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Article

Development and Implementation of an Elementary School-Based Indigenous Knowledge Pedagogical Model on Native Tree Species for Environmental Sustainability Education in Ghana

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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

1. Introduction

The conservation of native tree species as part of measures to protect the fast dwindling of native forest resources is an urgent global concern [1-4]. 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 [1,3,5]. The need to conserve native tree species is indispensable due to their natural, aesthetic, cultural, historical and socio-economic values [4]. Their conservation is very important because they assists greatly in the restoration of ecosystems, supporting rural livelihoods and contributing to cleaner environments as they act as sequester for carbon [6]. 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) [7].

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 [7]. 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' [7]. 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 [8-11].

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 [12]. 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 [13]. 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 [14] 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 [15]. Environmental education is recognised as a means for encouraging the active participation of learners toward sustainability [16], 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 [10]. 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 [17]. In Ghana, the need to integrate environmental education into the curriculum for Ghanaian schools was first 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 placed-based approaches efficient, impactful and sustainable for typical Ghanaian learners [18]. While the BGCI Report [7] advocates education of the youth, it acknowledges the contributions and adoption of instructional pedagogies rooted in traditional/indigenous knowledge sharing modes.[2] Adom [11] has recommended some pedagogical suggestions that hinge on indigenous knowledge systems that

[1] 15.6 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).

[2] 15.2 Create interfaces for traditional/indigenous knowledge sharing under the Objective 15 of the Planning conservation action for Ghana's threatened tree species, 2023 report.

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could be used to teach elementary school learners topics in environmental education. He avers that its 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 [19]. After all, it is within the childhood stages that their individual personalities are formed [20]. 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 [21].

Elementary education on biodiversity conservation would help create the awareness of biodiversity conservation in children at their early years [22]. In the case of Ghana, Eshun [23] 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 [18] 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 ESBIK pedagogical model, five native tree species were used in 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.Develop a pedagogical model based on Ghanaian indigenous knowledge systems to be used for native tree education on native tree species in Ghana

2.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

2. Methods

2.1. 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 [24] 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.

2.2. Data Collection Instruments and Procedure

Adapted versions of the *SCQ-instrument for measuring Sustainability Consciousness* [25] and the *Instrument for Measuring Student Sustainability Competencies* [26] were used for ascertaining the levels

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of elementary school learners' sustainability consciousness and sustainability competencies before and after the implementation of the ESBIK pedagogical model. 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. 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. A classroom observation checklist 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 [27] *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 [28]. *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, f*ocus 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.

2.3. 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 (Figure 1). 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.

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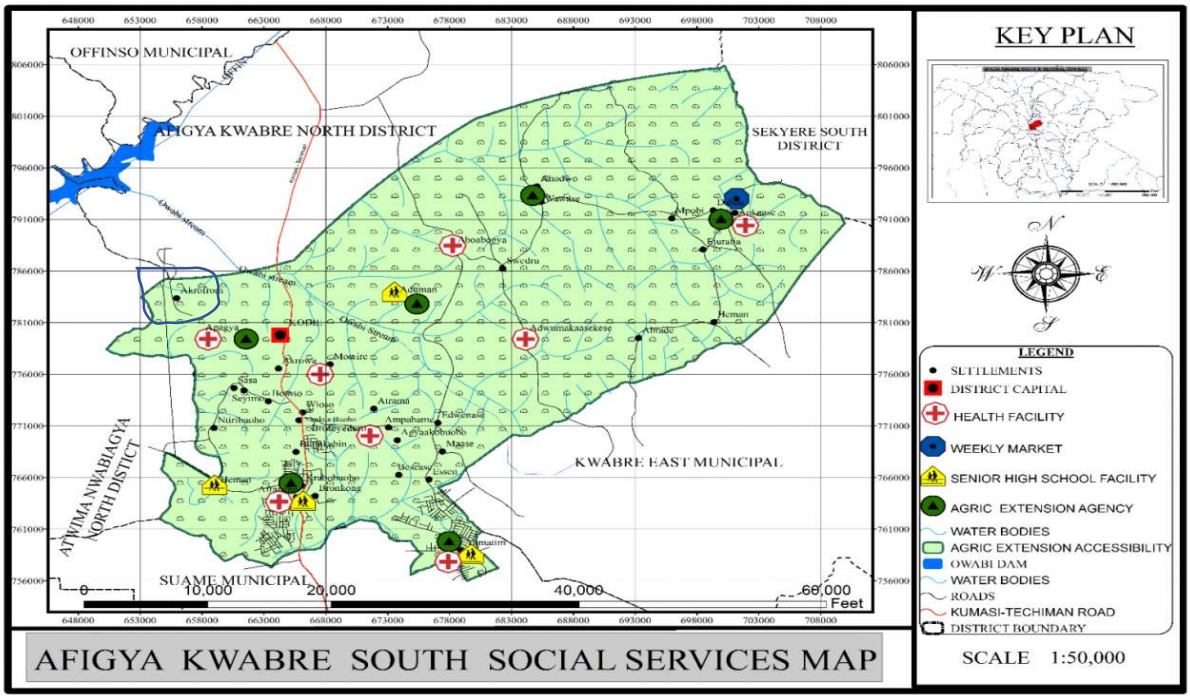

Figure 1. Map of Akrofrom, Afigya Kwabre South District, Ashanti Region, Ghana. Source: Afigya Kwabre South District Assembly, https://aksda.gov.gh/index.php/profile/.

2.4. Population, Sampling Designs and Sampling Size

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 ESBIK pedagogical model. Stratified random sampling was used for selecting the sample for the study (Table 1). 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 ESBIK pedagogical model were also recruited.

Table 1. Sample Description.

Population	*Private School*	*Public School*	*Sample Size*
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.

2.5. 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 [29] and with the help of the NVivo 12 software.

3. Results

3.1. Development of a pedagogical model based on Ghanaian indigenous knowledge systems to be used for environmental sustainability education on native tree species in Ghana

3.1.1. Pedagogical Framework Context

The ESBIK pedagogical model (Figure 3) with its pedagogical structure (Appendix A) 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.

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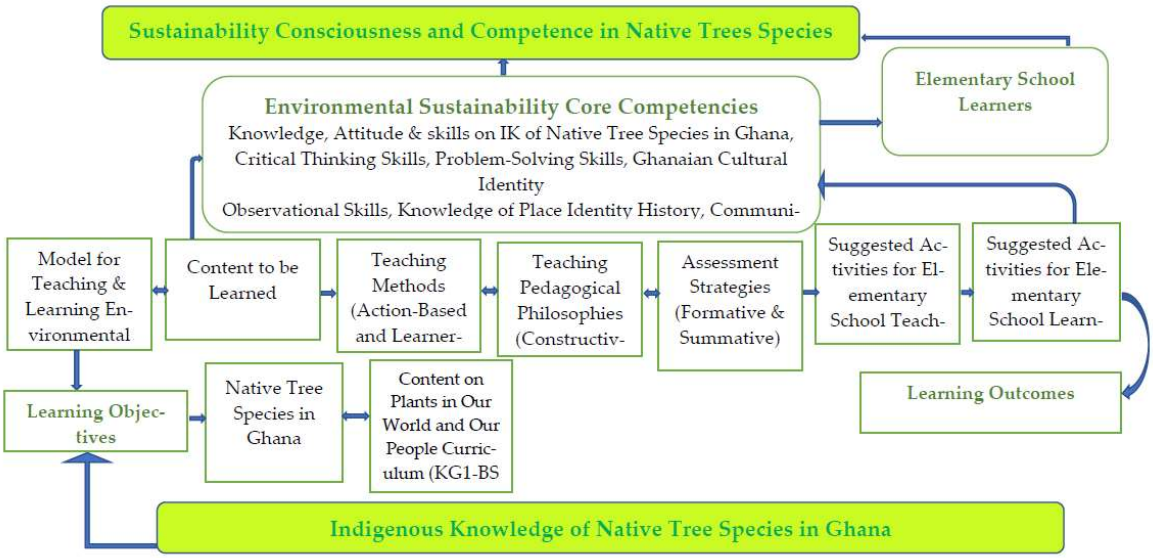

Source: Developed by the Researchers

Figure 3. The ESBIK Pedagogical Model.

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 [30]. 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.

3.1.2. 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 2. 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 [31] 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.

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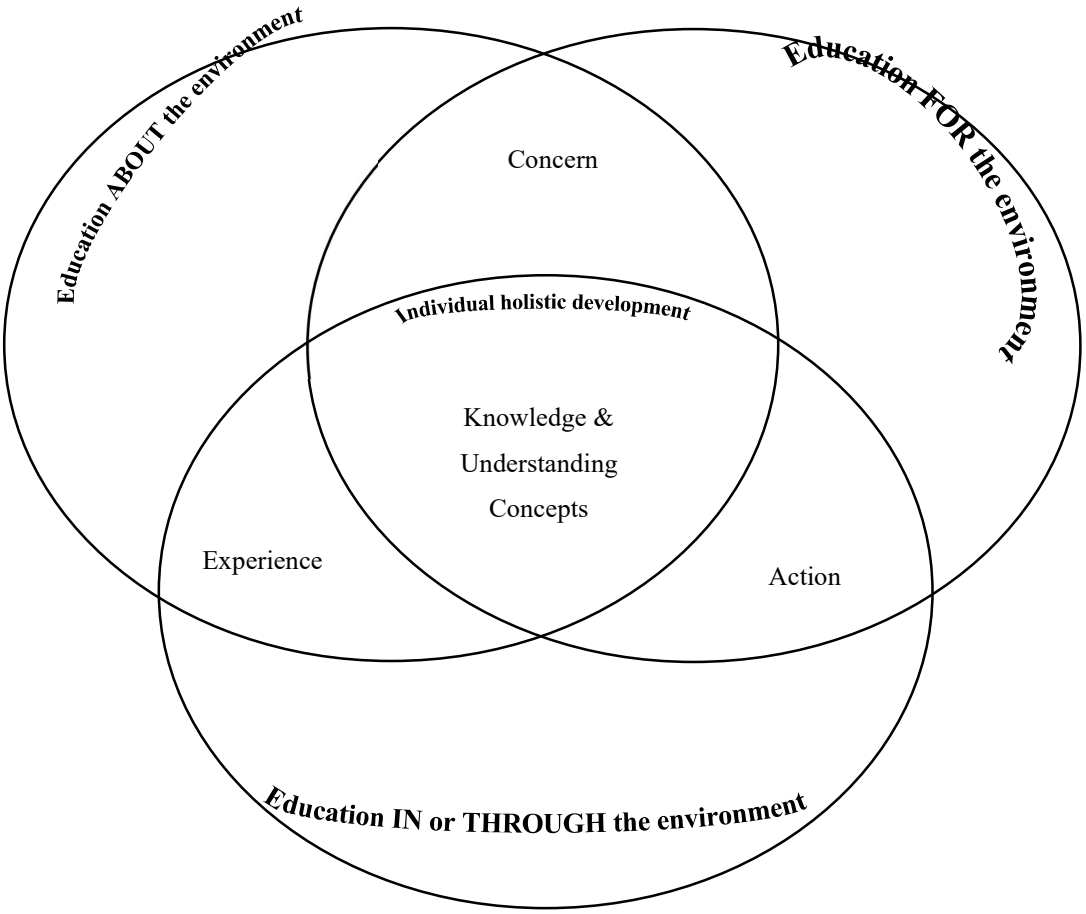

Figure 2. Model for holistic teaching and learning in environmental education. Source: [32].

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.

3.1.3. 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

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theoretical constructs in Palmer's [32] 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) [7] 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.

3.1.4. 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 [33]. 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 [34, 35, 11]. In communities where indigenous knowledge regarding native tree species looms high, such as Africa, nature, culture, and the people are inextricably linked [33]. 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 [36, 34, 37, 38] 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.

3.1.5. 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 [39]. Constructivism is a recent epistemological perspective that views knowledge as constructed based on human perception and social experience [40]. 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 [41]. 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 [42, 43], 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 [44]. 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 [44, 45]. Pragmatic thinking in education emphasizes functional objectives, learner-centered instruction, hands-on learning, teamwork, and

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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.

3.1.6. 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 [31]. 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 [46, 47, 18, 48, 21, 49, 23, 50]. 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 [39]. 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.

3.1.7. 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 ESBIK 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.

3.1.8. 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

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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.

3.1.9. 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

3.1.10. 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 [51].

3.1.11. 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 [52]. 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 [53] While helping students in owning their learning, it assist teachers in identifying misconceptions and gaps in learning to improve the teaching and learning strategies [54].

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More so, formative assessment is noted for helping in achieving quality and equity in elementary education [55] 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 [56]. 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 [57]. 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.

3.2. 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

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	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 Nikkies	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	Moderately important	2	11.1
	very important	11	61.1
	Extremely important	5	27.8

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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	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 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	Moderately important	1	5.6
	very important	15	83.3
	Extremely important	2	11.1
	Total	18	100
How well do you think the **proposed pedagogical philosophies** in the ESBIK	Somewhat important	1	5.6
	Very Important	13	72.2
	Extremely important	4	22.2

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pedagogical model would help teachers in their quest to teach elementary school learners about native tree species in Ghana?	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**	Moderately important	2	11.1
	very important	13	72.2
	Extremely important	3	16.7

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competencies proposed in the ESBIK pedagogical model to elementary school learners' environmental sustainability competence and consciousness?	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
	Very satisfactory	7	50

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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?	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 of the **assessment strategies** used for eliciting your understanding of the content taught on native tree species on your locality and Ghana?	Very satisfactory	11	78.6
	Extremely satisfactory	3	21.4
	Total	14	100

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**	Moderately knowledgeable	1	7.1
	Very Knowledgeable	9	64.3
	Extremely Knowledgeable	4	28.6

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species (those that were taught) in their locality and Ghana?	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 uses of some native tree species** (those that were taught) in their locality and Ghana?	Moderately knowledgeable	4	28.6
	Very Knowledgeable	10	71.4
	Total	14	100

Section 4. Determination of Elementary School Learners in Engaging in Environmental Practices related to Native Tree Species after the Implementation of the ESBIK 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	Very determined	8	57
	Extremely determined	6	43
	Total	14	100

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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.?			
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

Scheme 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

3.2.1. 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).

3.2.2. 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. 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).

3.2.3. 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).

3.2.4. 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

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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).

3.2.5. 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).

3.2.6. 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.

3.2.7. 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

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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).

3.2.8. Level of Satisfaction and Appropriateness of the Use of Elders as Co-Instructors in the ESBIK 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).

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3.2.9. 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)

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 ESBIK 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).

'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).

3.2.10. 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).

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

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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).

3.2.12. 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. The 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.

3.2.13. Knowledge Assessment of Elementary School Learners on Native Tree Species after the Implementation of the ESBIK Pedagogical Model

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).

3.2.14. Sustainability Awareness of Native Tree Species Among Elementary School Learners

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)' .

3.2.15. Sustainability Competence, Consciousness and Action Among Elementary School Learners After the Implementation of the ESBIK Pedagogical Model for Native Tree Species Education

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 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

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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).

4. Discussion

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. The results affirm the view of Lopus et al. [4] that native tree education is important as a means of preserving the aesthetic, cultural, medical, and other indispensable values of these tree species. Likewise, 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. Literature confirms that when objectives are SMART, they stand better chances of achievement [58]. 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. The findings affirm the views of Adom et al. [41] that constructivist pedagogical philosophies when deployed in teaching and learning, assist learners to explore and discover content through hands-on and experiential learning. Likewise, the pragmatist pedagogical approach prioritizes practical learning that makes learners active participants in the teaching and learning processes [44].

Moreover, the content in the ESBIK pedagogical model relies on the plant content in 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 findings from the pre-implementation and post-implementation stages of the ESBIK pedagogical model corroborate with those found in other studies [59-61]. For instance, when environmental education incorporates indigenous knowledge it acknowledges the relevance of cultural diversity and inclusivity as agents for conservation [59, 61]. Also, when environmental education for elementary learners incorporates indigenous knowledge of the local communities it helps learners in developing strong place connections to their environments bolstering their resolve to conserve their native tree species [60].

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 positive

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feedback from the study participants on the learner-centered and activity-based teaching methods specified in the ESBIK pedagogical model has been described as the most appropriate teaching methods for elementary school education [41], especially for elementary environmental education where discovery and activity-based approaches to teaching are paramount [46, 47, 18, 49, 22, 50].

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. Various studies [11, 12] support the tactful use of elders as co-instructors for environmental education, especially because of their rich knowledge of indigenous knowledge systems regarding native tree species. More so, their age and position in society command great respect, and elementary learners take their instruction very seriously [11] as confirmed by the findings of this study.

Furthermore, 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. 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 [62]. Therefore, using native tree species and spaces in their local regions as learning spaces, such as field trips and nature walks proposed by the ESBIK model, hold the benefits of helping learners 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 posters and flyers, as well as the construction of nurseries and gardens were seen to raise the environmental awareness and sustainability awareness of learners [63].

In terms of assessment, the assessment plan in the ESBIK pedagogical model offers long-term learning because it is geared purposefully toward learning especially for low-achieving learners. 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. 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 [52, 53], aid learners in grasping the practicalities of learned concepts [54], and motivate low achieving learners in diligently achieving the learning outcomes set.

In terms of assessing the knowledge assessment, sustainability awareness, consciousness, and competence of learners after the implementation of the ESBIK pedagogical model, 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

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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. The findings of the study have shown that good environmental education must target nurturing various forms of sustainability competencies. For instance, Vesterinen [64] mentions various forms of sustainability competence, some of which were evident in 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 [65]. 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 [66]. 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 [65]. 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 [25, 26].

5. 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.

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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 *Pericopsis elata* - Kokrodua, *Talbotiella gentii*- Takrowa-nua, etc., and others in the locality of your school) ***Pericopsis elata* (Kokrodua)**	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	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	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	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

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	Talbotiella gentii **(takurowa-nua)** *Ceiba pentandra* (Onyina) *Blighia sapida* (Akyee/Ackee) *Vernonia amygdalina* (onwono/Awonwone) *Voacanga africana* (Bedaa) *Bryophyllum pinnatum* (Egoro/Tan me o wu) *Morinda lucida* (Konkroma) *Alstonia boonei* (Nyamedua) *Margaritaria discoidea* (Pepea) *Newbouldia laevis* (Sesemasa) *Trema orientalis* (Sesea) Funtumia elastica (*Funtum*)	Demonstrate understanding of the parts of plants (KG 1 & KG 2)	Local and/or indigenous names and common	Constructivis	Experiential learning Team teaching with community elders Combination	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, folk story, or any information about it. 3. Present a picture or draw on the board, the native tree species and write underneath their scientific	pronunciations and spellings. 3. Critically observe the picture or video about the native tree species and comment on their distinctive features.		Good observational and descriptive Skills Good sense of place Good communication and linguistic skills Drawing/ representational skills Creativity and Innovation skills

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	Describe the parts of a native tree species (Use the list of threatened native species in Table X such as *Pericopsis elata* - Kokrodua, *Talbotiella gentii*- Takrowa-nua, etc., and others in the locality of your school)		descriptions are given to the parts of the native tree species. (Find examples in Appendix C) 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)	m & Pragmatism	of: Inquiry-based (interaction/ discussion) Activity-based Discovery Observation-based Experiential learning Team teaching with community elders	name and local/indigenous names. 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. 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.).	4. Draw the native tree species (or any of its parts) observed in the picture, video,, or during the field visit and color it.		

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	Discuss the growth development of native tree species from your locality and country (Use the list of	Demonstrate understanding of how plants grow (KG 1 & KG 2) Demonstrate	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.	Constructivism & Pragmatism	Combination of: Inquiry-based	5. Ask students to draw the native tree species described and color them. 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) Assignment: 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.	Assignment: 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. 1. Observe and share your views with your classmates on the growth development scenarios of the native tree species	Elementary school learners demonstrate knowledge and understanding of the growth development conditions of native	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

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	threatened native species in Table X such as *Pericopsis elata* - Kokrodua, *Talbotiella gentii*- Takrowa-nua, etc., and others in the locality of your school) Describe the relationship between native tree species and the environment (specifically, soil, sunlight, and water)	understanding of how living and non-living things in the environment are related (BS 5) i. Plants and soil ii. Plants and sunlight iii. Plants and water (BS 4)	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).		(interaction/ discussion) Activity-based Discovery Observation-based Experiential learning Team teaching with community elders	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	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	tree species in their locality/Ghana. Elementary school learners demonstrate knowledge of the significant roles and relationships between the environment (soil, water, and sunlight) with native tree species.	Creativity and Innovation skills

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						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 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	community elders on the factors that hinder or promote the growth development of native tree species. 5. Observe the varying conditions on the growth development of native tree species during the nature walk. Assignment: Together with your class group, design a chart/poster on the growth development conditions for native tree species in Ghana.		

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						to contribute to the discussion on what things native tree species need to grow well. 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. Assignment:			

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						Assign group projects for your class in designing a chart/poster on the growth development conditions for native tree species in Ghana.			
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)	Economic, cultural, spiritual/religious, and medicinal uses of the native tree species Medicinal Uses (e.g. seeds, barks, roots, and leaves for treating specific diseases (Appendix C). Cultural (spiritual/religious) Uses-haven/abodes of deities for worship, homesteads for spiritual protection, etc.	Constructivism & Pragmatism	Combination of: Inquiry-based (interaction/ discussion) Activity-based Discovery Observation-based Experiential learning	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. 2. With the assistance of community elders knowledgeable in IK, discuss with the learners,	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.	Elementary school learners' ability to describe the economic, cultural, spiritual/religious, and medicinal uses of the native tree species in their locality 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

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			Domestic Uses of native tree species e.g. fruits and leaves for food, etc.		Team teaching with community elders	the medicinal Uses (e.g. seeds, barks, roots, and leaves for treating specific diseases (Appendix C). 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. 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 industries, wood and furniture industries, brewery industries, textile industries, etc. in your locality and Ghana. 5. Plan a visit to local	4. Actively participate in the class discussion on local industries from native tree species. 6. Write down questions you want to ask managers and workers in industries that use native tree species. Record the feedback and your general observations during the		Good communication and linguistic skills Drawing/ representational skills Creativity and Innovation skills

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						industries that use native tree species and interact with the managers and workers Assignment: Ask learners to describe the different uses of native tree species (text, pictures/drawings, etc.)	visit for post-class discussions. Assignment: Describe the different uses of native tree species (text, pictures/drawings, etc.).		
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	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	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. 2. Discuss with the learners, the adverse effects of human activities related to native tree species such as climate change,	1 & 2. Share your views with your class on human activities that negatively affect native tree species in your locality and their adverse effects.	Elementary school learners engage in environmentally friendly activities that demonstrate their concern for the conservation of native tree species in their communities and Ghana.	Knowledgeable in Indigenous knowledge of native tree species Critical Thinking skills Problem-Solving skills Cultural Identity

		groups to create awareness of plant/tree conservation in their school (BS 5)			learning Team teaching with community elders	overconcentration of greenhouse gases, etc. 3. Help students in examining the traditional and contemporary agronomic practices that conserve native tree species in the environment. 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 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.	3. Share your views on how to prevent the adverse effects of negative human activities using traditional and contemporary agronomic practices. 4. Listen and share the traditional knowledge systems to know that frown on the negative human activities that adversely affect native tree species in your locality and Ghana. 5. Design and produce a pictorial poster or flyer and use it in the planned		Good observational and descriptive Skills Good sense of place Good communication and linguistic skills Drawing/ representational skills Creativity and Innovation skills

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						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.	school and community campaign against the negative human activities that adversely affect native tree species in your locality or Ghana.		
Exhibit environmental management skills and sustainable actions toward the native tree species in their communities and Ghana.	Engage in helpful environmental projects such as planting native tree species, etc.	Demonstrate understanding of the importance of trees in our environment (BS 6) Explain how to make and	Traditional agronomic planting strategies for native tree species (Appendix B) Cultural practices involved in tree planting among some communities and their relevance (scientific) (Appendix B)	Constructivism & Pragmatism	Combination of: Inquiry-based (interaction/ discussion) Activity-based Discovery Observation-based	1. Liaise with community elders to discuss with learners, the best traditional agronomic planting strategies for native tree species. 2. Liaise with a forester (from any of the forest reserves) to instruct learners on contemporary planting strategies for native tree species.	1. Listen and share in the discussion on the best traditional agronomic planting strategies for native tree species. 2. Listen and share in the discussion on contemporary planting strategies for native tree species.	Elementary school learners' exhibition of management skills and sustainable actions toward the native tree species in their communities and Ghana.	Knowledgeable in Indigenous knowledge of native tree species Critical Thinking skills Problem-Solving skills Creativity and

		maintain a garden (BS 3) Plant trees in their communities as a civic duty (BS 6)			Experiential learning Team teaching with community elders	3. Assist learners in appreciating the similarities and differences between traditional and contemporary tree planting strategies. 4. Lead learners to visit a nature reserve and engage in native tree-planting activities with the assistance of foresters and community elders. 5. Foresters share knowledge on seed handling, the establishment of nurseries to grow seedlings, storage behaviors, propagation, and planting of native tree species.	3. Listen and share in the discussion on the differences and similarities between traditional and contemporary tree-planting strategies. 4. Observe, record, and engage in native tree species planting activities with the assistance of foresters and community elders. 5. Record the knowledge shred 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.		Innovation skills

						6. Assist learners in undertaking group planting projects of native tree species in the school.	daily watering, measuring the height of the trees weekly, number of leaves. 6. Join your group and take an active role in the group planting projects of native tree species in the school.		

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