (2011) explored what he terms as the ‘*Sankofa* postcolonial methodology’ that aims at bringing back the ignored indigenous knowledge of the past into conservation education. He discussed the use of Akan orature specifically interpretative poems for conservation education in Ghana using the Fiema-Boabeng Monkey Sanctuary and its surrounding communities as study areas. He creatively developed various interpretative poems from historical narratives, myths, totemic practices and cosmological belief systems related to the use of biodiversity in the Akan context. He mentioned the use of local elders, priests, practitioners of herbal medicine as potential

instructors of environmental education. He cited the use of sacred groves and spaces where biodiversity are in their pristine forms as spaces for learning about biodiversity and the environment. Though his ideology was not experimented in a classroom setting, it offers relevant insights for the use of indigenous knowledge pedagogy.

Adom (2022) conceptualized environmental education at the elementary school level using indigenous knowledge pedagogy. He discussed the tactful use of traditional songs, folklore and folktales, landscape planting and design projects, participatory art activities on biodiversity, field visits to biocultural heritage sites and the use of local elders as co-instructors in classroom and out-of-classroom activities in environmental education. Though the proposed indigenous knowledge pedagogical strategies was not implemented in a classroom setting via this study, they hold very promising results.

Blanchet-Cohen and Reilly (2013) explored teachers' perspectives on the implications of culture-responsive environmental education and its related best practices from their experiences. They theorize that an effective and holistic environmental education must draw on content from transdisciplinary fields including cultural, religious and ethnic conceptions of the environment. They emphasized the use of activity-based, experiential and child-centred teaching strategies that would incite elementary school learners to take conservation actions to save the biodiversity in their societies in the classroom and off-classroom activities.

El Batri et al. (2022) investigated the approaches, methods and difficulties in teaching environmental themes in a primary school. They found out that when teaching strategies deployed for environmental education fail to engage learners, it makes it difficult to develop pro-environmental behaviours in them. They noted that learning objectives for environmental education should target the holistic development of learners, touching on their cognitive, affective, spiritual (religious), moral, behaviourist, pragmatic, and praxis aspects. To be able to achieve this, they experimented with the combination of experiential, systemic, holistic, interdisciplinary, cooperative, critical, problem-based and project-based approaches during the learning processes in environmental education in the primary school. This resulted in very high impact of environmental education on learners as they were able to exhibit pro-environmental behaviours.

Karwacki's (2023) study was aimed at designing a practical environmental education curriculum for elementary school learners. It combined three models for environmental education, which were place-based education, nature journaling and community partnerships. The curriculum designed prioritized the use of indigenous knowledge of place, through hands-on experiential activities in environmental activities related to the biodiversity in the localities of elementary school learners. This place-based experiential learning such as maintaining community gardens and stewardship activities assisted in the development of a sense of place through the conscious creation of emotional attachment between learners and their environments. The curriculum also stressed the need to approach environmental education by drawing on content from multiple disciplines such as natural science, history, geography, literacy and writing.

Palmer and Neal (1994) proposed various teaching strategies for elementary school environmental education. They stressed the need for elementary school teachers to

engage learners in action-based and participatory activities such as drawing and sketching of tree species with neatly written identification and descriptions of their physical characteristics such as shape, colour, habitat, planting cycle, etc. They posit that these activities would nurture in the learners the desire to protect tree species in their environment.

The best practices in the above case studies were incorporated in the development of the ESBIK pedagogical model.

Table X: Case Studies of Best Practices for Elementary School Environmental Education

Case Study	School Year/Grade	IK aspect highlighted	Teaching methods recommended	Main examples of developed epistemic practices
<p>Acharibasam and McVitte (2021)</p> <p>Two-eye methodology that incorporates indigenous knowledge with Western scientific knowledge for environmental education in Ghana</p>	<p>KG2 Curriculum</p>	<p>Cosmo-vision of the Kasenas of Boania in Northern Region of Ghana such as:</p> <p>Religiosity of activities and relationship between humans and the environment such as:</p> <ol style="list-style-type: none"> 1. totemic relationships-some environmental resources believed to be kinsmen 2. deifying some environmental resources (rivers/water bodies, plants, animals, etc.) 	<ol style="list-style-type: none"> 1. Place-based and context-relation with the known biological resources in their environment 2. Use of Folklores, folktales and myths related to the environmental resources 3. Local elders as regular and auxiliary instructors 4. Use of outdoor activities 5. Flexible child-led 	<p>Known local environmental resources used in the everyday life activities of the pupils and related to their experiences were used in the environmental education.</p> <p>Local sites were visited for children to engage in experiential outdoor activities related to the content taught in the classroom.</p> <p>The local elders adopted flexible approaches that are child-led and less-structured in teaching children environmental education.</p> <p>Strong reliance on folk songs, folk stories, myths and cosmological beliefs in the deployment of environmental education.</p>

<p>Eshun (2011)</p> <p>Sankofa postcolonial methodology discusses the use of Akan orature specifically interpretative poems for conservation education in Ghana using the Fiema-Boabeng Monkey Sanctuary and its surrounding communities as study areas.</p>	<p>Not specified</p>	<p>Cosmological belief systems about biodiversity</p> <p>Totemic relationship between humans and environmental resources (Monkeys as kinsmen)</p> <p>Folk stories of persons in the society who had serious physical and spiritual consequences for maltreating and/or misusing biodiversity resources in the environment.</p>	<ol style="list-style-type: none"> 1. Use of interpretative poems that incorporates folk songs, folk stories etc. 2. Local elders, chiefs, fetish priests, and practitioners of traditional plant medicine as living repositories of indigenous knowledge as instructors of environmental education. 3. Sacred groves as spaces for learning about biocultural heritage and the need to conserve biodiversity. 	<p>The use of interpretative poems in narrating causes and effects of bad and good environmental attitudes exhibited by known members in the community.</p>
<p>Adom (2022)</p> <p>Conceptual paper that suggests pedagogical strategies for environmental education of children in Ghana</p>	<p>Elementary school learners (KG-BS 6)</p>	<p>Biocultural heritage of native plants and animals in Ghana- history, relationship and uses (domestic, spiritual, medicinal).</p>	<ol style="list-style-type: none"> 1. Using traditional songs that illuminate the unique characteristics and relevance of plants and animals in the ecosystem. 2. Assigning landscape planting and design projects for elementary school learners 3. Using participatory art activities such as drawing and painting projects that describe children's experiences with local biodiversity species. 4. Use of folklore or folk stories that describe the historical, mythical and cultural of biodiversity resources (plants, animals, water bodies, etc.). Assigning students field projects to collect these folk stories from old sages in their communities. 	<p>The epistemic practices from these IK methodologies are yet to be explored through implementation</p>

			<p>5. Use of sacred groves, parks, homesteads, farms and reserves as field/study sites of biodiversity where participatory outdoor activities are well planned such as nursing native tree species or replanting native seedlings in degraded spaces at the sites.</p> <p>6. Elders as instructors of environmental education to share their wide repertoire of wisdom on native plants and animals with the elementary school learners.</p>	
<p>Blanchet-Cohen and Reilly (2013)</p> <p>Exploration of teachers' perspectives on the implications of culture-responsive environmental education and its related best practices from their experiences.</p>	Elementary school learners	Religious, cultural and ethnic conceptions of the environment	<p>1. Activity-based approaches in environmental education aimed at inciting attitudes in children that incite them to demonstrate actions toward the environment.</p> <p>2. Experiential strategies such as bringing plant species to the classroom for children to connect with them to experience it.</p> <p>3. Taking a transdisciplinary approach to environmental education where ideas from various disciplines are drawn to the subject.</p> <p>4. Flexible approach by allowing the children to engage in discussion and research.</p> <p>5. Holistic study of the content on environmental education (information</p>	Adoption of holistic approach to environmental education from transdisciplinary fields including cultural, religious and ethnic conceptions of the environment.

			regarding the linguistic, cultural, religious, and ethnic conceptions of the environment).	
El Batri et al. (2022) Approaches, methods and difficulties in teaching environmental themes in a primary school	Elementary school learners	No IK content	learning objectives for environmental education must relate to (cognitive, affective, spiritual (religious), moral, behaviourist, pragmatic, and praxis) learning processes for environmental education should be (experiential, systemic, holistic, interdisciplinary, cooperative, critical, problem-based and project-based approaches.	It was observed that the pedagogical approaches which were most valued by the teachers they engaged in environmental education in sequential order were those that were related to affective-moral, religious, behavioural, cooperative, and problem-solving approaches. Effective teaching methods often used were active methods such as discovery method and small group method
Karwacki (2023) Designing a practical environmental education curriculum	Elementary school learners	Emphasis on indigenous knowledge of the place related to the environmental resources such as trees, etc.	Place-based education that creates emotional attachment between learners and their environment to promote sense of place. Premium on experiential learning through hands-on experiences in environmental projects in real-life scenarios. Emphasis on multidisciplinary approach where various disciplines such as natural science, history, geography, literacy and writing are incorporated. The use of variety of teaching	Participation in stewardship activities or maintaining community gardens assisted in building a sense of place and emotional attachment in learners to specific spots in their communities bolstering their resolve to conserve nature.

			approaches to build the sense of place in learners.	
Palmer and Neal (1994) Teaching strategies for environmental education	Elementary school learners	No IK content	Aspects of trees such as dried leaves are mounted on a card, labelled and covered with a film and used as a teaching aid. Drawing and sketching of the tree species with neatly written identification and descriptions of their physical characteristics such as shape, colour, habitat, planting cycle, etc.	Class participatory activities on native tree species bolstered learners resolve to conserve the flora species in their communities,.

Research Objective Two: Develop a pedagogical model based on Ghanaian indigenous knowledge systems to be used for environmental sustainability education on native tree species in Ghana

Pedagogical Framework Context

The ESBIK pedagogical model is designed to provide comprehensive guidelines for elementary school teachers in Ghana on how to effectively teach elementary school learners about native tree species in Ghana. The model relies on approaches in the indigenous knowledge systems in Ghana, especially those related to ecological and environmental education. It employs the known vehicles of indigenous knowledge in Ghana such as traditional songs, folklore and folk stories, poems, and proverbs as well as the experiential knowledge of elders who are knowledgeable in indigenous knowledge systems in relaying the knowledge on native tree species. That notwithstanding, the model relies on best practices in deploying environmental education from various case studies around the globe. Notable for the indigenous knowledge systems of Ghana, this pedagogical model uses an interdisciplinary approach in delivering the content on native tree species while emphasizing child-led teaching and learning approaches that prioritize active, collaborative, experiential, discovery, and problem-solving strategies pivoted in the principles of constructivism. It is tailored in tandem with the content strands on the environment, especially those directly related to plant or tree species in the curriculum for Kindergarten one through to Basic School level six of the Our World and Our People subject which is compulsory for all elementary school learners in both private and public schools in Ghana.

The overarching purpose of the ESBIK pedagogical model is to help elementary school teachers know and implement best teaching practices in instructing elementary school learners about the native tree species in Ghana using the time-tested indigenous knowledge approaches that reflect their cultural realities (United Nations, 2005). It is aimed at throwing a spotlight on the knowledge of native tree species which is often overlooked in environmental education using teaching methodologies hinged on indigenous knowledge systems that sync with the lived experiences of elementary school learners in Ghana. This ESBIK pedagogical model is to be used in deploying environmental education related to the acquisition of knowledge on native tree species in Ghana, many of which are threatened, among elementary school learners. It is to safeguard the indigenous and scientific knowledge systems of these native tree species among elementary school learners to enhance their sustainability consciousness and competence in the native tree species in Ghana.

Learning Objectives

The learning objectives of this pedagogical model have been adopted from the model for holistic teaching and learning in environmental education (Palmer, 1998) as found in Figure 1. The model projects education about, for, and in or through the environment with emphasis on the acquisition of knowledge, understanding, skills, and attitudes that would help learners experience, demonstrate concern, and action toward the environment. The ideals espoused in the model have been modified to suit

the overarching purpose of this pedagogical model which is meant for native tree species education in Ghana. This is in agreement with the suggestion of Palmer and Neal (1994) that learning objectives for environmental education in any particular topic must be developed in relation to learning about, for, and in or through the environment with attention paid to how environmental experiences and attitudes would lead to environmental concern and action.

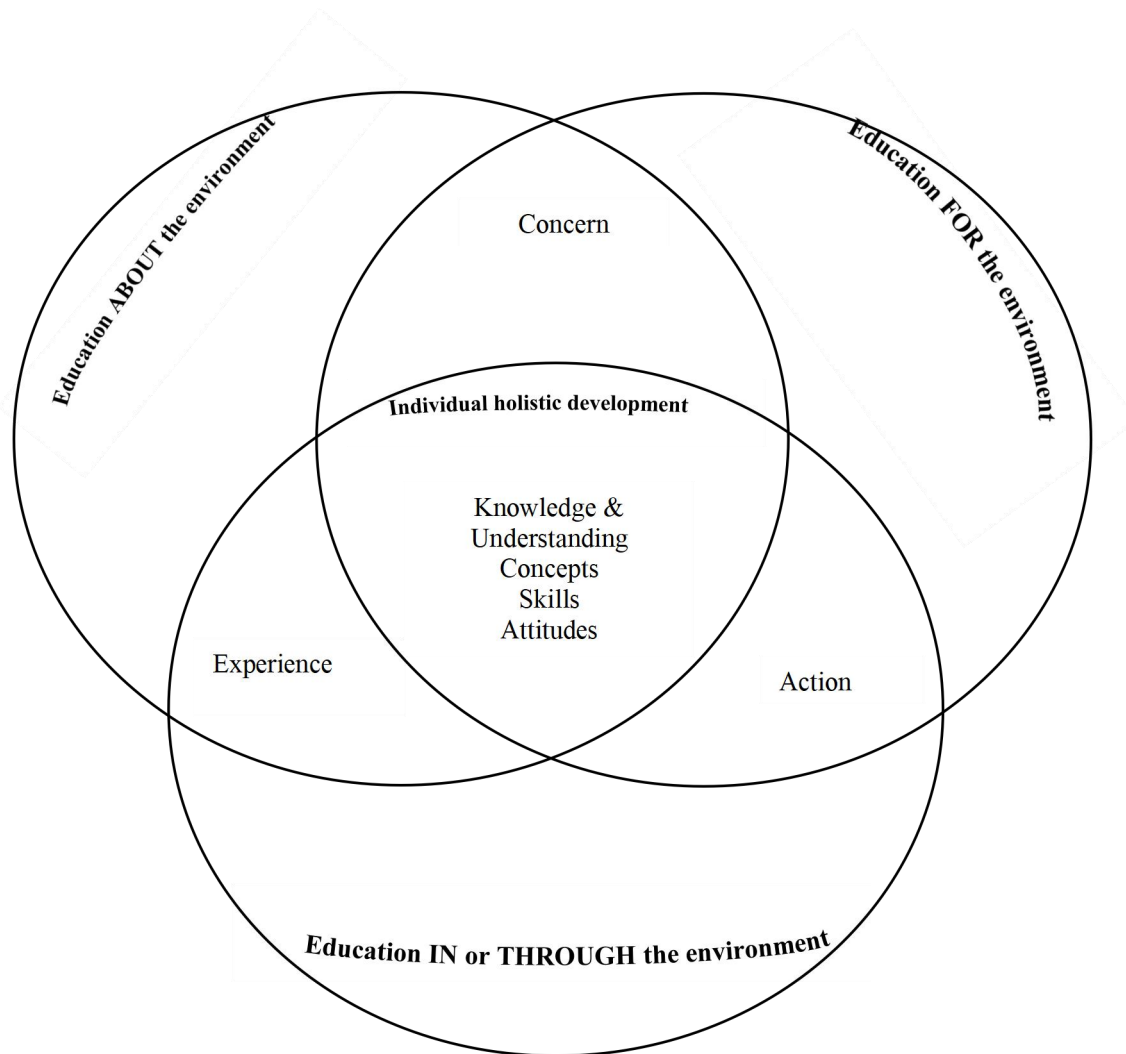


Figure 1: Model for holistic teaching and learning in environmental education
Source: Palmer (1998)

The broad learning objectives of this pedagogical model are to help elementary school learners to be able to:

1. recognize and acquire experiential knowledge on some of the native tree species in Ghana.
2. describe the different uses of some of the native tree species in Ghana such as their cultural, economic, and medicinal uses.
3. engage in a variety of activities that demonstrate their concern for conserving the native tree species in their communities and Ghana.

4. exhibit environmental management skills and sustainable actions toward the native tree species in their communities and Ghana.

Content

The content of the ESBIK pedagogical model is structured to equip elementary school learners in Ghana to be knowledgeable about the native tree species in their localities and Ghana. However, for the content to find a fit in the existing curriculum, the model relies on the contents on plants in the Our World and Our People Curriculum where children are expected to learn about plants in Ghana (Ministry of Education, 2019). This environmental education content on plants is tailored to utilize native tree species in illustrating the content to be taught. For instance, if the curriculum requires students to learn about the parts of a tree, a native tree species will be used for treating the content to consciously assist the elementary school learners to be well versed in the knowledge about their native tree species in their home region. That said, since the model aims at broadly catering to environmental education among elementary school learners, the content is also guided by the theoretical constructs in Palmer's (1998) model for holistic teaching and learning in environmental education.

The ESBIK pedagogical model recommends that elementary school teachers select from the native tree species from the list of 38 threatened native species reported by the Botanic Gardens Conservation International (BGCI) and the Conservation Planning Specialist Group (CPSG) (2023) in (Appendix A) such as *Pericopsis elata* - Kokrodua, *Talbotiella gentii*- Takrowa-nua etc. In addition to any one of these listed threatened native tree species, other native tree species with rich indigenous knowledge within the locality or community where the school is situated should be covered in the content.

Indigenous Knowledge Component that Drives the Model

This model acknowledges that the knowledge of native tree species relies greatly, if not entirely, on the indigenous knowledge systems in Ghana. Native tree species are culturally significant and knowledge about them and their conservation depends on the indigenous knowledge in the communities where they are located (Mucioki et al., 2022). Knowledge of the native tree species has been woven into traditional songs, proverbs, poems, folk stories, and myths, as well as cultural values and norms in the respective communities where these native tree species are found (Adom, 2018; 2019; 2022; Awuah-Nyamekye, 2013). In communities where indigenous knowledge regarding native tree species looms high, such as Africa, nature, culture, and the people are inextricably linked (Mucioki et al., 2021). The model agrees with the Paris Agreement (Article 7) as well as the Aichi Biodiversity Target 17 (Convention on Biological Diversity) emphasizes the need to respect traditional knowledge related to biodiversity, herein, native tree species in countries. Successful conservation projects related to native tree species have solidly relied on indigenous knowledge (Malunguja et al., 2021; Regal et al., 2021; Yalley et al., 2020; Maru et al., 2019; Elias, 2018; Adom, 2018; Reo & Ogden, 2018; Acquah et al., 2018; International Fund for Agricultural Development, 2016; Bruyere et al., 2016; Tongkul, 2013). With this in mind, the model's proposed content and all its other aspects are driven by the indigenous knowledge regarding these native tree species. The model attempts to provide supplementary data on the indigenous knowledge gathered on some of the

native tree species in Ghanaian communities. Though these indigenous knowledge supplementary data are not exhaustive, they offer a guide to elementary school teachers in the successful implementation of the model in the classroom.

Pedagogical Philosophies

This pedagogical model utilizes the principles in the constructivism and pragmatism philosophies. These are in tandem with the directions in the new curriculum for elementary schools in Ghana (Ministry of Education, 2019). Constructivism is a recent epistemological perspective that views knowledge as constructed based on human perception and social experience (Alam, 2017). It is closely related to pragmatism and relativism. Constructivism is a learning theory that emphasizes the active role of learners in their understanding. It suggests that learners must construct their knowledge through experiences and reflections rather than passively receiving information. It prioritizes experiential learning which is the focus of this pedagogical model for teaching elementary school learners about native tree species in Ghana. Elementary school teachers who are to use this pedagogical model are expected to encourage the learners to ask questions, explore, and discover new things (Adom, Yeboah, & Ankrah, 2016). Constructivism can be applied in teaching and learning through problem-based, inquiry-based, and project-based learning approaches which foster critical thinking and collaboration skills (Alsharif, 2014; Sert, 2008), the very teaching methods endorsed by this pedagogical model.

Also, this pedagogical model applies the principles in the pragmatism philosophical paradigm. Pragmatism is a philosophical framework that adopts a deconstructive perspective, wherein truth is not regarded as an absolute concept but rather as a dynamic and practical framework that facilitates comprehension of the natural world (Pham & Bui, 2021). Pragmatism as an educational philosophy emphasizes practical and experiential teaching and learning which are the basis for learning proposed by this pedagogical model. Pragmatic educators use active project-based learning methodologies, prioritizing subject matter relevant to students. Pragmatism in education emphasizes student-centered teaching, hands-on learning, and collaboration, valuing students' needs, interests, experiences, trial-and-error, and interdisciplinary learning (Pham & Bui, 2021; Etherington, 2020). Pragmatic thinking in education emphasizes functional objectives, learner-centered instruction, hands-on learning, teamwork, and interdisciplinary learning. While pragmatism prioritizes practical outcomes and students' needs, constructivism emphasizes active knowledge construction. Constructivism values students' autonomy, dialogue, inquiry, and puzzlement. It is hoped that by integrating these philosophies into this pedagogical model, elementary school teachers could create effective learning environments by encouraging students to think independently and promote dialogue, inquiry, and puzzlement, as they learn about the native tree species in their localities in Ghana.

Teaching methods

Successful environmental education at the elementary school level globally has been carried out using teaching methods that are underpinned by the constructivism and pragmatism teaching pedagogical philosophies exemplified above (Palmer & Neal, 1994). The various cases of best practices in environmental education that were reviewed also emphasized a combination of these teaching methods rooted in the

constructivism and pragmatism pedagogical philosophies such as inquiry-based (interaction/discussion), activity-based, discovery, observation-based and experiential learning, team teaching with community elders (Karwacki, 2023; El Batri et al., 2022; Acharibasam & McVitte, 2021; Shukla, 2021; Abbas, 2020; Blanchet-Cohen & Reilly, 2013; Eshun, 2011; Granić & Ćukušić, 2007). These teaching methods that have been prescribed in the pedagogical model are similar to those suggested in the Our World and Our People curriculum to be studied by elementary school learners in Ghana (Ministry of Education, 2019). It is hoped that when these learner-centered teaching methods are effectively deployed by elementary school teachers, they will enable the elementary school learners to be knowledgeable in native tree species in Ghana and charge them to engage in helpful projects that would lead to the conservation of the native tree species in their respective communities.

Suggested Activities for the Elementary School Teachers

The model presents suggested activities, though not exhaustive, for elementary school teachers on effective ways of delivering the specified content. These activities take cognizance of indigenous ways of knowing and approaches to knowledge dissemination. This approach is consciously used to make students knowledgeable not only about the native tree species in their localities but also about their esteemed biocultural heritage. While these suggested activities are aimed primarily at nurturing sustainability competence and consciousness of native tree species in elementary school learners, they would also help in preserving the indigenous knowledge about the native tree species that have been preserved in oral traditions. Interestingly, the indigenous knowledge medium encouraged by this model such as folk songs, folktales, myths, poems, proverbs, etc. give insight into the phenology, morphology, and medicinal as well as cultural uses of the native tree species within the diverse Ghanaian communities. The model also gives elementary teachers the flexibility to create suitable forms of the indigenous knowledge medium based on their class preference. For instance, if folk songs are noted by an elementary school teacher as the preferred choice by his or her elementary school learners and elicit the expected learning outcomes, available poems or proverbs about the native tree species to be learned could be creatively transformed into songs. This model prioritizes experiential learning and as such requires learners to engage in active and practice-led learning activities (drawing, painting, site visits/observations, planting, and other forms of experimentation, etc.) to discover the knowledge of the native tree species. Therefore, elementary school teachers using the ESBK pedagogical model are encouraged to plan participatory activities for learners as they embark on field visits and real-life observations and interactions with native tree species in their natural environments within their localities.

Suggested Activities for Elementary School Learners

The suggested activities for the elementary school learners are what they are expected to do in response to the suggested activities from their elementary school teachers. All the suggested activities for the elementary school learners are action-oriented and are meant to heighten their level of engagement with the native tree species in their communities and Ghana as a whole. Many of the activities suggested are to enable elementary school learners to discover knowledge on native tree species in Ghana. It allows them to interact with their family and community members who are well-

versed in the indigenous knowledge about the native tree species. This builds a cordial relationship between the learners and members of their community, making it easy for them to demonstrate positive concern and action toward the conservation of the native tree species in their immediate environment (i.e. homes, schools, communities, etc.). Also, participatory and activity-based activities such as recording, reporting, and presenting their observations about the native tree species within small groups with different abilities would foster collaborative and teamwork skills. These skills are essential as they grow up working with their kinsmen in taking positive actions toward the conservation of the native tree species and by extension, the biodiversity resources in their environment.

Learning Outcomes

The learning outcomes are the expected behavioral change in elementary school learners after the ESBIK pedagogical model has been successfully implemented. At the end of implementing the pedagogical model, the elementary school learners would be able to demonstrate sustainability consciousness and competence towards the native tree species in their communities and Ghana. Specifically, the elementary school learners would be able to demonstrate:

1. native tree recognition skills via thorough description of the distinctive characteristics of some native tree species in their communities and Ghana.
2. an understanding of the cultural, economic, and medicinal uses of some native tree species in their communities and Ghana
3. concern towards the conservation of some native tree species in their communities and Ghana through an engagement in planned environmental activities
4. environmental management skills, and sustainable actions toward the native tree species in their communities and Ghana

Expected Environmental Sustainability Core Competencies

While the ESBIK pedagogical model is broadly aimed at nurturing sustainability consciousness and competence in native tree species in elementary school learners in Ghana, there are specific core competencies that are expected to be developed in the elementary school learners as they learn the content and engage in the various activities specified in the model. These include knowledge in indigenous knowledge of native tree species, critical thinking skills, problem-solving skills, environmental management skills, cultural identity traits, good observational and descriptive skills, collaborative and team-building skills, good sense of place, good communication and linguistic skills, drawing/representational skills, and creativity and innovation skills. The listed core competencies are not exhaustive since other core competencies are likely to be developed in some elementary school learners as they are exposed to the ESBIK pedagogical model which would be recorded in the future. Interestingly, the expected competencies of the model listed are in tandem with the expected competencies of the environmental education approach (Sauvee, 1999).

Assessment strategies (Formative and Summative)

The ESBIK pedagogical model aims at a balanced assessment format of implementing both formative and summative assessment strategies in assessing learning processes and learning outcomes respectively (Mogboh & Okoye, 2019).

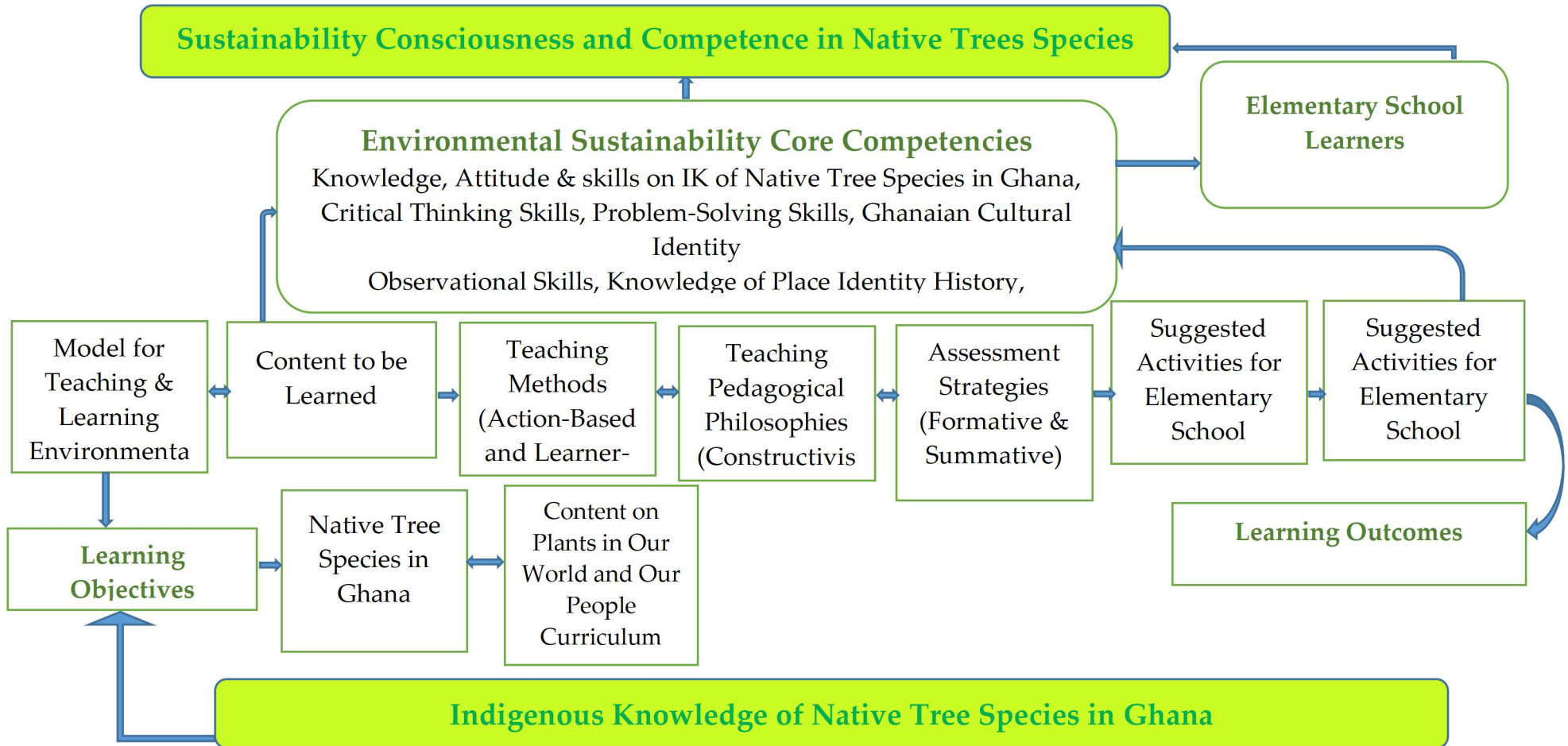
However, the model is biased toward formative assessment (it proposes 70% formative assessment as against 30% summative assessment) because it places a high premium on the active engagement of students in their learning processes to develop their high-order thinking skills while offering student data consistently that would be used in improving the teaching and learning processes of the model (Looney, 2011). While helping students in owning their learning, it assist teachers in identifying misconceptions and gaps in learning to improve the teaching and learning strategies (Trumbull & Lash, 2013).

More so, formative assessment is noted for helping in achieving quality and equity in elementary education (OECD, 2005) because it has proven to be beneficial to low-achieving elementary school learners as it encourages and motivates them to engage fully in the teaching and learning processes in the classroom (Gezera et al., 2021). The ESBIK pedagogical model is to assist elementary school learners in acquiring recognition skills on the native tree species in their environment, an often ignored content in elementary education (Kaasinen, 2009).

The formative assessment types recommended by this pedagogical model include the use of in-class discussions, group work and presentations, individual project works, homework assignments, and short quizzes. Teachers using this model must note that the examples of the formative assessment are not exhaustive and they should be flexible with the overarching objective of motivating students to learn so that they own their learning, impacting positively in the achievement of the learning outcomes. They should aim at encouraging students' reflection, promoting learners' self-motivating beliefs and self-esteem, encouraging teacher and learner dialogue, fostering learner self-reflection, promoting prompt, detailed, and actionable feedback as well as offering opportunities for learners to meet the desired performance expected. Teachers should embed the suggested assessment examples within the teaching and learning processes. They must adopt scaffolding strategies to assist learners in gaining comprehensive knowledge and understanding of native tree species in Ghana so that they would be able to demonstrate concern and actions towards the conservation of the native tree species in their environment.

That notwithstanding, summative assessment in the form of final presentations and instructor-created exams (standardized but flexible to accommodate individual learning needs especially for those with learning difficulties to ensure equity and inclusion) will be used by the model and assessed as 30% of the final grade expected. Teachers must design comprehensive rubrics of the expected performance criteria with their corresponding grades. In the instructor-created exams, teachers must design clear and effective questions that offer learners the freedom to express comprehensive answers to their meaning-making of the learned content.

Figure 3: The ESBIK Pedagogical Model



Source: Developed by the Researchers

Appendix 1

Structure of the ESBIK Pedagogical Model

Learning Objectives	Specific Native Tree Species Content	Related content strand in the Our World and Our People Curriculum/ Elementary School Level	Indigenous Knowledge component	Pedagogical philosophies	Teaching methods	Suggested Activities for the Elementary School Teachers	Suggested Activities for Elementary School Learners	Learning Outcomes	Expected Environmental Sustainability Core Competencies
recognize and acquire experiential knowledge of some of the native tree species in Ghana	Describe native tree species and give examples from your locality and country (Use the list of native species in Appendix A such as <i>Pericopsis elata</i> - Kokrodua, <i>Talbotiella gentii</i> - Takrowa-nua, etc., and others in the locality of your school) <i>Pericopsis elata</i> (Kokrodua) <i>Talbotiella gentii</i> (takurowa-nua) <i>Ceiba pentandra</i> (Onyina) <i>Blighia sapida</i> (Akyee/Ackee) <i>Vernonia amygdalina</i> (onwono/Awonwone) <i>Voacanga africana</i> (Bedaa) <i>Bryophyllum pinnatum</i> (Egoro/Tan me o wu) <i>Morinda lucida</i> (Konkroma) <i>Alstonia boonei</i>	Recognize different plants in the Environment (BS 1)	Traditional or folk songs, poems, and proverbial sayings about any of the native tree species in Appendix B or the locality of your school.	Constructivism & Pragmatism	Combination of: Inquiry-based (interaction/ discussion) Activity-based Discovery Observation-based Experiential learning Team teaching with community elders	1. Sing with learners, any traditional or folk song related to any of the native tree species described. OR narrate or dramatize a poem, proverb, or myth about the native tree species described. 2. Invite an elder or parent well-versed in indigenous knowledge related to any of the native tree species in the locality or Ghana to relate them with the learners in the school. NOTE: The number of native tree species described should be based on the academic level of learners. For instance, examples of native tree species for KG to BS 2 learners must not exceed two. NOTE: If there are no known songs, the teacher must create a song using indigenous content about the native tree species being described based on a known proverb, myth,	1. Listen, learn, and practice singing the traditional or folk song about the native tree species. 2. Write and learn the names (scientific name and indigenous name) of the native tree species. Learn their pronunciations and spellings.	Elementary school learners demonstrate native tree recognition skills via thorough descriptions of the distinctive characteristics of some native tree species in their communities and Ghana.	Knowledgeable in Indigenous knowledge of native tree species Critical Thinking skills Problem-Solving skills Cultural Identity Good observational and descriptive Skills Good sense of place Good communication and linguistic skills Drawing/ representational skills Creativity and Innovation skills

<p>(Nyamedua) <i>Margaritaria discoidea</i> (Pepea) <i>Newbouldia laevis</i> (Sesemasa) <i>Trema orientalis</i> (Sesea) <i>Funtumia elastica</i> (<i>Funtum</i>)</p> <p>Describe the parts of a native tree species (Use the list of threatened native species in Table X such as <i>Pericopsis elata</i> - Kokrodua, <i>Talbotiella gentii</i>- Takrowa-nua, etc., and others in the locality of your school)</p>	<p>Demonstrate understanding of the parts of plants (KG 1 & KG 2)</p>	<p>Local and/or indigenous names and common descriptions are given to the parts of the native tree species. (Find examples in Appendix C)</p> <p>Myths and folk stories related to the local or indigenous names given to the parts of the native tree species. (Find examples in Appendix C)</p>	<p>Constructivism & Pragmatism</p>	<p>Combination of: Inquiry-based (interaction/discussion) Activity-based Discovery Observation-based Experiential learning Team teaching with community elders</p>	<p>folk story, or any information about it.</p> <p>3. Present a picture or draw on the board, the native tree species and write underneath their scientific name and local/indigenous names.</p> <p>4. Present a picture/video of the native tree species being described and ask students to comment on their distinctive features after ensuring that its scientific name as well as local names have been rehearsed with the learners.</p> <p>If there are seedlings, leaves, or barks of the native tree species at hand, show them to the learners as you describe them. OR If there are some of the native tree species in the locality (homestead, farm, reserve, etc.), take the students there for them to experience the tree (by touching, enjoying its shade, walking around it, etc.).</p> <p>5. Ask students to draw the native tree species described and color them.</p> <p>NOTE: Depending on the academic level and abilities of the learners, the teacher can ask them to either draw the entire native tree species or any of their parts, such as their leaves. (Check Appendix A for pictures of some native tree species in Ghana)</p> <p>Assignment:</p>	<p>3. Critically observe the picture or video about the native tree species and comment on their distinctive features.</p> <p>4. Draw the native tree species (or any of its parts) observed in the picture, video,, or during the field visit and color it.</p> <p>Assignment:</p>		
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	<p>Discuss the growth development of native tree species from your locality and country (Use the list of threatened native species in Table X such as <i>Pericopsis elata</i> - Kokrodua, <i>Talbotiella gentii</i>- Takrowa-nua, etc., and others in the locality of your school)</p> <p>Describe the relationship between native tree species and the environment (specifically, soil, sunlight, and water)</p>	<p>Demonstrate understanding of how plants grow (KG 1 & KG 2)</p> <p>Demonstrate understanding of how living and non-living things in the environment are related (BS 5)</p> <p>i. Plants and soil ii. Plants and sunlight iii. Plants and water (BS 4)</p>	<p>Traditional or folk songs, poems, myths, and proverbial sayings about the growth development of the native tree species in Appendix A or the locality of your school.</p> <p>Folk stories and songs as well as myths on the significant roles of sunlight, water, and soil in the growth of native tree species. Most of these IK exemplifies and personifies the unique and mutual relationship that exists between environmental resources such as soil, water, and sunlight and some native tree species (Appendix B).</p>	<p>Constructivism & Pragmatism</p>	<p>Combination of: Inquiry-based (interaction/discussion) Activity-based Discovery Observation-based Experiential learning Team teaching with community elders</p>	<p>Ask learners to ask their parents or an elderly relative to relate any traditional song, proverb, myth, or folk story about the native tree species described for discussions in class.</p> <ol style="list-style-type: none"> 1. Present two native tree growth development scenarios (with the aid of pictures, videos, and/or drawings) and brainstorm with students on why and how the growth development of the native tree species differs from each other. 2. Discuss with the learners, the factors that generally affect the growth development of native tree species. 3. Ask children (provide support) to make a chart/poster of the factors that generally affect the growth development of native trees (Illustrations/drawings that offer pictorial explanations of those factors must be encouraged). 4. With the assistance of the community elders, provide learners with proverbs, poems, folk stories, myths, cultural practices, etc. that highlight the factors that hinder or promote the growth development of native tree species. 5. Go for a nature walk within the locality or outside 	<p>Ask your parents or elders in the family of your locality, traditional songs, proverbs, myths, or folk stories about a known native tree species and present them to your teacher and classmates.</p> <ol style="list-style-type: none"> 1. Observe and share your views with your classmates on the growth development scenarios of the native tree species presented by the teacher. 2. Listen and actively participate in the discussions on the factors (sunlight, soil, and water) affecting the growth development of native tree species discussed. 3. Help learners in designing a chart/poster with pictorial drawings/illustrations on the factors that affect the growth development of native tree species. 4. Listen and ask questions on the proverbs, poems, folk stories, myths, cultural practices, etc. Recounted by the community elders on the factors that hinder or promote the growth development of native tree species. 5. Observe the varying conditions on the growth 	<p>Elementary school learners demonstrate knowledge and understanding of the growth development conditions of native tree species in their locality/Ghana.</p> <p>Elementary school learners demonstrate knowledge of the significant roles and relationships between the environment (soil, water, and sunlight) with native tree species.</p>	<p>Knowledgeable in Indigenous knowledge of native tree species</p> <p>Critical Thinking skills</p> <p>Problem-Solving skills</p> <p>Cultural Identity</p> <p>Good observational and descriptive Skills</p> <p>Good sense of place</p> <p>Good communication and linguistic skills</p> <p>Drawing/ representational skills</p> <p>Creativity and Innovation skills</p>
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					<p>the locality (You can arrange to send the elementary school learners to a sacred grove/ forest reserve or particular spots in farms, homes, and streets in the locality) and observe why some plants grow very well but others not. Back to the classroom, call on learners randomly to contribute to the discussion on what things native tree species need to grow well.</p> <p>6. Ask learners to grow one native tree species (with seedlings available) in the locality and put them under two or three different places and conditions in and outside the classroom. Put somewhere there is no sunlight. Grow some in rocky soil, put some outside, grow some in good soil, and some in the classroom but without any water. Have students move to the grown native tree species observe them and come back and share their observations.</p> <p>Assignment:</p> <p>Assign group projects for your class in designing a chart/poster on the growth development conditions for native tree species in Ghana.</p>	<p>development of native tree species during the nature walk.</p> <p>Assignment:</p> <p>Together with your class group, design a chart/poster on the growth development conditions for native tree species in Ghana.</p>	
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Describe the different uses of some of the native tree species in Ghana such as their cultural, economic, and medicinal uses	Describe the economic, medicinal, cultural, spiritual (religious), and domestic (food) uses of native tree species	Demonstrate understanding of the functions of the parts of plants e.g. Plants provide oxygen, food, medicine, fuel wood, and clothes. (KG 1 & KG 2)	<p>Economic, cultural, spiritual/religious, and medicinal uses of the native tree species</p> <p>Medicinal Uses (e.g. seeds, barks, roots, and leaves for treating specific diseases (Appendix C).</p> <p>Cultural (spiritual/religious) Uses- haven/abodes of deities for worship, homesteads for spiritual protection, etc.</p> <p>Domestic Uses of native tree species e.g. fruits and leaves for food, etc.</p>	Constructivism & Pragmatism	<p>Combination of:</p> <p>Inquiry-based (interaction/discussion)</p> <p>Activity-based</p> <p>Discovery</p> <p>Observation-based</p> <p>Experiential learning</p> <p>Team teaching with community elders</p>	<p>1. With the assistance of community elders knowledgeable in IK, discuss with the learners, the economic, cultural, spiritual/religious, and medicinal uses of the native tree species. E.g. cultural (spiritual/religious) Uses- haven/abodes of deities for worship, homesteads for spiritual protection, etc.</p> <p>2. With the assistance of community elders knowledgeable in IK, discuss with the learners, the medicinal Uses (e.g. seeds, barks, roots, and leaves for treating specific diseases (Appendix C).</p> <p>3. With the assistance of community elders knowledgeable in IK, discuss with the learners, the domestic uses of native tree species e.g. fruits and leaves for food, etc.</p> <p>4. With the assistance of community elders knowledgeable in IK, discuss with the learners, the local industries from the native tree species such as herbal industries, fuel wood</p>	<p>1, 2 & 3. Actively participate and share your knowledge on the cultural, spiritual/religious, medicinal, and domestic uses of native tree species in your locality and Ghana.</p> <p>4. Actively participate in the class discussion on local industries from native tree species.</p> <p>6. Write down questions you want to ask managers and workers in industries that</p>	<p>Elementary school learners' ability to describe the economic, cultural, spiritual/religious, and medicinal uses of the native tree species in their locality and Ghana.</p>	<p>Knowledgeable in Indigenous knowledge of native tree species</p> <p>Critical Thinking skills</p> <p>Problem-Solving skills</p> <p>Cultural Identity</p> <p>Good observational and descriptive Skills</p> <p>Good sense of place</p> <p>Good communication and linguistic skills</p> <p>Drawing/ representational skills</p> <p>Creativity and Innovation skills</p>

						<p>industries, wood and furniture industries, brewery industries, textile industries, etc. in your locality and Ghana.</p> <p>5. Plan a visit to local industries that use native tree species and interact with the managers and workers</p> <p>Assignment: Ask learners to describe the different uses of native tree species (text, pictures/drawings, etc.)</p>	<p>use native tree species. Record the feedback and your general observations during the visit for post-class discussions.</p> <p>Assignment: Describe the different uses of native tree species (text, pictures/drawings, etc.).</p>		
Engage in a variety of activities that demonstrate their concern for conserving the native tree species in their communities and Ghana.	Engage in helpful environmental campaigns against human activities that negatively affect native tree species in your locality and their adverse effects such as the release of greenhouse gases and climate change.	Record human activities that cause over-concentration of greenhouse gases and climate change (BS 5) Learners design posters and flyers in groups to create awareness of plant/tree conservation in their school (BS 5)	Traditional knowledge systems in your locality and Ghana frown on negative human activities that affect the conservation of native tree species such as myths, taboos, cosmological belief systems, cultural practices and events (like festivals), folk stories, folk songs, etc. (Check Appendix B).	Constructivism & Pragmatism	Combination of: Inquiry-based (interaction/discussion) Activity-based Discovery Observation-based Experiential learning Team teaching with community elders	<p>1. Discuss with the learners, the human activities that negatively affect native tree species in your locality such as deforestation, wildfires, indiscriminate clearing of land for building projects, farming practices that negatively affect native tree species, etc.</p> <p>2. Discuss with the learners, the adverse effects of human activities related to native tree species such as climate change, overconcentration of greenhouse gases, etc.</p> <p>3. Help students in examining the traditional and contemporary agronomic practices that conserve native tree species in the environment.</p> <p>4. Team-teach with community elders and discuss with learners, the traditional knowledge systems in your locality and Ghana that frown on negative human activities</p>	<p>1 & 2. Share your views with your class on human activities that negatively affect native tree species in your locality and their adverse effects.</p> <p>3. Share your views on how to prevent the adverse effects of negative human activities using traditional and contemporary agronomic practices.</p> <p>4. Listen and share the traditional knowledge systems to know that frown on the negative human activities that adversely affect native tree species in</p>	Elementary school learners engage in environmentally friendly activities that demonstrate their concern for the conservation of native tree species in their communities and Ghana.	<p>Knowledgeable in Indigenous knowledge of native tree species</p> <p>Critical Thinking skills</p> <p>Problem-Solving skills</p> <p>Cultural Identity</p> <p>Good observational and descriptive Skills</p> <p>Good sense of place</p> <p>Good communication and linguistic skills</p> <p>Drawing/representational skills</p> <p>Creativity and Innovation skills</p>

						<p>that affect the conservation of native tree species such as myths, taboos, cosmological belief systems, cultural norms, practices, and events (like festivals), traditional and community-owned practices, folk stories, folk songs, etc.</p> <p>5. Assist learners in producing pictorial posters or flyers and engage in school and community campaigns on the need to eschew negative human activities such as wildfires, deforestation, etc.</p>	<p>your locality and Ghana.</p> <p>5. Design and produce a pictorial poster or flyer and use it in the planned school and community campaign against the negative human activities that adversely affect native tree species in your locality or Ghana.</p>		
<p>Exhibit environmental management skills and sustainable actions toward the native tree species in their communities and Ghana.</p>	<p>Engage in helpful environmental projects such as planting native tree species, etc.</p>	<p>Demonstrate understanding of the importance of trees in our environment (BS 6)</p> <p>Explain how to make and maintain a garden (BS 3)</p> <p>Plant trees in their communities as a civic duty (BS 6)</p>	<p>Traditional agronomic planting strategies for native tree species (Appendix B)</p> <p>Cultural practices involved in tree planting among some communities and their relevance (scientific) (Appendix B)</p>	<p>Constructivism & Pragmatism</p>	<p>Combination of:</p> <p>Inquiry-based (interaction/discussion)</p> <p>Activity-based</p> <p>Discovery</p> <p>Observation-based</p> <p>Experiential learning</p> <p>Team teaching with community elders</p>	<p>1. Liaise with community elders to discuss with learners, the best traditional agronomic planting strategies for native tree species.</p> <p>2. Liaise with a forester (from any of the forest reserves) to instruct learners on contemporary planting strategies for native tree species.</p> <p>3. Assist learners in appreciating the similarities and differences between traditional and contemporary tree planting strategies.</p> <p>4. Lead learners to visit a nature reserve and engage in native tree-planting activities with the assistance of foresters and community elders.</p>	<p>1. Listen and share in the discussion on the best traditional agronomic planting strategies for native tree species.</p> <p>2. Listen and share in the discussion on contemporary planting strategies for native tree species.</p> <p>3. Listen and share in the discussion on the differences and similarities between traditional and contemporary tree-planting strategies.</p> <p>4. Observe, record, and engage in native tree species planting activities with the assistance of foresters and community elders.</p>	<p>Elementary school learners' exhibition of management skills and sustainable actions toward the native tree species in their communities and Ghana.</p>	<p>Knowledgeable in Indigenous knowledge of native tree species</p> <p>Critical Thinking skills</p> <p>Problem-Solving skills</p> <p>Creativity and Innovation skills</p>

						<p>5. Foresters share knowledge on seed handling, the establishment of nurseries to grow seedlings, storage behaviors, propagation, and planting of native tree species.</p>	<p>5. Record the knowledge shared from the foresters on seed handling, establishment of nurseries, grow handling, storage behaviors, propagation, and planting of native species. Write down the processes of their project e.g. daily watering, measuring the height of the trees weekly, number of leaves.</p>		
						<p>6. Assist learners in undertaking group planting projects of native tree species in the school.</p>	<p>6. Join your group and take an active role in the group planting projects of native tree species in the school.</p>		

Pre-implementation and Post-Implementation of the ESBIK Pedagogical Model

After the development of the ESBIK pedagogical model, a pre-implementation questionnaire was designed to measure the level of satisfaction and importance of each of the aspects of the model (Table 3). However, after the implementation of the ESBIK pedagogical model, a post-implementation questionnaire was administered to measure its level of satisfaction and importance on elementary school learners' knowledge assessment on native tree species, sustainability awareness on native tree species as well as sustainability consciousness and competence toward the conservation of native tree species in their locality and Ghana as a whole (Table 4). A total of eighteen (18) study participants comprising of three (3) curriculum experts and fifteen (15) elementary school teachers (Table 2). All the study participants were Akan by ethnicity. This is as a result of the study location which is stepped in a typical Akan zone.

Table 2: Participants' Information

Socio-Demographic Variables	Items	Frequency	Percent
Teaching/ Academic grade	KG 1	2	11.1
	KG 2	2	11.1
	Curriculum experts	3	16.7
	Primary 1	1	5.6
	Primary 2	3	16.7
	primary 3	1	5.6
	Primary 4	2	11.1
	primary 5	2	11.1
	Primary 6	2	11.1
	Total	18	100
Job Description	Curriculum experts	3	16.7
	Elementary school teachers	15	83.3
	Total	18	100
Name of School/Organization	Akrofrom D/A Primary	11	61.1
	NaCCA	2	11.1
	KNUST	1	5.6
	Royal Nicky's	4	22.2
	Total	18	100
Ethnic Society	Akan	18	100
Location	Kumasi	3	16.7
	Kodie-Akrofrom	15	83.3
	Total	18	100

Table 3 shows the results from the questionnaire administered to measure the level of satisfaction and importance of the ESBIK pedagogical model before its implementation.

Table 3: Pre-Implementation Evaluation of the ESBIK Pedagogical Model

		N	Percent
How important is the overarching purpose of the ESBIK pedagogical model to general environmental education in Ghana?	Very Important	13	72.2
	Extremely important	5	27.7
	Total	18	100
How well do you think the proposed learning objectives in the ESBIK pedagogical model (refer to the model attached) would help in achieving its overarching purpose of helping elementary school teachers know and implement best teaching practices in instructing elementary school learners about the native tree species in Ghana using the time-tested indigenous knowledge approaches that reflect their cultural realities	Moderately important	2	11.1
	very important	11	61.1
	Extremely important	5	27.8
	Total	18	100
How well do you think the proposed content in the ESBIK pedagogical model would help elementary school teachers in the effective teaching and learning of native tree species in Ghana	Somewhat important	1	5.6
	Moderately important	1	5.6
	very important	11	61.1
	Extremely important	5	27.8
	Total	18	100
How important is the proposed indigenous	Moderately important	1	5.6
	very important	15	83.3
	Extremely important	2	11.1

knowledge component in the ESBIK pedagogical model that would assist in the effective teaching and learning of the content on native tree species in Ghana	Total	18	100
How well do you think the proposed pedagogical philosophies in the ESBIK pedagogical model would help teachers in their quest to teach elementary school learners about native tree species in Ghana?	Somewhat important	1	5.6
	Very Important	13	72.2
	Extremely important	4	22.2
	Total	18	100
How well do you think the proposed teaching methods in the ESBIK pedagogical model would help teachers in their quest to teach elementary school learners about native tree species in Ghana?	Moderately important	3	16.7
	very important	9	50
	Extremely important	6	33.3
	Total	18	100
How well do you think the proposed suggested activities for elementary school teachers in the ESBIK pedagogical model would effectively help them in teaching elementary school learners about native tree species in Ghana?	Moderately important	2	11.8
	very important	14	82.4
	Extremely important	1	5.9
	Total	17	100
How well do you think the proposed learning outcomes in the ESBIK pedagogical model (refer to the model attached) would help in achieving its overarching purpose and learning objectives of the model?	somewhat important	1	5.6
	very important	12	66.7
	Extremely important	5	27.8
	Total	18	100
How important are the expected environmental sustainability competencies proposed in the ESBIK pedagogical model to elementary school learners' environmental sustainability competence and consciousness?	Moderately important	2	11.1
	very important	13	72.2
	Extremely important	3	16.7
	Total	18	100

How well do you think the proposed assessment strategies in the ESBIK pedagogical model would help teachers in their quest to ascertain the learning processes and learning outcomes of elementary school learners on native tree species in Ghana?	somewhat important	2	11.1
	Moderately important	2	11.1
	very important	10	55.6
	Extremely important	4	22.2
	Total	18	100

Table 4: Post-Implementation Evaluation of the ESBIK Pedagogical Model

Section 1: The Effectiveness of the ESBIK Pedagogical Model

		N	Percent
what is your level of satisfaction of the content on native tree species in your locality and Ghana that was taught?	Very satisfactory	12	85.7
	Extremely satisfactory	2	14.3
	Total	14	100
what is your level of satisfaction on the teaching methods used for the native tree species in your locality and Ghana?	Very satisfactory	7	50
	Extremely satisfactory	7	50
	Total	14	100
what is your level of satisfaction of the use of indigenous knowledge such as folk songs, myths, folk stories, cosmological belief system that were used for the teaching native tree species in your locality and Ghana?	Very satisfactory	9	64.3
	Extremely satisfactory	5	35.7
	Total	14	100
what is your level of satisfaction of on the adoption of community elders as co-instructors in the teaching of native tree species in your locality and Ghana?	Very satisfactory	7	50
	Extremely satisfactory	7	50
	Total	14	100
what is your level of satisfaction of the teaching and learning activities used for teaching you native tree species in your locality and Ghana?	Very satisfactory	10	71.4
	Extremely satisfactory	4	28.6
	Total	14	100
what is your level of satisfaction	Very satisfactory	11	78.6
	Extremely satisfactory	3	21.4

of the assessment strategies used for eliciting your understanding of the content taught on native tree species on your locality and Ghana?	Total	14	100
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Section 2: Sustainability Awareness of Native Tree Species among Elementary School Learners after the Implementation of the ESBIK Pedagogical Model

		N	Percent
How would you rate the current understanding on the need for the sustainability of native tree species in their locality and Ghana?	Slightly better	1	7.1
	Much better	13	92.9
	Total	14	100
How would you rate the belief of elementary school learners on the importance of protecting and practicing sustainability toward the native tree species in their locality and Ghana??	My belief has somewhat strengthened	1	7.1
	My belief has very much strengthened that it's even more important	13	92.9
	Total	14	100

Section 3: Elementary School Learners' Knowledge Assessment on Native Tree Species in Their Locality and Ghana

		N	Percent
How knowledgeable are you in describing the physical characteristics of some native tree species (those that were taught) in their locality and Ghana?	Moderately knowledgeable	1	7.1
	Very Knowledgeable	9	64.3
	Extremely Knowledgeable	4	28.6
	Total		100
How knowledgeable are you in describing the medicinal uses of some native tree species (those that were taught) in their locality and Ghana?	Somewhat Knowledgeable	1	7.1
	Moderately knowledgeable	2	14.4
	Very Knowledgeable	10	71.4
	Extremely Knowledgeable	1	7.1
Total	14	100	
How knowledgeable are you in describing the economic uses of some native tree species (those that were taught) in their locality and Ghana?	Somewhat Knowledgeable	1	7.1
	Moderately knowledgeable	2	14.3
	Very Knowledgeable	11	78.6
	Total	14	100
How knowledgeable are you in describing the religious/spiritual	Moderately knowledgeable	4	28.6
	Very Knowledgeable	10	71.4
	Total	14	100

uses of some native tree species
(those that were taught) in their
locality and Ghana?

Section 4: Determination of Elementary School Learners in Engaging in Environmental Practices related to Native Tree Species after the Implementation of the ESBK Pedagogical Model

		N	Percent
How determined are you to exhibit sustainability competence and consciousness by engaging in environmentally friendly practices such as the planting of native tree species in their locality and Ghana?	Moderately determined	1	7.1
	Very determined	13	92.9
	Total	14	100
How determined are you to exhibit environmental sustainability competence and consciousness by engaging in environmentally friendly practices such as the refraining from negative human activities and behaviour that destroys native tree species and their habitats in their locality and Ghana such as wild fires, deforestation, etc.?	Very determined	8	57
	Extremely determined	6	43
	Total	14	100
How determined are you to exhibit environmental sustainability competence and consciousness by engaging in environmentally friendly practices such as engaging in an environmental campaign and education (leading or assisting others) against negative human activities and behaviour that destroys native tree species and their habitats in their locality and Ghana such as wild fires, deforestation, etc.?	Moderately determined	2	14.3
	Very determined	9	64.3
	Extremely determined	3	21.4
	Total	14	100

Section 5: Attitudes of Elementary School Learners Toward the Sustainability of Native Tree Species in Their Locality and Ghana

How sure are you that you would exhibit managerial skills and sustainability actions towards the native tree species in their locality and Ghana such as voluntarily planting native tree seedlings, preventing the indiscriminate cutting down of native tree species, watering or helping a naturally-growing native tree seedling?	Very sure	11	78.6
	Extremely sure	3	21.4
	Total	14	100

The overarching purpose of the ESBIK pedagogical model is very important because it will help elementary school learners to gain holistic knowledge on their native tree species since their knowledge is interwoven in the indigenous knowledge systems of local communities (Pre-Implementation Stage)

Generally, the study participants had high hopes that the model would be able to impact significantly on the sustainability consciousness and competence of elementary school learners who would be instructed with it. The overarching purpose of the model was rated very important (72.2%) and extremely important (27.7%) (Table 3). All the curriculum experts mentioned during the interview sessions that it was very important to tailor environmental education pedagogy to indigenous knowledge especially for content on native tree species. They asserted that the model will help elementary school learners to gain holistic knowledge on their native tree species since their knowledge is interwoven in the indigenous knowledge systems of local communities. Some of the views shared before the implementation of the model were:

‘This model will give a broader knowledge to the elementary school learners on the essential roles that their native plant species play and their benefits to their immediate environment’ (Curriculum Expert 2, Personal Interview, October 4 2023).

The results affirms the view of Lopus et al. (2023) that native tree education is important as a means of preserving the aesthetic, cultural, medical and other indispensable values of these tree species.

The learning objectives of the ESBIK pedagogical model are SMART and are aligned to the overarching purpose, activities and pedagogical activities specified for environmental education in Ghana by the Ministry of Education (Pre-Implementation Stage)

The four learning objectives that support the overarching purpose of the ESBIK pedagogical model were seen by all the study participants as important with 95% indicating that they were very important. The curriculum experts said that all the four learning objectives met the SMART (specific, measurable, achievable, reliable and time-bound) requirements. Literature confirms that when objectives are SMART, they stand better chances of achievement (Substance Abuse and Mental Health Services Administration, n.d.). Both the curriculum experts and elementary school teachers mentioned that they were very important in the quest of instructing learners in native tree species because of their association with the content and activities specified in the curriculum for environmental education by the Ministry of Education. Some of the views shared have been presented below:

‘The learning objectives are well adapted as they are linked to the purpose, content and pedagogical activities specified in the model’ (Elementary School Teacher 12-School B, Personal Interview, October 6 2023).

The ESBIK pedagogical model is rooted in the constructivism and pragmatism pedagogical philosophies that place premium on hands-on and experiential learning that re-aligns the experiences of elementary learners toward sustainability

consciousness and competence needed to conserve native tree species (Pre-Implementation Stage)

The pedagogical philosophies for the ESBIK model are rooted in the constructivism and pragmatism philosophies for teaching. These were seen by all the study participants (100%) as appropriate as they aligned very well with the curriculum by the Ministry of Education. Moreover, the elementary school teachers indicated that both constructivism and pragmatism prioritized hands-on and experiential learning which is action-based and essential in nurturing sustainability competence and consciousness for native tree species in elementary school learners.

‘Constructivist and pragmatist pedagogical philosophies emphasize hands-on experimental learning and reflection where students actively construct their knowledge and understanding through exploration and discovery. This promotes critical thinking and understanding in learners and would charge them to be actively involved in conservation initiatives for native tree species especially the threatened species’ (Elementary School Teacher 6-School A, Personal Interview, October 14, 2023).

The findings affirm the views of Adom, Yeboah and Ankrah (2016) that constructivist pedagogical philosophies when deployed in teaching and learning, assists learners to explore and discover content through hands-on and experiential learning. Likewise, the pragmatist pedagogical approach prioritizes practical learning that make learners active participants in the teaching and learning processes (Pham & Bui, 2021).

Level of Satisfaction and Appropriateness of the Content in the ESBIK Pedagogical Model (Pre-Implementation Stage)

In relation to the specified content to be taught, 100% of the study participants affirmed that the content proposed in the ESBIK pedagogical model was not alien to the plant content already specified in the Our World and Our People curriculum that has already been approved by the Ministry of Education used at the elementary school level. All the study participants (100%) agreed that the introduction of indigenous knowledge in the teaching of the content on native tree species was very important. The elementary school teachers were excited that the content was rather tailored to the indigenous knowledge on the native tree species which is often ignored or overshadowed with Western dominated content and exemplars in the existing curriculum. Also, the curriculum experts intimated that indigenous knowledge as the basis for teaching native tree species was very important and appropriate as it would serve as a vehicle for preserving cultural heritage.

‘Indigenous knowledge is very essential in understanding the native plant species since it involves interesting learning activities such as poems, songs, proverbs etc, and also has insightful wisdom to be passed on to future generations which plays a crucial role in preserving cultural heritage’ (Curriculum Expert 1, Personal Interview, October 2, 2023).

Level of Satisfaction and Appropriateness of the Content in the ESBIK Pedagogical Model (Post-Implementation Stage)

In terms of the content suggested by the ESBIK model for teaching native tree species, the model suggested that the content in the Our World and Our People (OWOP) curriculum is maintained and yet, a spotlight on the plants is tailored to native tree species. It suggested that all exemplars in the content should focus on native tree species in the locality of the learners and in the broader Ghanaian environment. Again, it suggested that at least one of the threatened native tree species in Ghana should be taught. In the implementation of the content, four native tree species were taught students. These included *Pericopsis elata* (*Kokrodua*), *Ceiba Pendantra* (*Onyina*), *Alstonia boonei* (*Nyamedua*), *Newbouldia laevis* (*Sesemasa*) and *Blighia sapida* (Ackee/Akyee).

The quantitative results indicated that all the study participants (100%) were very satisfied with the content suggested for teaching native tree species in the EBIK model. The qualitative findings from elementary school teachers and learners affirmed the quantitative results that the content suggested was very appropriate. For instance, the teachers said the content was very satisfactory because it was based on the standard curriculum by the Ministry of Education but the exemplars suggested were the native tree species found in the local environment of learners which they mentioned reflected the cultural realities and lived experiences of learners. Others said that because the learners were exposed to the native tree species which relates to their natural environment, it made it easy for them to learn the plant content in the OWOP curriculum. Also, the learners in the focus group sessions said that the content was comprehensive broadening their knowledge base on native tree species in their environment and proactive measures that can take to protect them. Likewise, the classroom observation reports showed positive indicators of greater learner involvement in all the lessons because the content were based on the native tree species in their environment.

‘It was also very important since the content provided knowledge on the significance of native trees in our local environment, some in our backyards at school and home and this made it easy for us to learn them. Also, the content we were taught stressed on the necessity to protect, manage and sustainably utilize the native tree species for the benefit of present and future generations’ (Elementary School Learners, FGD 1, November 11 2023).

The findings from the pre-implementation and post-implementation stages of the ESBIK pedagogical model corroborate with those found in other studies such as Nesterova (2020), Bergström (2021) and Radcliffe et al. (2016). For instance, when environmental education incorporates indigenous knowledge it acknowledges the relevance of cultural diversity and inclusivity as agents for conservation (Nesterova, 2020; Radcliffe et al., 2016). Also, when environmental education for elementary learners incorporated indigenous knowledge of the local communities it help learners in developing strong place connections to their environments bolstering their resolve to conserve their native tree species (Bergström, 2021).

Level of Satisfaction and Appropriateness of the Teaching Methods in the ESBIK Pedagogical Model (Pre-Implementation Stage)

All the study participants (100%) were convinced that the teaching methods in the ESBIK pedagogical model were appropriate and suitable for teaching the content on native tree species. The curriculum experts expressed positive remarks about the teaching methods in the ESBIK pedagogical model. They said that the teaching methods in the ESBIK model aligns very well with the constructivism and pragmatism philosophies. Interestingly, they are what the curriculum for Our World and Our People subject proposes and as such its implementation will be easy since the elementary school teachers are already familiar with them.

Level of Satisfaction and Appropriateness of the Teaching Methods in the ESBIK Pedagogical Model (Post-Implementation Stage)

According to the quantitative results, all the study participants (100%) were satisfied with the teaching methods in the ESBIK model. Similarly, the qualitative comments suggest that the teaching methods that were deployed by the elementary school teachers as specified in the ESBIK model were very appropriate. They remarked that it made the learners active and interactive in the teaching and learning activities. Also, they made the lessons on native tree species very practical and relatable to the learning experiences of learners. Moreover, it was observed during the classroom activities that the learners found the teaching methods as very appropriate.

‘We feel the teaching methods were very satisfactory because we were actively involved by our teachers in all the lessons. We were asked to draw, recite, point at, touch and describe our emotional responses and many others. We paired with our classmates in planting and watering native tree seedlings. We found the teaching methods as more meaningful because they were relatable to our everyday life experiences and we learned without coercion or whatsoever. It was excitement and fun’ ((Elementary School Learners, FGD 2, November 11 2023).

‘It was extremely satisfactory because students were excited to carefully observe the colours and physical characteristics of each of the native tree species, touching them, and this increased their understanding and appreciation of the species’ (Classroom Observation Report, 2023).

The positive feedback from the study participants on the learner-centered and activity-based teaching methods specified in the ESBIK pedagogical model have been described as the most appropriate teaching methods for elementary school education (Adom et al., 2016) especially for elementary environmental education where discovery and activity-based approaches to teaching are paramount (Karwacki, 2023; El Batri et al., 2022; Acharibasam & McVitte, 2021; Blanchet-Cohen & Reilly, 2013; Eshun, 2022; Granić & Ćukušić, 2007).

Level of Satisfaction and Appropriateness of the Use of Elders as Co-Instructors in the ESBK Pedagogical Model (Post-Implementation Stage)

The use of elders with immense indigenous knowledge on native tree species as co-instructors in the classroom and out-of-classroom activities was seen as very satisfactory and appropriate to all the study participants (100%). The qualitative views and classroom observation report emphasized that the learners felt at home when the elders used local language (*Asante Twi*) in the teaching. They saw them as their grandparents giving them directions and because they see such aged persons as arbiters of knowledge, they listened to them keenly with high interest and seriousness. Also, the elders carefully and patiently listened and addressed all the concerns and queries raised by the learners. The elementary school teachers also were excited about this arrangement because they realised that the elders filled their knowledge gaps in indigenous knowledge related to the native tree species as they satisfactorily taught the scientific and/or theoretical aspects of the content. The elders saw this arrangement as a privilege for them to impart to the children, the future leaders of their society, the rich knowledge on the native tree species to prevent any possible extinctions. They saw this as a spiritual duty that would be handsomely rewarded by the God and the ancestors. These were some of the qualitative views shared:

‘The community elders helped us greatly as co-instructors. They helped in filling our knowledge gaps and deficiencies in the indigenous knowledge related to the native tree species we were teaching the learners. They recounted the myths, cosmological beliefs and deepened our comprehension of the folklores and folk songs used for the instruction. They really helped in making the lessons very interesting and complete’ (Elementary School Teacher 9, School B, Personal Interview, November 11 2023).

‘We saw the elders as our grandparents teaching us about the sacrosanct nature of the native trees, their spiritual, economic and medicinal properties, the stories, myths and folk songs that exemplified the roles each of the native trees play in their lives in the past and our lives today. He [referring to the elderly man who taught them] reminded us that it was our duty to plant, sustain and conserve the native tree species because our ancestors required us to do this as a bait for their blessings and protection. After ever lesson, our resolve to jealously stand against all forms of abuse to the native tree species were renewed. In fact, they should be constant features in our classroom and out-of-classroom teaching and learning activities’ (Elementary School Learners, FGD-6, November 12 2023).

‘I am overjoyed that I have the privilege of serving as a teacher in a school, teaching my grandchildren things I was taught by my kinsmen about these native tree species. I am happy that at least they will know about them well and protect them for posterity. I see this responsibility as a spiritual duty required of me by God and my ancestors and I know they would reward me with a great reward after my physical passing to where they are’ (Elderly Man, Personal Interview, November 15 2023).

Various studies (Adom, 2022; Eshun, 2022) support the tactful use of elders as co-instructors for environmental education, especially because of their rich knowledge in indigenous knowledge systems regarding native tree species. More so, their age and position in the society as parents and grandparents command great respect and

elementary learners take their instruction very seriously (Suryani et al. 2021; Adom, 2022) as confirmed by the findings of this study.



Eldely Man Co-Teaching with an Elementary School Teacher



Elderly Woman Co-Teaching with an Elementary School Teacher

Source: Photographed by Dickson Adom

Level of Satisfaction and Appropriateness of the Teaching and Learning Activities in the ESBIK Pedagogical Model (Pre-Implementation Stage)

The suggested activities for elementary school teachers and learners were seen by the study participants (100%) as very important in the teaching and learning of native tree species in Ghana. Some of the elementary school teachers said:

‘The suggested activities for elementary school teachers and learners in this pedagogical model help plan participatory activities for learners as they embark on field visits and real- life observation and interactions with native tree species in their natural environment’ (Elementary School Teacher 12-School B, Personal Interview, October 11 2023).

Level of Satisfaction and Appropriateness of the Teaching and Learning Activities in the ESBIK Pedagogical Model (Post-Implementation Stage)

All the study participants (100%) positively admitted that the teaching and learning activities in the ESBIK pedagogical model was very and extremely satisfactory. In the qualitative views expressed by teachers during the personal interviews, focus group discussions and classroom observations made, it was evident that these suggested activities followed in the lessons on native tree species education were really helpful.

They mentioned that the teaching and learning activities such as field trips to nature reserves, nature walks in the local communities of the learners and other interactive sessions provided the learners with real-world experiences, making them active participants in the lessons. This motivated them to learn the content that was taught on native tree species. These were some of the comments shared by the study participants:

‘The teaching and learning activities in the ESBK model were very satisfactory as they provided real-world experiences for learners. This helped learners to be active participants rather than mere observers and also interact with and learn about native tree species’ (Elementary School Teacher 4, School B, November 11 2023).



Elementary School Teacher Teaching Learners Native Tree Species



Elementary School Teacher Teaching Learners Native Trees in a Nature Walk

Source: Photographed by Dickson Adom

‘The teaching and learning activities made us very interactive learners. We were able to interact well with the trees when we went on field trips and nature walks. Also, the group and individual projects pushed us to work and get involved in all the lessons on native tree species. Together with my classmates, we planted seedlings of native tree species, prepared and cared for a garden and did drawings and colouring works on native tree species for class presentations. They really helped us to own the learning’ (Elementary School Learners, FGD-5, November 13 2023).



Elementary School Teacher Using TLMs on Native Tree Species for Classroom Teaching

Source: Photographed by Dickson Adom

Studies point out that teaching and learning activities for environmental education must be able to actively engage elementary learners while connecting them to real-world experiences such as local customs and their everyday lived experiences (Nath, n.d.). Therefore, using native tree species and spaces in their local regions as learning spaces, such as field trips and nature walks proposed by the ESBK model, hold the benefits of helping learners to connect with their native tree species, heightening their resolve to conserve them. Likewise, participatory art activities and other group projects on native trees and the environment such as drawing, painting, designing of posters and flyers, as well as construction of nurseries and gardens were seen to raise the environmental awareness and sustainability awareness of learners (Yeşilyurt, Balakoğlu & Erol, 2020).



Resource Person Instructing Learners on Native Tree Species
During an Educational Field Trip

Source: Photographed by Dickson Adom

Level of Satisfaction and Appropriateness of the Assessment Strategies in the ESBIK Pedagogical Model (Pre-Implementation Stage)

The assessment plan in the ESBIK pedagogical model offers long term learning because it is geared purposefully toward learning especially for low achieving learners. It prioritizes formative assessment strategies pegged around 70% of the entire assessment of the teaching and learning activities for the content on native tree species specified with 30% summative assessment. One of the curriculum experts remarked about the assessment plan in the ESBIK pedagogical model:

‘The assessment in the model gives much consideration for formative assessment strategies that consider assessment as a part of the learning of learners with an accompanied comprehensive rubrics to guide learners on how to achieve success. It stresses on assessment as a medium for long life learning on native tree species’ (Curriculum Expert 2, Personal Communication, October 4 2023).

An elementary school teacher after deciphering the assessment plan proposed by the model said:

‘The assessment strategies are meant to help the elementary school learners to achieve the expected learning outcomes and succeed in the acquisition of indigenous knowledge on native tree species to bolster their resolve to conserve the remnant in their local communities’ (Elementary School Teacher 12-School B, Personal Interview, October 11 2023).

Level of Satisfaction and Appropriateness of the Assessment Strategies in the ESBIK Pedagogical Model (Post-Implementation Stage)

The study participants (100%) indicated via the quantitative results that they were very satisfied with the assessment strategies specified in the ESBIK model. The qualitative views expressed by the study participants indicated that the emphasis on formative assessment that required assessing learners during the learning processes and not at the end of the learning processes helped greatly in improving the performance of the learners, especially those with learning difficulties who often trail behind during summative assessments of subjects in their schools. Moreover, they indicated that learners were informed on what they were to do to get their grades via comprehensive assessment rubrics that were explained to them. This put them on guard always and motivated them to perform the required activities to succeed in the OWOP subject under which the content on native tree species was delivered. In the summative assessments of learning on native tree species, all learners performed satisfactorily. These were some of the qualitative views shared:

‘The formative assessment that took 70% of the assessment score of learners is a good initiative because it helped us in following the performance of each of the learners. It also helped them a lot in getting marks for each activity of the learning process, something we ignore mostly when we focus greatly on summative assessment. I saw that the learners were motivated to do other activities when they saw their marks recorded for the earlier activities. It is not surprising that the equally performed well in the summative assessment, generally reflecting satisfactory performances in the overall assessment on native tree species education’ ((Elementary School Teacher 7, School B, November 13 2023).

‘We scored a point or some points for every activity in class or out-of-class. This motivated us to engage in all the other activities because we were rewarded. We need what we must do to excel in the lessons and the activities were not beyond us. They were fun to do them so it came to us easily. We didn’t fear the final exam to assess our knowledge because we were instructed well’ (Elementary School Learners, FGD-5, November 13 2023).

The positive feedback from the study’s findings on the assessment format prescribed in the ESBIK model that ranks formative assessment high (70%) and summative assessment low (30%) is noted in the literature as helping in developing high-order thinking skills (Mogboh & Okoye, 2019; Looney, 2011) aid learners in grasping the practicalities of learned concepts (Trumbull & Lash, 2013), and motivate low achieving learners in diligently achieving the learning outcomes set.

The expected environmental sustainability core competencies specified in the learning outcomes of the ESBIK model (Pre-Implementation Stage)

The curriculum experts indicated that the learning outcomes in the ESBIK pedagogical model were very aligned to the learning objectives and they were stated in much clarity making it easy for elementary school teachers in knowing their expectations for learners after a successful deployment of the pedagogical model in teaching and learning. Also, they were geared toward developing in learners' core competencies on sustainability consciousness and competence regarding native tree species. The curriculum experts interviewed indicated that the core competencies on environmental sustainability that the model proposes were what learners need for the 21st century. They added that it would ensure the holistic personal development of elementary school learners, making them function well in the society as agents of change for the native tree species in their various communities.

The elementary school teachers indicated that the development of the core competencies in environmental sustainability such as critical thinking and problem-solving skills, good sense of place, cultural identity, creativity and innovation skills among others, would incite learners to appreciate the environment as well as sustain, preserve and conserve the native tree species in Ghana for generations to come while preserving the cultural heritage. These competencies cited by the ESBIK model have been equally mentioned in the literature on expected competencies for environmental education ((Sauvee, 1999).



Elementary School Learners Planting Native Tree Species

Source: Photographed by Dickson Adom

Knowledge Assessment of Elementary School Learners on Native Tree Species after the Implementation of the ESBIK Pedagogical Model (Post-Implementation Stage)

The elementary school teachers and the learners (100%) were very optimistic that their levels of knowledge regarding their native tree species have been significantly increased. In the qualitative interviews and FGD sessions, they mentioned that the learners can now confidently describe the physical characteristics of the native tree species they were taught. Also, the learners said that they could describe the domestic, medicinal, cultural, spiritual/religious as well as economic relevance of each of the native tree species that were taught. The learners exhibit a changed attitude toward the tree species, treating them gently with care unlike their initially careless attitude toward them. These are some of the comments shared:

‘All the learners in our school including the Kindergarten learners can now identify native tree species based on their leaf structure and pattern, colour, fruits, barks, height, width etc. They can recount and describe more vividly, the medicinal, cultural, economic, religious and/or spiritual uses of some of the native tree species’ (Elementary School Teacher 3, School A, Personal Interview, November 11 2023).

‘The heightened knowledge on the native tree species have increased learners’ awareness of them. Some parents have told us the high interests shown by their wards in native tree species in their homestead and communities. They jealously care for them, watering native tree seedlings in and around their homes and streets’ (School Administrator School A, Personal Interview, November 11 2023) .

‘While sending some of our learners to school, one of the learners asked a tree how it was faring because he has been taught it’s a living thing with a protective spirit. This action can only be as a result of the recent native tree species education we gave the learners’ (Elementary School Teacher 7, School B, November 15 2023).

Sustainability Awareness of Native Tree Species Among Elementary School Learners (Post-Implementation Stage)

All the elementary school learners and their teachers (100%) affirmed that the native tree species education using the ESBIK model was very successful because the learners now have a much better understanding on the need to take sustainability actions toward native tree species in their environment such as planting and watering native tree seedlings, caring for gardens, and engaging in environmental campaign among their colleagues on the need to live sustainably and engage in sustainable practices toward the native tree species in their environment.

‘Knowing that native tree species play vital roles in maintaining ecological balance, the learners in our school have adopted the habit of planting and watering seedlings of trees, including native tree species, to safeguard the natural environment of the school and there are reports that they are pressuring their parents to do so in their homes’ (Elementary School Teacher 6, School B, Personal Interview, November 10 2023).

‘Now we have nurseries in our homes where we've planted seedlings of various trees including native tree species. Anytime it becomes necessary, we tell our friends and neighbours about our tree projects in school and in the house. We encourage them to

do same after letting them know of the tremendous benefits we get from native trees and all other tree species’ (Elementary School Learners, FGD 4, November 12 2023)’ .

Sustainability Competence, Consciousness and Action Among Elementary School Learners After the Implementation of the ESBIK Pedagogical Model for Native Tree Species Education (Post-Implementation Stage)

The quantitative data affirmed that the study participants were much determined to exhibit sustainability competence and consciousness by engaging in environmentally friendly practices such as the planting of native trees (Very Determined 92.9%), refraining from negative human activities and behaviour that destroys native tree species and their habitats in their locality and Ghana such as wild fires, deforestation, etc (Very determined to extremely determined 100%) and engaging in environmentally friendly practices such as environmental campaign and education (leading or assisting others) against negative human activities and behaviour that destroys native tree species and their habitats in their locality and Ghana such as wild fires, deforestation, etc. (very determined to extremely determined 85.7%). Likewise, the study participants were very certain of exhibiting managerial skills and sustainability actions towards the native tree species in their locality and Ghana such as voluntarily watering or helping a naturally-growing native tree seedling, preventing the indiscriminate cutting down of native tree species, etc. (Very Sure-78.6% to Extremely Sure-21.4%). Some of the qualitative views expressed by the study participants were:

After instructing the learners on native tree species, you could see that they now demonstrate profound appreciation for the values and importance of these native trees. This increased appreciation motivates them to desist from negative human practices such as bush fire, deforestation etc. That often destroy native tree species (Elementary School Teacher 8, School A, Personal Interview, November 5 2023).

We are able to self-manage the nurseries of native tree species in our schools with little to no support from our teachers. Some of us have our own nurseries at home which we solely manage. We are teaching the children and other younger teens how to set up nurseries and gardens for native tree species. We are delighted to share the knowledge we have about the native tree species (Elementary School Learners, FGD-3, November 14 2023).

It was observed during the classroom and out-of-classroom teaching and learning activities on native tree species that learners were very much excited to engage in environmentally friendly activities such as planting and watering seedlings of native trees, caring for naturally-grown seedlings in the communities. When teachers asked them to design posters on ways of caring for native tree species and ways of refraining from negative environmental practices such as bush fires and indiscriminate cutting down of trees (Classroom Observation Report, 2023).

The findings of the study have shown that a good environmental education must target nurturing various forms of sustainability competences. For instance, (Vesterinen, 2024) mentions various forms of the sustainability competence, some of which were evident in the elementary school learners after the implementation of the

ESBIK pedagogical model. Action-oriented competence requires that learners collectively design and implement interventions to conserve biodiversity and protect the environment. They are to take action that could transform society, promote nature and shape sustainable futures (Bianchi et al., 2022). This was evident when the learners engaged in developing nurseries for native trees at home and in their schools to replant in various degraded areas of their schools and communities. Others protected and cared for naturally-grown native tree species, setting personal goals of caring for them (Wiek et al., 2011). They collaboratively (collaborative competence) designed posters with inscriptions on protecting and saving threatened species which were displayed in their schools as a form of environmental campaign (Bianchi et al., 2022). These actions demonstrated by the elementary school learners show that they have considerable sustainability consciousness, competence and action toward the native tree species in their environment (Gerike et al., 2019; Waltner et al., 2019).

Conclusions

The study was undertaken to develop an indigenous knowledge-inspired pedagogical model to be used for elementary school environmental education on native tree species in Ghana. The pedagogical model (ESBIK) was successfully developed by the researchers by incorporating best practices in existing pedagogical models for environmental education that utilise indigenous knowledge systems and with the suggestions and inputs from curriculum experts and some elementary school teachers in Ghana. The results and findings from the quantitative and qualitative datasets on the pre-implementation and post-implementation stages of the ESBIK pedagogical model showed high satisfaction and importance across all the study participants. All the study participants unanimously indicated that the ESBIK pedagogical model was able to give elementary school learners the requisite knowledge on native tree species as well as help them develop sustainability consciousness and competence toward native tree species by engaging in actionable pursuits on the conservation and campaign for the protection of native tree species. The study contends that the ESBIK pedagogical model possesses the pedagogical strength to effectively teach elementary school learners about the native tree species in their local communities as well as those threatened in Ghana.

Specifically, the use of indigenous knowledge as the key driver of environmental education on native tree species (i.e. content, teaching methods, teaching and learning activities, and use of elders as co-instructors) helps learners to relate their learning experiences to their lived experiences and cultural realities thereby heightening their appreciation for the harmonious relationship between them, their native tree species and esteemed cultural heritage. Moreover, the study contends that the use of learner-centered teaching and learning approaches that are rooted in constructivism and pragmatism pedagogical philosophies for environmental education assist learners in owning the learning process and raises their motivation to achieve the set learning outcomes since they become active explorers and discoverers of environmental knowledge, in the case of this study, knowledge on native tree species. Furthermore, the study confirms that the use of a flexible and balanced assessment plan for environmental education that emphasizes formative assessment (preferably 70% of all assessments) as against summative assessment (preferably 30% of all assessments) motivates all learners especially the low-achieving learners to actively partake in all

the specified activities during the environmental education, significantly improving their learning processes and outcomes.

While this study has made novel contributions in encouraging native tree species education among elementary school learners in Ghana, certain limitations might have affected its conclusions. For instance, the conclusions drawn from the study were based solely on the data from a relatively small sample size comprising curriculum experts, school administrators, elementary school teachers, and elementary school learners in Ghana. Only two elementary schools in one district of the Ashanti Region of Ghana were involved in the study. The implementation period was only three months and was difficult to trace all the noticeable transformations in elementary school learners' sustainability consciousness and competence. Owing to this, it would be wrong to make bold generalizations of the study conclusions as potential representational results about the implementation of the developed ESBIK pedagogical model in the broader Ghanaian elementary school landscape.

Based on these study limitations, future studies could consider using a larger sample size comprising elementary schools from several regions out of the sixteen (16) regions and engage in scholarly regional comparison of the results after the implementation of the ESBIK pedagogical model. Moreover, the study period needs to be expanded to be able to confirm the results from the implementation of the ESBIK model. Likewise, it would be great to run pre-tests and post-tests of elementary school learners' sustainability consciousness and competence before and after the implementation of the ESBIK pedagogical model for native tree education. Also, it will be important to run more advanced analyses on the aspects of the ESBIK pedagogical model using various statistical packages since simple descriptive analyses were done in this study.

Despite these potential limitations of the study, the study makes a novel attempt at the development and implementation of the ESBIK pedagogical model while making inferences using both qualitative and quantitative datasets. It offers an important first step in the search for a more effective pedagogical model that relies on indigenous knowledge systems in Ghana for offering native tree species education, an aspect of elementary environmental education that is often ignored as a result of the absence of a comprehensive pedagogical model. The study recommends that the Ministry of Education carefully consider the ESBIK pedagogical model as a crucial tool in its quest to dispense environmental education in the various elementary schools in Ghana. The ministry must offer financial and technical support in further stakeholder consultations through workshops to heighten the ESBIK pedagogical model. They must provide funding to test its efficacy on a grander scale to validate it and finally ensure its mainstreaming into the curriculum for elementary school education in Ghana. While this is greatly needed urgently, elementary school teachers in Ghana must adopt the prescribed content on native tree species, teaching methods, teaching and learning activities suggested, assessment plan, and use of indigenous knowledge in the ESBIK pedagogical model in teaching the plant content in the Our World and Our People (OWOP) curriculum. This would greatly help in filling the dearth of knowledge on native tree species in the elementary school curriculum in Ghana. It would satisfactorily increase elementary school learners' knowledge awareness, sustainability consciousness, and sustainability competence in native tree species,

leading to a determined younger generation who demonstrate actions, skills, and attitudes toward the conservation of native tree species in Ghana.

References

- [1] Buyinza, J.; Agaba, H.; Ongodia, G.; Eryau, K.; Sekatuba, J.; Kalanzi, F.; Kwaga, P.; Mudondo, S.; Nansereko, S. On-farm Conservation and Use Values of Indigenous Trees Species in Uganda. *Research Journal of Agriculture and Forestry Sciences* 2015, 3(3), 19-25.
- [2] Subiakto, A.; Rachmat, H. H.; Sakai, C. Choosing native tree species for establishing man-made forest: A new perspective for sustainable forest management in changing world. *Biodiversitas* 2016, 17(2), 620-625 DOI: 10.13057/biodiv/d170233
- [3] Wang, T.; Smets, P.; Chourmouzis, C.; Aitken, S. N.; Kolotelo, D. Conservation status of native tree species in British Columbia. *Global Ecology and Conservation* 2020, 24, e01362.
- [4] Lopus, M; Palakkad, V.; Shakeela, M. S.; Reshma, D.; Subaiba, M. S.; Shafi, M. S.; Abdulla Habeeb, M. S.; Kushwaha, A. Conservation of Native Tree Species in The Agroforest of Rice-Based Agroecosystems Will Contribute to The Sustainable Agriculture. *Research Square* 2023, 1-19. DOI: <https://doi.org/10.21203/rs.3.rs-3046439/v1>
- [5] Woods, A.J.; Martín-García, J.; Bulman, L.; Vasconcelos, M.W.; Boberg, J.; La Porta, N.; Peredo, H.; Vergara, G.; Ahumada, R.; Brown, A.; Diez, J.J. Needle Blight, Weather and Possible Climatic Triggers for the Disease's Recent Emergence. *For. Pathol.* 2016, 46, 443e452.
- [6] Byabashija, M.; Esegu, J.; Kidiya, J.; Basoga, M.; Ondia, R.. Traditional Uses of Indigenous Tree Species. *Ug. J. of Agric. Sciences* 2004, 9: 367-371.
- [7] Botanic Gardens Conservation International (BGCI). Planning Conservation Action For Ghana'S Threatened Tree Species. United Kingdom: BGCI February 2023. 41 p.
- [8] Kostova, Z; Atasoy, E. Methods Of Successful Learning In Environmental Education. *Journal of Theory and Practice in Education* 2008 , 4 (1), 49-78. http://eku.comu.edu.tr/index/4/1/zkostova_eatasoy.pdf
- [9] Morara, F.; Peterlicean, A. The Role and Importance of Educating Youth Regarding Biodiversity Conservation in Protected Natural Areas. *Procedia Economics and Finance* 2012, 3, 1117 – 1121.
- [10] Suryani, A.; Soedarso, M.; Saifulloh, Z.; Muhibbin, W.; Hanoraga, T.; Muchammad, N.; Umi, T.; Lienggar R.; Rahmawati, D. Education for Environmental Sustainability: A Green School Development. *IPTEK Journal of Proceedings Series* 2019, No. 6, The 1st International Conference on Global Development - ICODEV

November 19th, 2019, Rectorate Building, ITS Campus, Sukolilo, Surabaya, Indonesia.

[11] Adom, D. Catch them Young: Children as Messengers of Indigenous Ecological Knowledge for Biodiversity Conservation in Ghana., *Journal of Wildlife and Biodiversity* 2022, 6(3), 12-25. DOI: <https://doi.org/10.5281/zenodo.6522108>.

[12] United Nations Educational, Scientific, and Cultural Organization (UNESCO). *Intergovernmental Conference on Environmental Education: Final Report*. 1977. Accessed on October 25, 2023 from www.gdrc.org/uem/ee/EE-Tbilisi_1977.pdf.

[13] National Curriculum Council (1990). *Curriculum Guidance 7: Environmental Education*. York: National Curriculum Council.

[14] Dobson, A. *Environmental citizenship and pro-environmental behaviour: Rapid research and evidence review*. Sustainable Development Research Network. 2010.

[15] United Nations Educational, Scientific, and Cultural Organization (UNESCO). *Education for Sustainable Development. A Roadmap* (UNESCO, Ed.). UNESCO Publishing. 2020. <https://unesdoc.unesco.org/ark:/48223/pf0000374802.locale=en>

[16] Hadjichambis, A. C.; Reis, P. Introduction to the Conceptualisation of Environmental Citizenship for Twenty-First-Century Education. In: *Environmental Discourses in Science Education*. Springer Open, 2020, 4, 1-15.

[17] Hooykaas, M.J.D.; Schilthuizen, M.; Smeets, I. Expanding the role of biodiversity in laypeople's lives: The view of communicators. *Sustainability* 2020, 12, 2768.

[18] Acharibasam, J.B.; McVittie, J. The use of a two-eyed seeing approach to include Indigenous Knowledge in Early Childhood Care and Development in Ghana. *International Education Journal: Comparative Perspectives* 2021, 20(1), 81-98.

[19] Berry, A.; Vintimilla, C. D.; Pacini-Ketchabaw, V. Interrupting Purity in Andean Early Childhood Education: Documenting the Impurities of a River. *Equity and Excellence in Education* 2020, 53(3): 276-287.

[20] Bissoli, M.F. Development of Children's Personality: The Role of Early Child Education. *Psicol. Estud.* 2014, 19, 587-597. DOI: 10.1590/1413-73722163602

[21] Abbas, Z. *The Role of Teaching Methods in Promoting Environmental Education in Kindergarten: A Comparative Analysis of Turkey and Norway*. 2020. Faculty of Social Sciences, University of Stavanger.

[22] Eshun, F.; Wotorchie, R. K.; Buahing, A. A.; Harrison-Afful, A. A.; Atiatorme, W. K.; Amedzake, G.; Adofo-Yeboah, Y.; Mante, V. A Survey of the Role of Environmental Education in Biodiversity Conservation in the Greater Accra Region of Ghana. *Conservation* 2022, 2, 297-304. <https://doi.org/10.3390/conservation2020021>

[23] Eshun, G. *Building bridges in tourism and hospitality research in Africa: A*

- postcolonial methodological contribution*. 2011.
https://www.researchgate.net/publication/50402143_Ecotourism_Development_in_Ghana_A_Postcolonial_Study_with_Focus_on_BoabengFiema_Monkey_Sanctuary_and_Kakum_National_Park
- [24] Bazeley, P.; Kemp, L. Mosaics, Triangles, and DNA: Metaphors for Integrated Analysis in Mixed Methods Research. *Journal of Mixed Methods Research* 2012, 6(1), 55-72. DOI: 10.1177/1558689811419514
- [25] Gerike, N.; Pauw, J. B.; Berglund, T.; Olsson, D. The Sustainability Consciousness Questionnaire: The Theoretical Development and Empirical Validation of an Evaluation Instrument for Stakeholders Working with Sustainable Development. *Sustainable Development* 2019, 27(1), 35-49.
- [26] Waltner, E.M.; Werner, R.; Mischo, C. Development and Validation of an Instrument for Measuring Student Sustainability Competencies. *Sustainability* 2019, 11(6), 1717 <https://doi.org/10.3390/su11061717>
- [27] Bowen, G. A. Document Analysis as a Qualitative Research Method. *Qualitative Research Journal* 2009, 9(2), 27-40. <https://doi.org/10.3316/QRJ0902027>
- [28] Silva, J. A. A Didactic Model to Support the Use of Senses and Sensors in Environmental Education Problem Solving. *Australian Journal of Environmental Education* 2023, 39, 108–124 DOI:10.1017/ae.2022.22
- [29] Dahlberg, K.; Dahlberg, H.; Nystrom, M. *Reflective Life-World Research* (2nd Ed.). Studentlitteratur, 2008.
- [30] United Nations. Transforming our world: the 2030 Agenda for Sustainable Development. Resolution 70/1 adopted by the General Assembly on 25 September 2015. Available at: <http://www.un.org/en/ga/70/resolutions.shtml>. Accessed Jan 2023.
- [31] Palmer, J.; Neal, P. *The Handbook of Environmental Education*. 1994. London: Routledge
- [32] Palmer, J.A. *Environmental Education in the 21st Century In Theory, Practice, Progress and Promise*. London: Routledge, 1998.
- [33] Mucioki, M.; Sowerwine, J.; Sarna-Wojcicki, D.; Lake, F. K.; Bourque, S. Conceptualizing Indigenous Cultural Ecosystem Services (ICES) and Benefits under Changing Climate Conditions in the Klamath River Basin and Their Implications for Land Management and Governance. *Journal of Ethnobiology* 2021, 41(3), 313-330. <https://doi.org/10.2993/0278-0771-41.3.313>
- [34] Adom, D.; Opoku, M., Newton, R.; Yeboah, A. Adinkra Cultural Symbols for Environmental Sustainability Education in Ghana. *World Environment* 2018, 8(2), 36-46.
- [35] Adom, D. The Place and Voice of Local People, Culture, and Traditions: A Catalyst for Ecotourism Development in Rural Communities in Ghana. *Scientific African* 2019, 6 (e00184), 1-22.

- [36] Malunguja, G.K.; Chowdhury, R.; Mokhets'engoane, S.; Diliban, N.P.; Zeleke, T.Y.; Sharma, P.S.; Devi, A.; Rubanza, C.D.K. *Indigenous Knowledge in Forest Conservation, Species Diversity and Stocking Potential: A Historical Perspectives of Northwest Tanzania*. In: *Biological Diversity: Current Status and Conservation Policies*. 2021, 1, 137-157. DOI: 10.26832/aesa-2021-bdcp-09.
- [37] Acquah, S. B., Sraku-Lartey, M., Samar, S. B., & Djagbletey, G. D. (2018). Traditional knowledge and consumption of forest plant foods in Ghana. *Ghana Journal of Forestry*, 34(1), 49-70.
- [38] Bruyere, B. The Effects of Environmental Education on Ecological Literacy of First-Year College Students. *Journal of Natural Resources and Life Sciences Education* 2008, 37, 20-26.
- [39] Ministry of Education. *Kindergarten curriculum (KG 1&2). Kindergarten curriculum for preschools*. National Council for Curriculum and Assessment. Ministry of Education, Accra, Ghana. 2019.
- [40] Alam, M. Constructivism and the Classroom Curriculum. *International Journal of Indian Psychology*, 2017, 5(1), 2349-3429. DOI:10.25215/0501.103
- [41] Adom, D.; Yeboah, A.; Ankrah, A. K. Constructivism Philosophical Paradigm: Implication for Research, Teaching and Learning. *Global Journal of Arts Humanities and Social Sciences*, 2016, 4(10), 1-9.
- [42] Alsharif, K. How Do Teachers Interpret the Term 'Constructivism' as a Teaching Approach in the Riyadh Primary Schools Context? *Social and Behavioral Sciences* 2014, 1009 –1018. doi:10.1016/j.sbspro.2014.05.170
- [43] Sert, N. Constructivism in the elementary school curricula. *Journal of Theory and Practice in Education* 2008, 4(2), 291-316. DOI:1304-9496
- [44] Pham, K. T.; Bui, D. X. Pragmatist Idea of Democracy in Education and Its Meaning for Educational Innovation in Vietnam Today. *Studia Gilsoniana* 2021, 10 (4), 975–995. DOI:10.26385/SG.
- [45] Etherington, M. B. From Epistemological Pragmatism to Educational Pluralism. *Journal of Contemporary Research in Education* 2020, 7(1), 1-19.
- [46] Karwacki, K. Nature's Classroom: Designing a Practical Environmental Nature's Classroom: Designing a Practical Environmental Education Curriculum. 2023. https://digitalcommons.hamline.edu/hse_cp
- [47] El Batri, B.; Maskour, L.; Ksiksou, J.; Jeronen, E.; Ismaili, J.; Alami, A.; Lachkar, M. Teaching Environmental Themes within the “Scientific Awakening” Course in Moroccan Primary School: Approaches, Methods and Difficulties. *Educ. Sci.* 2022, 12, 837. <https://doi.org/10.3390/educsci12110837>

- [48] Shukla, R.K. New Systematic Approach of Teaching and Learning of Forensic Science for Interdisciplinary Students: A Step Towards Renovating the Forensic Education System. *Forensic Science International: Synergy* 2021, 3, 100146.
- [49] Blanchet-Cohen, N.; Reilly, R.C. Teachers' Perspectives on Environmental Education in Multicultural Contexts: Towards Culturally-Responsive Environmental Education. *Teaching and Teacher Education* 2013, 36, 12-22.
- [50] Granić, A.; Ćukušić, M. *An Approach to the Design of Pedagogical Framework for e-Learning*. EUROCON 2007 The International Conference on "Computer as a Tool" Warsaw, September 9-12.
- [51] Sauvee, L. Environmental Education between Modernity and Postmodernity: Searching for an Integrating Educational Framework. *Canadian Journal of Environmental Education* 1999, 4, 9-35.
- [52] Mogboh, V.; Okoye, A. C. Formative and Summative Assessment: Trends and Practices in Basic Education. *Journal of Education and Practice* 2019, 10(27), 39-45.
- [53] Looney, J. W. Integrating Formative and Summative Assessment: Progress Toward a Seamless System? *OECD Education Working Papers* 2011, 58, OECD Publishing. <http://dx.doi.org/10.1787/5kghx3kbl734-en>
- [54] Trumbull, E.; Lash, A. *Understanding Formative Assessment: Insights from Learning Theory and Measurement Theory*. 2013. San Francisco: WestEd.
- [55] OECD. *Formative Assessment: Improving Learning in Secondary Classrooms*, OECD, Paris. 2005.
- [56] Gezera, T.; Wang, C.; Pollyc, A.; Martind, C.; Pugalee, D.; Lambert, R. The Relationship between Formative Assessment and Summative Assessment in Primary Grade Mathematics Classrooms. *International Electronic Journal of Elementary Education* 2021, 13(5), 673-685.
- [57] Kaasinen, E; Linasuo, M.; Schmalfu, F.; Koskinen, H.; Aromaa, S.; Heikkila, P.; Honka, A.; Mach, S.; Malm, T. A Worker-Centric Design and Evaluation Framework for Operator 4.0 Solutions that Support Work Well-Being. In: Human Work Interaction Design. HWID 2018. *IFIP Advances in Information and Communication Technology* 2019, 554, 263-282. Springer, Cham. https://doi.org/10.1007/978-3-030-05297-3_18
- [58] [Substance Abuse and Mental Health Services Administration \(SAMHSA\)](https://www.samhsa.gov). *Setting Goals and Developing Specific, Measurable, Achievable, Relevant, and Time-bound Objectives*.n.d. www.samhsa.gov
- [59] Nesterova, Y. Rethinking Environmental Education with the Help of Indigenous Ways of Knowing and Traditional Ecological Knowledge. *Journal of Philosophy of Education* 2020, 4(4), 1047-1052. <https://doi.org/10.1111/1467-9752.12471>

- [60] Bergström, J. Whose Knowledge Counts? The Struggle to Revitalise Indigenous Knowledges in Guatemala. *Sustainability* 2021, 13(21), 11589. <https://doi.org/10.3390/su132111589>
- [61] Radcliffe, C.; Parissi, C.; Raman, A. Valuing indigenous knowledge in the highlands of Papua New Guinea: a model for agricultural and environmental education. *Australian Journal of Environmental Education* 2016, 32(3), 243-259. <https://doi.org/10.1017/aee.2016.19>
- [62] Nath, B. Environmental Education And Awareness –Participation in Common Environmental Activities in and Out of School. *Encyclopedia of Life Support Systems (EOLSS)*, n.d., 1, 1-6. <http://www.eolss.net>
- [63] Yeşilyurt, M.; Özdemir Balakoğlu, M.; Erol, M. The Impact of Environmental Education Activities on Primary School Students' Environmental Awareness and Visual Expressions. *Qualitative Research in Education* 2020, 9(2), 188-216. doi:10.17583/qre.2020.5115
- [64] Vesterinen, M. Sustainability Competencies in Environmental Education: Research on Guidebooks for Teachers at Finnish Primary Schools. *Cogent Education* 2024, 11(1). DOI: 10.1080/2331186X.2023.2286120
- [65] Bianchi, G.; Pisiotis, U.; Cabrera Giraldez, M. GreenComp- the European Sustainability Competence Framework. In: Bacigalupo, M.; Punie, Y. (Eds.). EUR 30955EN (p.56). Publications Office of the European Union. 978-92-76-46485-3.
- [66] Wiek, A.; Withycombe, L.; Redman, C. L. Key Competencies in Sustainability: A Reference Framework for Academic Program Development. *Sustainability Science* 2011, 6(2), 203-218.

APPENDIX A

Threatened Species on Priority List

Family	Taxon
Anacardiaceae	<i>Trichoscypha cavalliensis</i>
Annonaceae	<i>Monocyclanthus vignei</i>
Apocynaceae	<i>Hunteria ghanensis</i>
Burseraceae	<i>Commiphora dalzielii</i>
Chrysobalanaceae	<i>Dactyladenia dinklagei</i>
Dichapetalaceae	<i>Tapura ivorensis</i>
Ebenaceae	<i>Diospyros barteri</i>
Euphorbiaceae	<i>Croton aubrevillei</i>
Euphorbiaceae	<i>Suregada ivorensis</i>
Fabaceae	<i>Gilbertiodendron splendidum</i>
Fabaceae	<i>Hymenostegia gracilipes</i>
Fabaceae	<i>Millettia irvinei</i>
Fabaceae	<i>Talbotiella gentii</i>
Fabaceae	<i>Pericopsis elata</i>
Huaceae	<i>Afrostryrax lepidophyllus</i>
Malvaceae	<i>Cola reticulata</i>
Malvaceae	<i>Cola boxiana</i>
Malvaceae	<i>Cola umbratilis</i>
Malvaceae	<i>Octolobus angustatus</i>
Meliaceae	<i>Turraea ghanensis</i>
Phyllanthaceae	<i>Phyllanthus profusus</i>
Putranjivaceae	<i>Drypetes singroboensis</i>
Rubiaceae	<i>Coffea togoensis</i>
Rubiaceae	<i>Pavetta mollissima</i>
Rubiaceae	<i>Pavetta sonjae</i>
Rubiaceae	<i>Robynsia glabrata</i>
Rubiaceae	<i>Schumanniohyton problematicum</i>
Rubiaceae	<i>Sericanthe toupetou</i>
Rubiaceae	<i>Tarenna agnata</i>
Rutaceae	<i>Aeglopsis mangenotii</i> (?prob. syn of <i>A. chevalieri</i>)
Sapindaceae	<i>Lecaniodiscus punctatus</i>
Sapindaceae	<i>Placodiscus attenuatus</i>
Sapindaceae	<i>Placodiscus bancoensis</i>
Sapindaceae	<i>Placodiscus bracteosus</i>
Sapindaceae	<i>Placodiscus oblongifolius</i>
Sapotaceae	<i>Aubregrinia taiensis</i>
Sapotaceae	<i>Gambeya azagueiana</i>
Sapotaceae	<i>Synsepalum aubrevillei</i>
Sapotaceae	<i>Synsepalum ntimii</i>

Supplementary List of Common Native Tree Species

Family	Taxon	Local/Indigenous Name
Malvaceae	<i>Ceiba pentandra</i>	(Onyina)
	<i>Blighia sapida</i>	(Akyee/Ackee)
	<i>Vernonia amygdalina</i>	(onwono/Awonwone)
	<i>Voacanga africana</i>	(Bedaa)
	<i>Bryophyllum pinnatum</i>	(Egoro/Tan me o wu)
	<i>Morinda lucida</i>	(Konkroma)
	<i>Alstonia boonei</i>	(Nyamedua)
	<i>Margaritaria discoidea</i>	(Pepea)
	<i>Newbouldia laevis</i>	(Sesemasa)
	<i>Funtumia elastica</i>	(Funtum)

APPENDIX B

Indigenous Saying/Song on *Pericopsis elata* (Kokrodua)

Asante Twi Version

Kokrodua nimuonyamfo! ɔbrane a wo tenten tumi boro anammɔn aduosia! Wo a w'akokɔsrade honam ma yehu senea wosom bo fa!

Hwe wo dua na ema akapentafo di adwini ahorɔɔ a ema wiase ye fe na ɔde nya won ho tam.

Hwe ! wo aponnwa eden paa, eho twa na enseɛ. O! enti na Kwasi borɔni pe se wɔde aborɔkyire sika tu wo ase kɔ ne man mu. Mahu, na mate nea enti a wo ho akɔ atwe saa we yen man Ghana mu no ase yiye.

enti mehwe wo so yiye na sikaniberefo anye wo amfi me nsam o! Kokrodua nimuonyamfo!

Kokrodua nimuonyamfo! Mesre wo bra m'afuo asaase so na san ma asaase no ahocden nsan mmra na entumi mmc aduan ma me ne m'abusua efise yen asaase no ase O! Kokrodua nimuonyamfo!

English Version

Respected *Kokrodua*! A giant whose height could exceed 60 metres! You, whose yellowish colour symbolizes your value!

Look! Your wood has made carpenters wealthy since it allows them to create innovative designs that makes the world beautiful.

Look! Your wooden products are hard, remarkable and timeless. Oh! That is why foreigners want to trade you off to their land with their currency. I have seen, heard and can now deeply understand why you have gone extinct in our country Ghana.

Owing to this I will take good care of you so that greedy persons wont take you away from me oh! Respected *Kokrodua!*

Respected *Kokrodua!* Please, come to my farmland and restore its nutrients so as to give bountiful yield for me and my family for our land is degraded Oh! Respected *Kokrodua!*

Indigenous Saying/Song on *Pericopsis elata* (Kokrodua)

Asante Twi Version

Kokrodua nimuonyamfo! ɔbrane a wo tenten tumi boro anammɔn aduosia! Wo a w'akokɔsrade honam ma yehu senea wosom bo fa!

Hwe wo dua na ema akapentafo di adwini ahorɔɔ a ema wiase ye fe na ɔde nya wɔn ho tam.

Hwe ! wo aponnwa eden paa, eho twa na ensee. O! enti na Kwasi borɔni pe se wɔde aborɔkyire sika tu wo ase kɔ ne man mu. Mahu, na mate nea enti a wo ho akɔ atwe saa we yen man Ghana mu no ase yiye.

enti mehwe wo so yiye na sikaniberefo anye wo amfi me nsam o! Kokrodua nimuonyamfo!

Kokrodua nimuonyamfo! Mesre wo bra m'afuo asaase so na san ma asaase no ahocden nsan mmra na entumi mmc aduan ma me ne m'abusua efise yen asaase no ase O! Kokrodua nimuonyamfo!

English Version

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Look! Your wood has made carpenters wealthy since it allows them to create innovative designs that makes the world beautiful.

Look! Your wooden products are hard, remarkable and timeless. Oh! That is why foreigners want to trade you off to their land with their currency. I have seen, heard and can now deeply understand why you have gone extinct in our country Ghana.

Owing to this I will take good care of you so that greedy persons wont take you away from me oh! Respected *Kokrodua*!

Respected *Kokrodua*! Please, come to my farmland and restore its nutrients so as to give bountiful yield for me and my family for our land is degraded Oh! Respected *Kokrodua*!

Indigenous Saying/Song on *Alstonia boonei* (Nyamedua)

Asante Twi Version

Nyamedua....me nkwa hye wo nsa...o! Nyame bo me ho ban na sa me yaree x2

Tena me fie ha, wo me nkyen wo me mpa ho, hye me botom na ne me ntena!

Akuafɔ, adansifo ne akapentafo eee mesre wo hwe na wanfa wo nsa anka me Nyamedua...me kra banbofo no!

Nyamedua....me nkwa hye wo nsa...o! Nyame bo me ho ban na sa me yaree x2

Hwe atamfo atwa me ho ahyia, wope se woba me fie na wobesee m'adwuma, m'abusua ne m'aware...see won ma me Nyame...wone me bofo!

Nyamedua....me nkwa hye wo nsa...o! Nyame bo me ho ban na sa me yaree x2

entemkyem agu me ba Akwasi, mesre wo fa w'abena no bi sa no yaree. Hwe! Aboa bone aka me wo afuo mu, o! hu me mmobo na sa me yaree .

Nyamedua....me nkwa hye wo nsa...o Nyame bo me ho ban na sa me yaree x2

English Version

Nyamedua (Alstonia boonei) ...my life is in your hands...Oh! God protect me and heal me. x2

Stay with me in my house, stay close to me on my bed, I will keep me in my pocket, please stay with me

Farmers, building constructors and carpenters please do not touch my *Nyamedua (Alstonia boonei)*, my life protector!

Nyamedua (Alstonia boonei) ...my life is in your hands...God protect me and heal me. x2

Look I am surrounded by enemies, they want to come to my house to destroy my work, my family and my marriage...destroy them for me...you are my creator!

Nyamedua (Alstonia boonei) ...my life is in your hands...Oh! God protect me and heal me. x2

My son Akwasi is affected with measles, please use some of your barks. Look! A dangerous animal has bitten me in the farm, please have mercy on me and heal me.

Nyamedua (Alstonia boonei) ...my life is in your hands...Oh! God protect me and heal me. x2

Indigenous Saying/Song on *Alstonia boonei* (Nyamedua)

Asante Twi Version

Nyamedua....me nkwa hye wo nsa...o! Nyame bo me ho ban na sa me yaree x2

Tena me fie ha, wo me nkyen wo me mpa ho, hye me botom na ne me ntena!

Akuafow, adansifow ne akapentafo eee mesre wo hwe na wanfa wo nsa anka me Nyamedua...me kra banbofo no!

Nyamedua....me nkwa hye wo nsa...o! Nyame bo me ho ban na sa me yaree x2

Hwe atamfo atwa me ho ahyia, wape se woba me fie na wbesee m'adwuma, m'abusua ne m'aware...see won ma me Nyame...wone me bofo!

Nyamedua....me nkwa hye wo nsa...o! Nyame bo me ho ban na sa me yaree x2

entemkyem agu me ba Akwasi, mesre wo fa w'abena no bi sa no yaree. Hwe! Aboa bone aka me wo afuo mu, o! hu me mmobo na sa me yaree .

Nyamedua....me nkwa hye wo nsa...o Nyame bo me ho ban na sa me yaree x2

English Version

Nyamedua (Alstonia boonei) ...my life is in your hands...Oh! God protect me and heal me. x2

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Nyamedua (Alstonia boonei) ...my life is in your hands...God protect me and heal me. x2

Look I am surrounded by enemies, they want to come to my house to destroy my work, my family and my marriage...destroy them for me...you are my creator!

Nyamedua (Alstonia boonei) ...my life is in your hands...Oh! God protect me and heal me. x2

My son Akwasi is affected with measles, please use some of your barks. Look! A dangerous animal has bitten me in the farm, please have mercy on me and heal me.

Nyamedua (Alstonia boonei) ...my life is in your hands...Oh! God protect me and heal me. x2

Indigenous Saying/Song on *Newbouldia laevis* (Sesemasa)

Asante Twi Version

Sesemansa eee....bɔ me ho ban x3

Ahonhonmmɔne ne abayifo pɛ sɛ wɔma asetena fono me

Sc wo gya no na pam wɔn

Sesemansa eee....bc me ho ban x3

S3 wɔkyea me nsam na ɔwɔ adwenmmɔne a, tea wɔn ma me

Sesemansa eee....bɔ me ho ban x3

Sɛ mekogya m'abusuafo ne me nnamfo wɔ asieɛ a,

Samanbɔne biara a ɔbedi m'akyi no, pam no ma me

Sesemansa eee....bɔ me ho ban x3

Sesemansa eee sa me yareɛ...

Mmaa apemfo a wɔkɔ awo so ne wɔn a wonni nnufusuo, sa wɔn yareɛ

Sesemansa eee....bɔ me ho ban x3

English Version

Newbouldia laevis (Sesemasa)...protect me x3

Bad spirits and witches want to make life miserable for me

Light up your fire and drive them away

Newbouldia laevis (Sesemasa)...protect me x3

If they shake my hands and they have bad intentions, discipline them for me

Newbouldia laevis (Sesemasa)...protect me x3

If I accompany my family members and my friends at a funeral,

drive away any wicked ghost that follows me

Newbouldia laevis (Sesemasa)...protect me x3

Newbouldia laevis (Sesemasa)...please heal me

Pregnant women and lactating mothers who do not have enough breast milk, heal them

Newbouldia laevis (Sesemasa)...protect me x3

Indigenous Saying/Song on *Alstonia boonei* (Nyamedua)

Asante Twi Version

Nyamedua....me nkwa hye wo nsa...o! Nyame bo me ho ban na sa me yaree x2

Tena me fie ha, wo me nkyen wo me mpa ho, hye me botom na ne me ntena!

Akuafow, adansifow ne akapentafow eee mesre wo hwe na wanfa wo nsa anka me Nyamedua...me kra banbwofo no!

Nyamedua....me nkwa hye wo nsa...o! Nyame bo me ho ban na sa me yaree x2

Hwe atamfo atwa me ho ahyia, wape se woba me fie na wobesee m'adwuma, m'abusua ne m'aware...see won ma me Nyame...wone me bwofo!

Nyamedua....me nkwa hye wo nsa...o! Nyame bo me ho ban na sa me yaree x2

entemkyem agu me ba Akwasi, mesre wo fa w'abena no bi sa no yaree. Hwe! Aboa bone aka me wo afuo mu, o! hu me mmobwofo na sa me yaree .

Nyamedua....me nkwa hye wo nsa...o Nyame bo me ho ban na sa me yaree x2

English Version

Nyamedua (Alstonia boonei) ...my life is in your hands...Oh! God protect me and heal me. x2

Stay with me in my house, stay close to me on my bed, I will keep me in my pocket, please stay with me

Farmers, building constructors and carpenters please do not touch my *Nyamedua (Alstonia boonei)*, my life protector!

Nyamedua (Alstonia boonei) ...my life is in your hands...God protect me and heal me. x2

Look I am surrounded by enemies, they want to come to my house to destroy my work, my family and my marriage...destroy them for me...you are my creator!

Nyamedua (Alstonia boonei) ...my life is in your hands...Oh! God protect me and heal me. x2

My son Akwasi is affected with measles, please use some of your barks. Look! A dangerous animal has bitten me in the farm, please have mercy on me and heal me.

Nyamedua (Alstonia boonei) ...my life is in your hands...Oh! God protect me and heal me. x2

Indigenous Song on *Blighia sapida* (Ackee/Akyee)

Akyee m'adamfo...w'adamfofa ye me fe...wo ho bibiara ho twa na eso wo mfaso x2

M'adamfo pa...Ka w'akwantuo no mu nsem kyerε me ε...Metee se wotuu kwan fii Akyem abusuakuo no mu kɔɔ Jamaica ne n'aborcno so wo afe 1725. Mehu wo a ka w'ani so adeε kyerε me wai.

Akyee m'adamfo...w'adamfofa ye me fe...wo ho bibiara ho twa na eso wo mfaso x2

Hwe w'aduaba bere a εε paa...metumi di ne saa, metumi noa anaa mekye di...wo de kyen aborofo Milik a wɔde kube aka ho. eno nti na ahonhom mpo di bie no.

Akyee m'adamfo...w'adamfofa ye me fe...wo ho bibiara ho twa na eso wo mfaso x2

Hwe mani so aye me wisiwisi, aye kuro, eye me ya paa...w'adamfo nhu ade yiye...mesre wo fa w'ahaban no mu nsuo sɔ m'ani na menhu ade yiye, na matumi asan ahu w'ahocfe no bio

Agee meti pae me, ase m'asan anya atiridii...fa w'haban no ne wo mman no bi ma meho nsisi me ho so bio..o! m'adamfo..

etwerefo ne mo a mowc akomayareε eee...m'adamfo se mommra na onsa mo yareε

Akyee m'adamfo...w'adamfofa ye me fe...wo ho bibiara ho twa na eso wo mfaso x2

English Version

Blighia sapida (Ackee/Akyee) my friends...I cherish your friendship...everything about you is perfect and beneficial. x2

My good friend...tell me me more about your travels...I heard that you travelled from the Akyem family to Jamaica and its environs in the year 1725. When I see you, tell me about you experiences please.

Blighia sapida (Ackee/Akyee) my friends...I cherish your friendship...everything about you is perfect and beneficial. x2

Look when your fruit is ripe it tastes very good...I can eat it raw, I can boil it oor fry

it...your taste is better than foreigner's Milk with coconut. Its taste has attracted many spirits who yearn to eat it.

Blighia sapida (Ackee/Akyee) my friends...I cherish your friendship...everything about you is perfect and beneficial x2

Look I have blurred vision, its become sore, its paining me very much...your friend cant see things properly...please apply the decoction from your leaves on my eye so I can see properly, so I can see your beauty once again.

My head aches badly, I also feel feverish...use some of your leaves and bark to make me well again..oh! My friend!

Those suffering from epilepsy and heartache...my friend is inviting you to come so as to get healed.

Blighia sapida (Ackee/Akyee) my friends...I cherish your friendship...everything about you is perfect and beneficial. x2

APPENDIX C

Parts of the Native Tree Species	Indigenous/Local Name
Leaves	Nhahan/Nhaban
Seeds	N'aba/ aba
Bark	Dua abena
Roots	Dua nhini

APPENDIX D

Post-Implementation Questionnaire on the ESBIK Pedagogical Model for Native Tree Species Education in Ghana

(Elementary School Learners)

Section 1: Participant Information

- a) Participant ID (for tracking purposes):.....
- b) Grade/Class:.....
- c) Age:.....
- d) School Name:.....
- e) Location (City/Region):.....
- f) Ethnic Society:.....

Section 2: The ESBIK Pedagogical Model after its Implementation

1. What is your level of satisfaction on the content on native tree species in your locality and Ghana that was taught? (Tick the appropriate answer below)

- Not satisfactory at all (1)
- Somewhat satisfactory (2)
- Moderately satisfactory (3)
- Very Satisfactory (4)
- Extremely satisfactory (5)

Comments:.....
.....
.....
.....
.....
.....
.....
.....

2. What is your level of satisfaction on the teaching methods used for teaching native tree species in your locality and Ghana? (Tick the appropriate answer below)

- Not satisfactory at all (1)
- Somewhat satisfactory (2)
- Moderately satisfactory (3)
- Very Satisfactory (4)
- Extremely satisfactory (5)

Comments:.....
.....
.....

.....
.....
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.....
.....

3. What is your level of satisfaction on the use of indigenous knowledge such as folk songs, myths, folk stories, cosmological belief systems, etc. That were used for teaching native tree species in your locality and Ghana? (Tick the appropriate answer below)

- Not satisfactory at all (1)
- Somewhat satisfactory (2)
- Moderately satisfactory (3)
- Very Satisfactory (4)
- Extremely satisfactory (5)

Comments:.....
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4. What is your level of satisfaction on the adoption of community elders as co-instructors in the teaching of native tree species in your locality and Ghana? (Tick the appropriate answer below)

- Not satisfactory at all (1)
- Somewhat satisfactory (2)
- Moderately satisfactory (3)
- Very Satisfactory (4)
- Extremely satisfactory (5)

Comments:.....
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5. What is your level of satisfaction on the teaching and learning activities used for teaching you native tree species in your locality and Ghana? (Tick the appropriate answer below)

- Not satisfactory at all (1)

- Somewhat satisfactory (2)
- Moderately satisfactory (3)
- Very Satisfactory (4)
- Extremely satisfactory (5)

Comments:.....

6. What is your level of satisfaction on the assessment strategies used for eliciting your understanding of the content taught on native tree species in your locality and Ghana? (Tick the appropriate answer below)

- Not satisfactory at all (1)
- Somewhat satisfactory (2)
- Moderately satisfactory (3)
- Very Satisfactory (4)
- Extremely satisfactory (5)

Comments:.....

Section 3: Sustainability Awareness of Native Tree Species among Elementary School Learners after the Implementation of the ESBIK Pedagogical Model

7. How would you rate your current understanding on the need for the sustainability of native tree species in your locality and Ghana?

- Much worse (1)
- Slightly worse (2)
- No change (3)
- Slightly better (4)
- Much better (5)

8. How would you rate your belief on the importance of protecting and practicing sustainability toward the native tree species in your locality and Ghana?

- My belief has somewhat weakened (1)
- I believe it's less important (2)

- No change in my belief (3)
- My belief has somewhat strengthened (4)
- My belief has very much strengthened that its even more important (5)

Section 4: Elementary School Learners’ Knowledge Assessment on Native Tree Species in Their Locality and in Ghana

9. How knowledgeable are you in describing the physical characteristics of some native tree species (those that were taught) in your locality and Ghana?

- Not knowledgeable at all (1)
- Somewhat knowledgeable (2)
- Moderately knowledgeable (3)
- Very knowledgeable (4)
- Extremely knowledgeable (5)

Comments:.....

10. How knowledgeable are you in describing the medicinal uses of some native tree species (those that were taught) in your locality and Ghana?

- Not knowledgeable at all (1)
- Somewhat knowledgeable (2)
- Moderately knowledgeable (3)
- Very knowledgeable (4)
- Extremely knowledgeable (5)

Comments:.....

11. How knowledgeable are you in describing the cultural (religious/spiritual) uses of some native tree species (those that were taught) in your locality and Ghana?

- Not knowledgeable at all (1)
- Somewhat knowledgeable (2)
- Moderately knowledgeable (3)
- Very knowledgeable (4)

- Extremely knowledgeable (5)

Comments:.....
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12. How knowledgeable are you in describing the economic uses of some native tree species (those that were taught) in your locality and Ghana?

- Not knowledgeable at all (1)
- Somewhat knowledgeable (2)
- Moderately knowledgeable (3)
- Very knowledgeable (4)
- Extremely knowledgeable (5)

Comments:.....
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Section 5: Determination of Elementary School Learners in Engaging in Environmental Practices related to Native Tree Species after the Implementation of the ESBIK Pedagogical Model

13. How determined are you to exhibit environmental sustainability competence and consciousness by engaging in environmentally friendly practices such as the planting of native tree species in your locality and Ghana?

- Not determined at all (1)
- Somewhat determined (2)
- Moderately determined (3)
- Very determined (4)
- Extremely determined (5)

Comments:.....
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14. How determined are you to exhibit environmental sustainability competence and consciousness by engaging in environmentally friendly practices such as the refraining from negative human activities and behaviour that destroys native tree species and their habitats in your locality and Ghana such as wild fires, deforestation, etc.?

- Not determined at all (1)
- Somewhat determined (2)
- Moderately determined (3)
- Very determined (4)
- Extremely determined (5)

Comments:.....
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15. How determined are you to exhibit environmental sustainability competence and consciousness by engaging in environmentally friendly practices such as engaging in an environmental campaign and education (leading or assisting others) against negative human activities and behaviour that destroys native tree species and their habitats in your locality and Ghana such as wild fires, deforestation, etc.?

- Not determined at all (1)
- Somewhat determined (2)
- Moderately determined (3)
- Very determined (4)
- Extremely determined (5)

Comments:.....
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Section 6: Attitudes of Elementary School Learners Toward the Sustainability of Native Tree Species in Their Locality and Ghana

16. How sure are you that you would exhibit managerial skills and sustainability actions towards the native tree species in your locality and Ghana such as voluntarily planting native tree seedlings, preventing the indiscriminate cutting down of native tree species, watering or helping a naturally-growing native tree seedling?

- Not sure at all (1)
- Somewhat sure (2)
- Moderately sure (3)
- Very sure (4)
- Extremely sure (5)

Comments:.....
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Section 7: Open Feedback

17. Any other general comments on the model’s implementation:.....
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THANK YOU

APPENDIX E

Post-Implementation Questionnaire on the ESBIK Pedagogical Model for Native Tree Species Education in Ghana

(Elementary School Teachers)

Section 1: Participant Information

- a) Participant ID (for tracking purposes):.....
- b) Teaching Grade/Class:.....
- c) Years of Teaching Experience (for teachers):.....
- d) School Name:.....
- e) Location (City/Region):.....
- f) Ethnic Society:.....

Section 2: The ESBIK Pedagogical Model after its Implementation

1. After implementing the model, what is your level of satisfaction of the ESBIK pedagogical model meeting its **overarching purpose**? (Tick the appropriate answer below)

- Not satisfactory at all (1)
- Somewhat satisfactory (2)
- Moderately satisfactory (3)
- Very Satisfactory (4)
- Extremely satisfactory (5)

Comments:.....
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2. After implementing the model, what is your level of satisfaction of the ESBIK pedagogical model meeting its **learning objectives**? (Tick the appropriate answer below)

- Not satisfactory at all (1)
- Somewhat satisfactory (2)
- Moderately satisfactory (3)
- Very Satisfactory (4)
- Extremely satisfactory (5)

Comments:.....
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3. After implementing the model, what is your level of satisfaction of **the content in the ESBIK pedagogical model** in imbibing in the elementary school learners environmental sustainability consciousness and competence towards the native tree species in their locality and Ghana? (Tick the appropriate answer below)

- Not satisfactory at all (1)
- Somewhat satisfactory (2)
- Moderately satisfactory (3)
- Very Satisfactory (4)
- Extremely satisfactory (5)

Comments:.....
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4. After implementing the model, what is your level of satisfaction of **the indigenous knowledge component in the ESBIK pedagogical model** in imbibing in the elementary school learners environmental sustainability consciousness and competence towards the native tree species in their locality and Ghana? (Tick the appropriate answer below)

- Not satisfactory at all (1)
- Somewhat satisfactory (2)
- Moderately satisfactory (3)
- Very Satisfactory (4)
- Extremely satisfactory (5)

Comments:.....
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5. After implementing the model, what is your level of satisfaction of **the teaching pedagogical philosophies in the ESBIK pedagogical model** in imbibing in the elementary school learners environmental sustainability consciousness and

competence towards the native tree species in their locality and Ghana? (Tick the appropriate answer below)

- Not satisfactory at all (1)
- Somewhat satisfactory (2)
- Moderately satisfactory (3)
- Very Satisfactory (4)
- Extremely satisfactory (5)

Comments:.....
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6. After implementing the model,what is your level of satisfaction of **the suggested activities for elementary school teachers in the ESBIK pedagogical model** in imbining in the elementary school learners environmental sustainability consciousness and competence towards the native tree species in their locality and Ghana? (Tick the appropriate answer below)

- Not satisfactory at all (1)
- Somewhat satisfactory (2)
- Moderately satisfactory (3)
- Very Satisfactory (4)
- Extremely satisfactory (5)

Comments:.....
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7. After implementing the model,what is your level of satisfaction of **the suggested activities for elementary school learners in the ESBIK pedagogical model** in imbining in the elementary school learners environmental sustainability consciousness and competence towards the native tree species in their locality and Ghana? (Tick the appropriate answer below)

- Not satisfactory at all (1)
- Somewhat satisfactory (2)
- Moderately satisfactory (3)
- Very Satisfactory (4)
- Extremely satisfactory (5)

Comments:.....
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8. After implementing the model, what is your level of satisfaction of the ESBIK pedagogical model meeting its **expected environmental sustainability competencies** ? (Tick the appropriate answer below)

- Not satisfactory at all (1)
- Somewhat satisfactory (2)
- Moderately satisfactory (3)
- Very Satisfactory (4)
- Extremely satisfactory (5)

Comments:.....
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9. After implementing the model, what is your level of satisfaction of the **assessment strategies** in the ESBIK pedagogical model in imbibing in the elementary school learners environmental sustainability consciousness and competence towards the native tree species in their locality and Ghana? (Tick the appropriate answer below)

- Not satisfactory at all (1)
- Somewhat satisfactory (2)
- Moderately satisfactory (3)
- Very Satisfactory (4)
- Extremely satisfactory (5)

Comments:.....
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Section 3: Sustainability Awareness of Native Tree Species among Elementary School Learners after the Implementation of the ESBIK Pedagogical Model

10. How would you rate the current understanding of the elementary school learners on the need for the sustainability of native tree species in their locality and Ghana?

- Much worse (1)
- Slightly worse (2)
- No change (3)
- Slightly better (4)
- Much better (5)

11. How would you rate the belief of elementary school learners on the importance of protecting and practicing sustainability toward the native tree species in their locality and Ghana?

- Their belief has somewhat weakened (1)
- They believe it's less important (2)
- No change in their belief (3)
- Their belief has somewhat strengthened (4)
- Their belief has very much strengthened that its even more important (5)

Section 4: Elementary School Learners' Knowledge Assessment on Native Tree Species in Their Locality and Ghana

12. How knowledgeable do you think the elementary school learners would be able to describe the physical characteristics of some native tree species (those that were taught) in their locality and Ghana?

- Not knowledgeable at all (1)
- Somewhat knowledgeable (2)
- Moderately knowledgeable (3)
- Very knowledgeable (4)
- Extremely knowledgeable (5)

Comments:.....
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13. How knowledgeable do you think the elementary school learners would be able to describe the medicinal uses of some native tree species (those that were taught) in their locality and Ghana?

- Not knowledgeable at all (1)

- Somewhat knowledgeable (2)
- Moderately knowledgeable (3)
- Very knowledgeable (4)
- Extremely knowledgeable (5)

Comments:.....

14. How knowledgeable do you think the elementary school learners would be able to describe the cultural (religious/spiritual) uses of some native tree species (those that were taught) in their locality and Ghana?

- Not knowledgeable at all (1)
- Somewhat knowledgeable (2)
- Moderately knowledgeable (3)
- Very knowledgeable (4)
- Extremely knowledgeable (5)

Comments:.....

15. How knowledgeable do you think the elementary school learners would be able to describe the economic uses of some native tree species (those that were taught) in their locality and Ghana?

- Not knowledgeable at all (1)
- Somewhat knowledgeable (2)
- Moderately knowledgeable (3)
- Very knowledgeable (4)
- Extremely knowledgeable (5)

Comments:.....

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Section 5: Determination of Elementary School Learners in Engaging in Environmental Practices related to Native Tree Species after the Implementation of the ESBIK Pedagogical Model

16. How determined do you think the elementary school learners are in exhibiting environmental sustainability competence and consciousness by engaging in environmentally friendly practices such as the planting of native tree species in their locality and Ghana?

- Not determined at all (1)
- Somewhat determined (2)
- Moderately determined (3)
- Very determined (4)
- Extremely determined (5)

Comments:.....
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17. How determined do you think the elementary school learners are in exhibiting environmental sustainability competence and consciousness by engaging in environmentally friendly practices such as the refraining from negative human activities and behaviour that destroys native tree species and their habitats in their locality and Ghana such as wild fires, deforestation, etc.?

- Not determined at all (1)
- Somewhat determined (2)
- Moderately determined (3)
- Very determined (4)
- Extremely determined (5)

Comments:.....
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18. How determined do you think the elementary school learners are in exhibiting environmental sustainability competence and consciousness by engaging in

environmentally friendly practices such as engaging in an environmental campaign and education (leading or assisting others) against negative human activities and behaviour that destroys native tree species and their habitats in their locality and Ghana such as wild fires, deforestation, etc.?

- Not determined at all (1)
- Somewhat determined (2)
- Moderately determined (3)
- Very determined (4)
- Extremely determined (5)

Comments:.....
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Section 6: Attitudes of Elementary School Learners Toward the Sustainability of Native Tree Species in Their Locality and Ghana

19. How sure are you that the elementary school learners would exhibit managerial skills and sustainability actions towards the native tree species in their locality and Ghana such as voluntarily planting native tree seedlings, preventing the indiscriminate cutting down of native tree species, watering or helping a naturally-growing native tree seedling?

- Not sure at all (1)
- Somewhat sure (2)
- Moderately sure (3)
- Very sure (4)
- Extremely sure (5)

Comments:.....
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Section 7: Open Feedback

20. Any other general comments on the model's implementation:.....
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THANK YOU

APPENDIX F

General Knowledge of the ESBIK Pedagogical Model for Native Tree Species Education in Ghana

(Elementary School Teachers, Elementary School Administrators, Elementary School Curriculum Planners)

Participant Information

- a) Participant ID (for tracking purposes):.....
- b) Teaching Grade/Class (for teachers):.....
- c) Job description/Position:
- d) Years of Working Experience:.....
- e) School Name:.....
- f) Location (City/Region):.....
- g) Ethnic Society:.....

1. How important is the **overarching purpose** of the ESBIK pedagogical model to general environmental education in Ghana? (Tick the appropriate answer below)

- Not important at all (1)
- Somewhat important (2)
- Moderately important (3)
- Very important (4)
- Extremely important (5)

Comments:.....
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2. How well do you think the **proposed learning objectives** in the ESBIK pedagogical model (refer to the model attached) would help in achieving its overarching purpose of helping elementary school teachers know and implement best teaching practices in instructing elementary school learners about the native tree species in Ghana using the time-tested indigenous knowledge approaches that reflect their cultural realities.

- Not satisfactory at all (1)
- Somewhat satisfactory (2)
- Moderately satisfactory (3)
- Very Satisfactory (4)
- Extremely satisfactory (5)

Comments:.....
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3. How well do you think the **proposed content** in the ESBIK pedagogical model would help elementary school teachers in the effective teaching and learning of native tree species in Ghana?

- Not satisfactory at all (1)
- Somewhat satisfactory (2)
- Moderately satisfactory (3)
- Very Satisfactory (4)
- Extremely satisfactory (5)

Comments:.....
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4. How important is the **proposed indigenous knowledge component** in the ESBIK pedagogical model that would assist in the effective teaching and learning of the content on native tree species in Ghana?

- Not important at all (1)
- Somewhat important (2)
- Moderately important (3)
- Very important (4)
- Extremely important (5)

Comments:.....
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5. How well do you think the **proposed teaching pedagogical philosophies** in the ESBIK pedagogical model would help teachers in their quest to teach elementary school learners about native tree species in Ghana?

- Not satisfactory at all (1)
- Somewhat satisfactory (2)
- Moderately satisfactory (3)
- Very Satisfactory (4)
- Extremely satisfactory (5)

Comments:.....
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6. How well do you think the **proposed teaching methods** in the ESBIK pedagogical model would help teachers in their quest to teach elementary school learners about native tree species in Ghana?

- Not satisfactory at all (1)
- Somewhat satisfactory (2)
- Moderately satisfactory (3)
- Very Satisfactory (4)
- Extremely satisfactory (5)

Comments:.....
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7. How well do you think the **proposed suggested activities for elementary school teachers** in the ESBIK pedagogical model would effectively help them in teaching elementary school learners about native tree species in Ghana?

- Not satisfactory at all (1)
- Somewhat satisfactory (2)
- Moderately satisfactory (3)
- Very Satisfactory (4)
- Extremely satisfactory (5)

Comments:.....
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8. How well do you think the **proposed suggested activities for elementary school learners** in the ESBIK pedagogical model would effectively help them learn about native tree species in Ghana?

- Not satisfactory at all (1)
- Somewhat satisfactory (2)
- Moderately satisfactory (3)
- Very Satisfactory (4)
- Extremely satisfactory (5)

Comments:.....
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9. How well do you think the **proposed learning outcomes** in the ESBIK pedagogical model (refer to the model attached) would help in achieving its overarching purpose and learning objectives of the model?

- Not satisfactory at all (1)
- Somewhat satisfactory (2)
- Moderately satisfactory (3)
- Very Satisfactory (4)
- Extremely satisfactory (5)

Comments:.....
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10. How important are the **expected environmental sustainability competencies proposed** in the ESBIK pedagogical model to elementary school learners' environmental sustainability competence and consciousness? (Tick the appropriate answer below)

- Not important at all (1)

- Somewhat important (2)
- Moderately important (3)
- Very important (4)
- Extremely important (5)

Comments:.....

11. How well do you think the **proposed assessment strategies** in the ESBIK pedagogical model would help teachers in their quest to ascertain the learning processes and learning outcomes of elementary school learners on native tree species in Ghana?

- Not satisfactory at all (1)
- Somewhat satisfactory (2)
- Moderately satisfactory (3)
- Very Satisfactory (4)
- Extremely satisfactory (5)

Comments:.....

12. Any other general comments on the model:.....

THANK YOU

APPENDIX G

Post-Implementation Interview Guide on the ESBIK Pedagogical Model for Native Tree Species Education in Ghana

(Elementary School Teachers)

Section 1: Participant Information

- a) Participant ID (for tracking purposes):.....
- b) Grade/Class:.....
- c) Age:.....
- d) School Name:.....
- e) Location (City/Region):.....
- f) Ethnic Society:.....

Section 2: The ESBIK Pedagogical Model after its Implementation

1. What do you think about the appropriateness of the content on native tree species that was taught?
2. How did you find the teaching methods used for teaching native tree species in your locality and Ghana?
3. What is your view on the use of indigenous knowledge such as folk songs, myths, folk stories, cosmological belief systems, etc. during the teaching of the native tree species?
4. How did you find the use of community elders with expertise in indigenous knowledge as co-instructors in the teaching of native tree species in your locality and Ghana?
5. How did you find the teaching and learning activities that were used for teaching native tree species in your locality and Ghana?
6. What is your take on the assessment strategies used for eliciting your understanding of the content taught on native tree species in your locality and Ghana?

Section 3: Sustainability Awareness of Native Tree Species among Elementary School Learners after the Implementation of the ESBIK Pedagogical Model

7. In what ways do you think the elementary school learners' current understanding of the need for the sustainability of native tree species in your locality and Ghana would be impacted after the teaching and learning activities using the ESBIK pedagogical model?
8. How has the education on native tree species using the model affected the elementary school learners' belief in the importance of protecting and practicing sustainability toward the native tree species in your locality and Ghana?

Section 4: Elementary School Learners' Knowledge Assessment on Native Tree Species in Their Locality and Ghana

9. After taking the elementary school learners through the education on native tree species using the ESBIK pedagogical model, how convinced are you that they would be able to thoroughly describe some of the physical characteristics of some native tree species (those that were taught) in your locality and Ghana?

10. After taking the elementary school learners through the education on native tree species using the ESBIK pedagogical model, how convinced are you that they would be able to thoroughly describe some of the medicinal uses of some native tree species (those that were taught) in your locality and Ghana?

11. After taking the elementary school learners through the education on native tree species using the ESBIK pedagogical model, how convinced are you that they would be able to thoroughly describe some of the cultural (religious/spiritual) uses of some native tree species (those that were taught) in your locality and Ghana?

12. After taking the elementary school learners through the education on native tree species using the ESBIK pedagogical model, how convinced are you that they would be able to thoroughly describe some of the economic uses of some native tree species (those that were taught) in your locality and Ghana?

Section 5: Determination of Elementary School Learners in Engaging in Environmental Practices related to Native Tree Species after the Implementation of the ESBIK Pedagogical Model

18. After taking the elementary school learners through the education on native tree species using the ESBIK pedagogical model, how convinced are you that they are determined to exhibit environmental sustainability competence and consciousness? Are the learners determined to engage in environmentally friendly practices such as the planting of native tree species in your locality and Ghana? If yes/no, why?

19. After taking the elementary school learners through the education on native tree species using the ESBIK pedagogical model, how convinced are you that they are determined to exhibit environmental sustainability competence and consciousness? Are the learners determined to refrain from negative human activities and behaviour that destroys native tree species and their habitats in your locality and Ghana such as wildfires, deforestation, etc? If yes/no, why?

20. After taking the elementary school learners through the education on native tree species using the ESBIK pedagogical model, how convinced are you that they are determined to exhibit environmental sustainability competence and consciousness? Are the learners determined to engage in an environmental campaign and education (leading or assisting others) against negative human activities and behaviour that destroy native tree species and their habitats in your locality and Ghana such as wildfires, deforestation, etc.? If yes/no, why?

Section 6: Attitudes of Elementary School Learners Toward the Sustainability of Native Tree Species in Their Locality and Ghana

21. After taking the elementary school learners through the education on native tree species using the ESBIK pedagogical model, how convinced are you that they would be willing to engage in activities such as voluntarily planting native tree seedlings, preventing the indiscriminate cutting down of native tree species, watering or helping a naturally-growing native tree seedling? If yes/no, why?

Section 7: Open Feedback

22. Do you have any other general comments on the model's implementation that you would want to share?

THANK YOU

APPENDIX H

Post-Implementation Interview Guide on the ESBIK Pedagogical Model for Native Tree Species Education in Ghana

(Elementary School Learners)

Section 1: Participant Information

- a) Participant ID (for tracking purposes):.....
- b) Grade/Class:.....
- c) Age:.....
- d) School Name:.....
- e) Location (City/Region):.....
- f) Ethnic Society:.....

Section 2: The ESBIK Pedagogical Model after its Implementation

1. What do you think about the appropriateness of the content on native tree species that was taught?
2. How did you find the teaching methods used for teaching native tree species in your locality and Ghana?
3. What is your view on the use of indigenous knowledge such as folk songs, myths, folk stories, cosmological belief systems, etc. during the teaching of the native tree species?
4. How did you find the use of community elders with expertise in indigenous knowledge as co-instructors in the teaching of native tree species in your locality and Ghana?
5. How did you find the teaching and learning activities that were used for teaching native tree species in your locality and Ghana?
6. What is your take on the assessment strategies used for eliciting your understanding of the content taught on native tree species in your locality and Ghana?

Section 3: Sustainability Awareness of Native Tree Species among Elementary School Learners after the Implementation of the ESBIK Pedagogical Model

7. What is your current understanding of the need for the sustainability of native tree species in your locality and Ghana after going through the teaching and learning activities using the ESBIK pedagogical model?
8. How has the education on native tree species using the model affected your belief in the importance of protecting and practicing sustainability toward the native tree species in your locality and Ghana?

Section 4: Elementary School Learners' Knowledge Assessment on Native Tree Species in Their Locality and Ghana

9. After going through the education on native tree species using the ESBIK pedagogical model, can you thoroughly describe some of the physical characteristics of some native tree species (those that were taught) in your locality and Ghana?
10. After going through the education on native tree species using the ESBIK pedagogical model, can you thoroughly describe some of the medicinal uses of some native tree species (those that were taught) in your locality and Ghana?
11. After going through the education on native tree species using the ESBIK pedagogical model, can you thoroughly describe some of the cultural (religious/spiritual) uses of some native tree species (those that were taught) in your locality and Ghana?
12. After going through the education on native tree species using the ESBIK pedagogical model, can you thoroughly describe some of the economic uses of some native tree species (those that were taught) in your locality and Ghana?

Section 5: Determination of Elementary School Learners in Engaging in Environmental Practices related to Native Tree Species after the Implementation of the ESBIK Pedagogical Model

13. After going through the education on native tree species using the ESBIK pedagogical model, how are you determined to exhibit environmental sustainability competence and consciousness? Are you determined to engage in environmentally friendly practices such as the planting of native tree species in your locality and Ghana? If yes/no, why?
14. After going through the education on native tree species using the ESBIK pedagogical model, how are you determined to exhibit environmental sustainability competence and consciousness? Are you determined to refrain from negative human activities and behaviour that destroys native tree species and their habitats in your locality and Ghana such as wildfires, deforestation, etc? If yes/no, why?
15. After going through the education on native tree species using the ESBIK pedagogical model, how are you determined to exhibit environmental sustainability competence and consciousness? Are you determined to engage in an environmental campaign and education (leading or assisting others) against negative human activities and behaviour that destroy native tree species and their habitats in your locality and Ghana such as wildfires, deforestation, etc.?If yes/no, why?

Section 6: Attitudes of Elementary School Learners Toward the Sustainability of Native Tree Species in Their Locality and Ghana

16. After going through the education on native tree species using the ESBK pedagogical model, how do you intend to exhibit managerial skills and sustainability actions towards the native tree species in your locality and Ghana? Are you certain of engaging in activities such as voluntarily planting native tree seedlings, preventing the indiscriminate cutting down of native tree species, watering, or helping a naturally-growing native tree seedling? If yes/no, why?

Section 7: Open Feedback

17. Do you have any other general comments on the model's implementation that you would want to share?

THANK YOU

APPENDIX I

OBSERVATION GUIDE

Classroom Lessons on Native Tree Species Education Using the ESBIK Pedagogical Model

School: **Class:**
Age Group:.....**Topic:**
Instructors:..... **Date:**..... **Duration:**.....

Angle of Observation	Attributes (The specific aspects observed)	Checklist			
		Yes	No	Somehow	Best Practice(s) Observed
Content on native tree species taught is in line with those specified in the ESBIK pedagogical model					
Teaching methods employed are in line with those specified in the ESBIK pedagogical model					
Indigenous knowledge related to native tree species is employed as specified in the ESBIK pedagogical model					
Teaching and learning activities reflect on the teaching philosophical approaches specified in the ESBIK					

pedagogical model (constructivism & Pragmatism)					
Suggested teacher activities reflect those specified in the ESBIK pedagogical model					
Suggested learner activities reflect those specified in the ESBIK pedagogical model					
Teaching and learning activities consciously targeted at developing in learners the core competencies specified in the ESBIK pedagogical model					
Teacher employs both summative and formative assessment strategies during the teaching and learning activities as specified in the ESBIK pedagogical model					

