



Inclusive mathematics and science teacher education for sustainable development: A hermeneutical phenomenological study in Ghanaian colleges of education

Ernest Frimpong Akosah¹ and Ebenezer Appah Bonney²

¹Department of Mathematics and ICT, Peki College of Education, Ghana (ORCID: 0000-0002-9792-5311)

²Department of Science Education, University of Cape Coast, Ghana (ORCID: 0000-0002-5945-8863)

Corresponding Author: Ebenezer Appah Bonney, eappahbonney@gmail.com

Submitted: 22 March 2026 Revised: 12 May 2026 Accepted: 2 June 2026 Published online: 27 September 2026

Abstract

This study explores the challenges and strategies associated with implementing inclusive mathematics and science teaching in Ghanaian Colleges of Education within the broader framework of sustainable education. Guided by principles of Social Model of Disability, a hermeneutical phenomenological design was employed to explore the lived experiences of eight purposively selected respondents, including mathematics and science lecturers and quality assurance officers. The findings reveal persistent barriers such as limited access to inclusive resources, inadequate professional training, monocultural pedagogical practices, and weak technology integration, which collectively hinder the sustainability of inclusive teaching. Despite these constraints, participants identified practical strategies including continuous professional development, differentiated instruction, collaborative learning, curriculum adaptation, and improved access to assistive technologies as pathways toward inclusive and sustainable education. The study contributes to theory by strengthening the linkage between inclusive education and sustainable education, while emphasizing the role of lecturer preparedness in promoting equitable learning environments. It is recommended that teacher education institutions and policymakers prioritize continuous capacity-building programmes and investment in inclusive teaching resources to support sustainable implementation. The findings align with the goals of United Nations Sustainable Development Goal 4 and offer implications for policy, curriculum reform, and practice in resource-constrained contexts.

Keywords: Ghana; Inclusive education; Mathematics education; Science education; SDG 4; Sustainable education; Teacher education

1. Introduction

Sustainable development is development that aims to improve the quality of life for all people around the world, both present and future generations (Mensah, 2019; Yu et al., 2020; Yusoff, 2020). According to Onoshakpokaiye (2021) every country must ensure that its people live sustainability-oriented. Education is widely recognized as a critical driver of sustainable development, particularly in its capacity to promote social equity, economic advancement, and inclusive societies. In response to growing concerns about environmental degradation and social inequalities resulting from rapid industrialization and economic expansion, the concept of sustainability emerged in the second half of the 20th century and has become increasingly important in contemporary society (Abera, 2023; Tonegawa, 2023). In 2015, at the Sustainable Development Summit, the 193 United Nations member states worldwide adopted the 2030 Agenda for Sustainable Development and its 17 Sustainable Development Goals (SDGs). The SDGs represent a universal call to action to end poverty, protect the planet, combat inequality and injustice, and above all tackle climate change by 2030. SDGs can be related to mathematics and science education, as they provide contexts in which critical reasoning, data analysis, and mathematical modelling can be meaningfully applied. For example, SDG 13 (climate action) may be addressed through the analysis and modelling of climate-related data, SDG 12 (responsible consumption and production) through the examination of resource use and efficiency, and SDG 10 (reduced inequalities) through the statistical exploration of social and economic disparities. Within this framework, SDG 4 (quality education) which advocates for inclusive, equitable, and quality education and lifelong learning opportunities for all (UNESCO, 2020; United Nations, 2015). Sub-goal 4.7, education for sustainable development (ESD), states that schools must also provide education about sustainability. Central to this goal is the concept of inclusive education, which seeks to ensure that all learners, including those with disabilities and diverse learning needs, have

access to meaningful and equitable learning opportunities. In this regard, sustainable education extends beyond access to schooling to encompass the creation of adaptive, resilient, and inclusive learning systems that respond effectively to learner diversity (Sapayev et al., 2026; Yassim et al., 2025). Hence, quality education and learning for sustainable development at all levels and in society is urgently needed (Glavič, 2020; Malik, 2018; Vinuesa et al., 2020).

Mathematics and science education occupy a strategic position within sustainable development efforts, as they equip learners with critical thinking, problem-solving skills, and scientific literacy necessary for addressing complex global challenges (Akosah & Bonney, 2025; Makramalla et al., 2025). However, the sustainability of mathematics and science education systems depends significantly on their inclusivity and their ability to accommodate learners with varied abilities and backgrounds. Global initiatives such as the Programme for International Student Assessment (PISA), led by the Organisation for Economic Co-operation and Development, highlight the importance of equitable learning outcomes and inclusive pedagogical practices in enhancing educational quality (OECD, 2021). Similarly, inclusive education frameworks, including the Salamanca Statement and the United Nations Convention on the Rights of Persons with Disabilities, reinforce the need for education systems to address structural barriers that hinder participation (UNESCO, 1994; United Nations, 2006).

In Ghana, efforts to align educational practices with global sustainability priorities have led to significant policy reforms, including the adoption of the Inclusive Education Policy and the introduction of the 2018 Bachelor of Education (B.Ed.) curriculum. These reforms aim to embed inclusive pedagogies within teacher education and to prepare lecturers capable of fostering equitable and sustainable learning environments (Ministry of Education, 2017; Ministry of Education, 2020). The National Teacher Education Curriculum Framework further emphasizes inclusivity as a cross-cutting theme, highlighting the need for teachers to respond effectively to diverse learner needs. Despite these policy advancements, the implementation of inclusive education within teacher education institutions remains a challenge. Sustainable education requires not only policy alignment but also institutional capacity, resource availability, and continuous professional development to ensure long-term effectiveness (Adams et al., 2018; Aggarwal, & Agarwala, 2026). In many contexts, including Ghana, teacher education institutions face systemic constraints such as inadequate resources, limited training opportunities, and rigid curricular structures, which undermine the effective integration of inclusive practices (Schuelka, 2018). Furthermore, the theoretical grounding of inclusive education within the Social Model of Disability provides a critical perspective for understanding sustainability in education systems. This model shifts attention from individual impairments to the structural and environmental barriers that limit participation, thereby aligning with the principles of equity and social justice inherent in sustainable education (Retief & Letšosa, 2018). Within this framework, achieving sustainable inclusive education requires systemic transformation, including curriculum adaptation, pedagogical innovation, and institutional reform.

Against this backdrop, this study adopts a hermeneutical phenomenological approach to explore the lived experiences of mathematics and science lecturers in Ghanaian Colleges of Education. By examining how inclusive education is interpreted and implemented within the context of the reformed B.Ed. curriculum, the study seeks to provide insights into the sustainability of inclusive teaching practices. In doing so, it contributes to the broader discourse on how teacher education systems can be strengthened to support inclusive and sustainable development.

1.1. Current Study

Despite global commitments to inclusive and sustainable education, a significant gap persists between policy intentions and actual classroom practices, particularly within teacher education institutions. While SDG 4 emphasizes the preparation of teachers who can deliver inclusive and equitable education, evidence suggests that many educators enter the profession without adequate practical competencies to effectively implement inclusive teaching strategies (Akosah & Bonney,

2025). This gap raises critical concerns about the sustainability of inclusive education reforms, especially in developing contexts such as Ghana. Research by Makramalla et al. (2025) indicates that teacher education programs often emphasize the theoretical aspects of inclusive education while providing limited opportunities for practical application. As a result, lecturers and pre-service teachers frequently experience difficulties in translating inclusive pedagogical knowledge into effective classroom practices (Kowalczyk-Walędziak et al., 2025). This challenge is particularly pronounced in mathematics and science education, where traditional teaching approaches and abstract content may further marginalize learners with diverse needs (Gilbert et al., 2025).

In Ghana, the introduction of the revised B.Ed. curriculum represents a significant effort to integrate inclusive education into teacher preparation. However, there is limited empirical evidence on how these inclusive principles are enacted within Colleges of Education, particularly from the perspective of mathematics and science lecturers. Existing studies have largely focused on policy analysis or general classroom practices, leaving a gap in understanding the lived experiences of lecturers who are directly responsible for implementing inclusive education within subject-specific contexts.

Moreover, sustainable education requires systems that are not only inclusive but also adaptable, resource-efficient, and capable of addressing long-term educational inequalities (Sapayev et al., 2026). However, persistent structural challenges including large class sizes, limited access to teaching and learning materials, inadequate assistive technologies, and insufficient professional development continue to hinder the effective implementation of inclusive practices (Akosah & Bonney, 2025; Boakye & Tekperterey, 2025). These challenges not only compromise the quality of instruction but also threaten the sustainability of educational reforms aimed at achieving equity and inclusion. Another critical gap in the literature is the limited focus on the experiences of lecturers as key agents in the implementation of inclusive education. While previous studies have explored inclusive education broadly, few have examined how mathematics and science lecturers interpret, negotiate, and sustain inclusive practices within teacher education institutions. Given that lecturers play a central role in shaping the competencies and pedagogical orientations of future teachers, understanding their experiences is essential for ensuring the long-term sustainability of inclusive education systems. Therefore, this study addresses these gaps by employing a hermeneutical phenomenological approach to explore the experiences of mathematics and science lecturers in Ghanaian Colleges of Education. Guided by the Social Model of Disability and framed within the principles of sustainable education, the study seeks to examine how inclusive education is operationalized, the challenges encountered, and the strategies adopted to promote sustainable inclusive practices. The findings are expected to inform policy, curriculum development, and capacity-building efforts aimed at strengthening inclusive and sustainable education in Ghana and similar contexts.

This study addresses the following research questions:

RQ 1) What challenges do mathematics and science lecturers in Ghana's Colleges of Education face in implementing inclusive classroom practices within the context of sustainable education?

RQ 2) What strategies can be adopted to promote inclusive and sustainable mathematics and science classroom practices in Ghana's Colleges of Education?

2. Background

2.1. Theoretical Framework

The Social Model of Disability (SMD) provides a useful theoretical lens for understanding this nexus. The SMD, originally developed by the Union of the Physically Impaired Against Segregation (UPIAS, 1976) and later advanced by Oliver (1990), conceptualizes disability as a product of societal barriers rather than individual impairments. SMD views disability as a result of societal and environmental barriers rather than individual impairments. In education, this model emphasizes that learners experience difficulties when teaching methods, classroom environments, and institutional structures are not designed to accommodate diversity. Therefore, inclusive education requires the removal of these barriers to ensure equitable participation for all students

(Retief & Letšosa, 2018). This perspective aligns closely with sustainable education principles, which advocate for equity, social justice, and the removal of barriers to participation. Within this framework, inclusive education becomes a mechanism for achieving sustainable development by addressing the root causes of exclusion and inequality.

2.2. Sustainable Education and Inclusive Education Nexus

The growing global emphasis on sustainable development has repositioned education as a transformative tool for addressing social inequalities, promoting equity, and fostering inclusive societies. Within this paradigm, sustainable education is not limited to environmental awareness but encompasses the development of education systems that are equitable, adaptive, and capable of responding to diverse learner needs (Sapayev et al., 2026; Yassim et al., 2025). Central to this vision is the integration of inclusive education, which ensures that all learners regardless of ability, background, or socio-economic status can access and benefit from quality education. This alignment is explicitly reflected in SDG 4, which underscores inclusion and equity as foundational to achieving sustainable educational outcomes (UNESCO, 2020; United Nations, 2015). Scholarly discourse increasingly positions inclusive education as a prerequisite for sustainable education systems rather than a complementary objective. According to Adams et al. (2018), universities and teacher education institutions play a critical role in embedding sustainability principles into educational practice, particularly through curriculum design and pedagogical innovation. Similarly, Aggarwal and Agarwala (2026) argue that higher education institutions serve as strategic platforms for advancing sustainability by preparing educators who can address complex societal challenges, including educational exclusion. In this sense, inclusive education contributes to sustainability by reducing educational disparities and promoting social cohesion. However, the relationship between sustainable education and inclusive education is not merely conceptual but deeply structural. Inclusive education requires systemic transformation, including the redesign of curricula, teaching methods, and assessment practices to accommodate diverse learners (Schuelka, 2018). This aligns with the broader goals of sustainable education, which emphasize resilience, adaptability, and long-term effectiveness of educational systems. Sapayev et al. (2026) further contend that sustainability in education involves not only access but also the quality and relevance of learning experiences, particularly in preparing learners for real-world challenges. In spite of this theoretical alignment, empirical studies reveal persistent gaps in the implementation of inclusive education within sustainable education frameworks. In many developing contexts, including Ghana, structural barriers such as inadequate resources, limited institutional capacity, and insufficient teacher preparation undermine the realization of inclusive and sustainable education (Husamah, 2022). These challenges highlight a critical tension between policy aspirations and practical realities, raising questions about the sustainability of inclusive education reforms.

Moreover, the sustainability of inclusive education is closely linked to teacher preparedness and institutional capacity. Research indicates that teachers are central to the successful implementation of inclusive practices, yet many lack the necessary training and resources to effectively support diverse learners (Kowalczyk-Wałędziak et al., 2025). In the context of Ghana, this challenge is further compounded by systemic issues such as large class sizes, rigid curricula, and limited access to assistive technologies (Buabeng & Amo-Darko, 2025). These constraints not only hinder inclusive practices but also threaten the long-term sustainability of education reforms.

In addition, culturally responsive pedagogy has emerged as a critical dimension of the sustainable-inclusive nexus. Bonney et al. (2026) emphasize that inclusive education should account for cultural diversity in order to be truly equitable. Monocultural teaching practices, which fail to reflect the diverse backgrounds of learners, can perpetuate exclusion and undermine the goals of both inclusive and sustainable education. Thus, achieving sustainability in education requires a shift toward pedagogical approaches that are contextually relevant, participatory, and responsive to learners' lived experiences.

Furthermore, the integration of technology in education has been identified as a key enabler of both inclusivity and sustainability. Assistive technologies and digital tools have the potential to

enhance access and participation for learners with disabilities and diverse needs. However, studies in Ghana indicate that the effective use of technology in education is limited by infrastructural challenges and insufficient teacher training (Akosah & Bonney, 2025). This gap underscores the need for investment in digital capacity as part of broader efforts to promote sustainable inclusive education.

Overall, the literature suggests that while there is strong theoretical alignment between sustainable education and inclusive education, significant challenges remain in translating these principles into practice. The nexus between the two concepts highlights the need for systemic, pedagogical, and institutional reforms that can support equitable and sustainable learning environments. In particular, teacher education institutions play a pivotal role in operationalizing this nexus by preparing educators who are capable of implementing inclusive practices in diverse and resource-constrained contexts.

However, there is a notable gap in the literature regarding how this sustainable-inclusive nexus is experienced and enacted within subject-specific domains such as mathematics and science education. Most existing studies adopt a general perspective on inclusive education, with limited attention to the unique challenges and opportunities associated with STEM-related disciplines. This gap is particularly significant in the context of Ghana's Colleges of Education, where lecturers are tasked with implementing inclusive education within the framework of the reformed B.Ed. curriculum.

Therefore, this study contributes to the literature by examining the lived experiences of mathematics and science lecturers through a hermeneutical phenomenological lens. By doing so, it provides context-specific insights into how sustainable and inclusive education principles are interpreted, negotiated, and enacted in practice. This approach not only advances theoretical understanding but also offers practical implications for strengthening teacher education and promoting sustainable inclusive education in Ghana and similar contexts.

3. Method

3.1. Research Design

This study adopted a qualitative research approach using a hermeneutical phenomenological design to explore the lived experiences of mathematics and science lecturers in implementing inclusive education within the context of sustainable education. Hermeneutic phenomenology, as articulated by van Manen (2023), was selected because the study sought to understand respondents' interpretations, meanings, and experiences regarding inclusive teaching practices in Colleges of Education. The design enabled an in-depth examination of how lecturers perceive challenges and identify strategies for promoting inclusive and sustainable learning environments. Data were collected between January and February 2026. The researchers acknowledge their prior professional involvement in Colleges of Education in Ghana. To mitigate interpretive bias, reflexive journaling and bracketing were employed throughout the research process to ensure transparency in meaning-making and interpretation.

3.2. Research Setting

The study was conducted in 2 Colleges of Education in Ashanti and Volta region of Ghana purposively selected. These colleges play a critical role in preparing pre-service teachers and implementing the revised Bachelor of Education curriculum, which emphasizes inclusive and equitable education. The colleges were chosen because they represent teacher preparation contexts where mathematics and science lecturers are expected to model inclusive teaching practices that align with sustainable education principles.

The study involved eight participants selected purposively from selected Colleges of Education in Ghana. The participants comprised mathematics lecturers, science lecturers, and quality assurance officers who were directly involved in implementing inclusive education practices within teacher preparation programmes. Participants were selected based on their teaching experience, professional roles, and familiarity with inclusive classroom practices.

3.3. Participants

The study involved eight respondents comprising mathematics lecturers, science lecturers, and quality assurance officers. These participants were purposively selected based on their experience in teacher education and their direct involvement in implementing inclusive teaching practices. Purposive sampling was employed to ensure that participants possessed relevant knowledge and could provide rich information about inclusive and sustainable classroom practices. The inclusion of quality assurance officers provided additional perspectives on institutional policies and curriculum implementation.

A total of eight individuals responded in the study, consisting of three mathematics lecturers (M1-M3), three science lecturers (S1-S3), and two quality assurance officers (QA1-QA2). Their demographic characteristics included gender, age, educational level, years of professional experience, and regional representation as shown in Table 1.

Table 1

Demographic characteristics of the Respondents

<i>Pseudonym</i>	<i>Respondent Category</i>	<i>Gender</i>	<i>Age</i>	<i>Years of Experience</i>	<i>Education Level</i>	<i>College Region</i>
M1	Mathematics lecturer	Male	42	12	PhD	Ashanti
M2	Mathematics lecturer	Female	39	16	Master's	Volta
M3	Mathematics lecturer	Male	46	14	Master's	Ashanti
S1	Science lecturer	Male	41	17	Master's	Volta
S2	Science lecturer	Female	43	9	Master's	Ashanti
S3	Science lecturer	Male	51	14	PhD	Volta
QA1	QA Officer	Male	49	4	Master's	Ashanti
QA2	QA Officer	Female	51	2	Master's	Volta

3.4. Instruments

Data were collected using semi-structured interviews to elicit respondents' lived experiences freely while ensuring that discussions remained focused on the research questions. The interview guide included questions related to challenges in implementing inclusive education, strategies for promoting inclusive practices, and the role of sustainable education in mathematics and science teaching. Follow-up questions were used to probe deeper into participants' responses and clarify emerging issues.

3.5. Data Collection Procedure

The protocol was pilot-tested to refine question clarity and relevance. Permission to conduct the study was obtained from the selected Colleges of Education. Respondents were contacted and informed about the purpose of the study. Interviews were conducted at times convenient to the respondents, either face-to-face or through virtual platforms where necessary. Each interview lasted approximately 30–45 minutes and was audio-recorded with respondents' consent. Field notes were also taken to capture non-verbal cues and contextual information relevant to the study.

3.6. Data Analysis

The data were analyzed using thematic analysis following a phenomenological approach. Given the interpretive stance of hermeneutic inquiry, the researchers engaged in reflexive journaling and bracketing to acknowledge and manage subjective assumptions during interpretation. Transcribed interviews were read iteratively to identify significant statements, generate meaning units, and develop themes that reflected how inclusive teaching is practiced in Colleges of Education. Coding and theme development progressed inductively, while continuously referencing field notes and reflexive memos to ensure interpretive depth. Themes were refined through cross-comparison across participants groups to ensure analytical rigor and representation of diverse perspectives. Thematic content analysis was employed to identify, interpret, and organize patterns from the qualitative data gathered in this study.

This approach provided a systematic means of capturing participants' lived experiences and representing them in a structured manner (Kiger & Varpio, 2020). In line with the exploratory focus and phenomenological orientation of this study, an inductive thematic analysis approach was used. This ensured that themes were generated directly from the data rather than imposed a priori, allowing respondents' voices to guide interpretation and enabling context-specific understanding to emerge naturally. The analysis process was guided by a refined adaptation of Braun and Clarke's (2006) thematic analysis framework, as explained by Byrne (2022). This procedure involved six iterative steps: familiarize yourself with your data; generate initial codes; search for themes; review themes; define and name themes; and produce the report. Interview transcripts were first subjected to open coding, followed by axial coding to establish relationships among coded segments, and finally, selective coding leading to the emergence of core themes and sub-themes. Codes were generated inductively and compared across respondents categories.

To ensure rigor within a hermeneutic phenomenological orientation, trustworthiness was guided by the criteria of credibility, transferability, dependability, and confirmability (Lincoln & Guba, 1985). Credibility was enhanced through prolonged engagement, verbatim transcription, and member reflections, which enabled respondents to clarify and affirm meanings emergent from interviews. Dependability was enhanced by maintaining a clear audit trail of the data collection and analysis processes. Transferability was supported through detailed descriptions of the research context and participants. Confirmability was achieved by ensuring that findings were grounded in respondents' narratives rather than researcher bias.

The methodological approach supports sustainable education by capturing lecturers' experiences in promoting inclusive, equitable, and adaptable learning environments. By focusing on systemic challenges and practical strategies, the study generates insights that contribute to strengthening inclusive mathematics and science teacher education for sustainable development in Ghana.

4. Findings

The findings are organized into two major themes: challenges faced by mathematics and science lecturers in implementing inclusive classroom practices, and strategies for promoting inclusive and sustainable mathematics and science education. The themes, subthemes, and related codes generated from the thematic analysis are presented in Table 2.

Table 2

Themes, Subthemes, and Related Codes

<i>Theme / Subthemes</i>	<i>Related Codes</i>
Challenges in Implementing Inclusive Practices	
Limited access to resources	Lack of teaching aids, inadequate assistive technology, insufficient materials
Inadequate professional training	Limited workshops, insufficient practical training, low lecturer preparedness
Systemic barriers	Large class sizes, rigid curriculum, examination pressure
Monocultural teaching practices	Cultural exclusion, limited diversity in teaching examples
Weak technology integration	Poor digital infrastructure, lack of ICT skills
Strategies for Promoting Inclusive and Sustainable Education	
Continuous professional development	Workshops, seminars, pedagogical training
Differentiated instruction	Flexible teaching methods, learner-centered pedagogy
Collaborative learning	Group work, peer support, dialogical learning
Curriculum reform	Context-based curriculum, diversified assessment
Improved resource provision	Assistive technologies, inclusive teaching materials

4.1. Thematic Analysis

This section presents the findings of the study according to the two core research questions. The themes and sub-themes emerged from the thematic analysis of interviews with mathematics lecturers, science lecturers and quality assurance officers. The findings below integrate respondents' voices and provide interpretive commentary to convey a comprehensive understanding of inclusive education practices challenges, and strategies in Ghanaian CoEs.

4.1.1. Theme 1. Challenges Faced by Mathematics and Science Lecturers in Implementing Inclusive Classroom Practices

This section presents the findings related to the first research question, focusing on the challenges encountered by mathematics and science lecturers in implementing inclusive classroom practices within Ghana's CoE. The analysis revealed a set of interrelated structural, pedagogical, and institutional barriers that constrain the realization of inclusive and sustainable education. These challenges are organized into key themes: limited access to resources, inadequate training, systemic barriers, monocultural practices, lack of technology integration, imbalance between theory and practice, and non-participatory teaching approaches.

Sub - Theme 1.1. Limited Access to Resources. A dominant theme emerging from the data is the lack of access to essential instructional materials and assistive technologies. Respondents consistently reported that the absence of specialized teaching aids, such as braille materials, screen readers, and adaptive tools, significantly limits their ability to support learners with diverse needs. This resource gap undermines the inclusivity and sustainability of teaching practices, as lecturers are unable to provide equitable learning opportunities. One mathematics lecturer explained:

We need more teaching aids that cater to the needs of all students, especially those with visual or hearing impairments. In most cases, lecturers are forced to rely on traditional teaching methods because the necessary inclusive materials are unavailable. This makes it very difficult to ensure equal participation and meaningful learning experiences for all students in the classroom. (M3).

Similarly, a science lecturer explained:

Some students require practical and adaptive learning materials, but the college does not have enough resources to support them effectively. For example, students with special learning needs often struggle during practical lessons because the available materials are not designed to accommodate them. This situation negatively affects students' participation, confidence, and overall learning outcomes. (S2)

From a sustainable education perspective, this finding highlights how resource inequities create systemic barriers that hinder long-term inclusive educational outcomes.

Sub - Theme 1.2. Inadequate Training on Inclusive Practices: Another critical challenge identified is the insufficient professional preparation of lecturers in inclusive pedagogies. Respondents indicated that they had limited exposure to training on differentiated instruction, inclusive assessment strategies, and classroom management for diverse learners. The absence of continuous professional development opportunities leaves lecturers feeling unprepared to implement inclusive practices effectively. A mathematics lecturer explained:

Hmm sir, although inclusive education has been emphasized in the new curriculum, many of us have not received adequate professional training on how to apply inclusive teaching strategies in mathematics classrooms. Most of the workshops organized are either too theoretical or infrequent, making it difficult for lecturers to develop the practical skills needed to support learners with diverse educational needs effectively. (M2)

Similarly, a science lecturer noted:

Ok, we need more frequent workshops that teach us how to apply inclusive teaching strategies. Right now, there's hardly any support in terms of training, especially on how to manage practical science lessons for students with different learning abilities. Because of this, many lecturers struggle to confidently implement inclusive practices during classroom instruction. (S1)

A quality assurance officer also shared:

There is a clear gap in continuous professional development regarding inclusive education in the colleges. Many lecturers have the willingness to support all learners, but they lack the specialized training and institutional support required to effectively implement inclusive and sustainable teaching practices. This challenge affects the overall quality and consistency of inclusive education delivery. (QA1).

This finding suggests that the sustainability of inclusive education is closely tied to ongoing capacity building, which remains inadequate in the current system.

Sub - Theme 1.3. Systemic Barriers. Structural constraints, particularly large class sizes and rigid, exam-oriented curricula, emerged as significant obstacles to inclusive teaching. Respondents emphasized that overcrowded classrooms limit their ability to individualize instruction and provide adequate support to learners with diverse needs. Additionally, the strong emphasis on standardized examinations restricts pedagogical flexibility. A mathematics lecturer explained:

One of the major challenges we face is the large number of students in a single classroom. In some mathematics classes, the student population is so high that it becomes difficult to identify and support learners who need special attention. This situation limits interaction between lecturers and students and affects the implementation of inclusive teaching practices. (M1)

Similarly, a science lecturer stated:

Science lessons usually involve practical activities and close supervision, but the large class sizes make this difficult to achieve. When there are too many students in the laboratory or classroom, lecturers are unable to attend to individual learning differences effectively. This affects participation and reduces the quality of inclusive science instruction. (S3)

A quality assurance officer also remarked:

Class sizes are too large to accommodate personalized teaching. In some cases, lecturers handle over 60 students in one classroom, making it almost impossible to implement inclusive practices effectively. Besides the overcrowding, the pressure to complete the syllabus and prepare students for examinations also limits lecturers' flexibility in adapting instruction to meet diverse learner needs. (QA1)

These systemic issues reflect deeper institutional challenges that compromise both the effectiveness and sustainability of inclusive education reforms.

Sub - Theme 1.4. Monocultural Practices in Multicultural Classrooms. The findings also reveal the persistence of monocultural teaching practices in culturally diverse classrooms. Lecturers acknowledged that many instructional approaches and materials do not reflect the diverse cultural and linguistic backgrounds of students, leading to exclusion and disengagement among minority learners. A mathematics lecturer stated:

Our lessons are too focused on a single cultural perspective. Most of the examples, illustrations, and teaching materials used during instruction do not reflect the diverse cultural backgrounds of students in the classroom. As a result, some learners find it difficult to relate to the lesson content, which affects their participation and interest in mathematics. (M1)

Similarly, a science lecturer explained:

Science teaching should connect with students' everyday experiences and cultural backgrounds, but this is not always the case in our classrooms. Sometimes, the examples used during lessons are unfamiliar to some students because they are drawn from only one cultural setting. This can make learning less meaningful and reduce students' confidence to actively contribute during classroom discussions. (S2)

A quality assurance officer also noted:

Most lecturers still rely on traditional teaching approaches that do not fully recognize the cultural diversity of students within the colleges. Inclusive education should involve adapting instructional methods and learning materials to reflect different cultural perspectives. Without this, some students may feel excluded from the teaching and learning process, which undermines the goal of equitable and sustainable education. (QA2)

This highlights a critical gap in equity pedagogy, suggesting that sustainable inclusive education must incorporate culturally responsive teaching practices.

Sub - Theme 1.5. Lack of Technology-Integrated Pedagogy. Respondents identified limited technological infrastructure and insufficient digital skills as major barriers to inclusive teaching. Although technology is recognized as a potential enabler of accessibility, lecturers reported that they lack both the tools and the training required to integrate it effectively into their teaching.

A mathematics lecturer explained:

Technology can make mathematics lessons more interactive and inclusive, especially for students who learn at different paces, but many of us do not have access to the necessary digital tools and equipment. In some classrooms, there are no projectors, smart boards, or assistive technologies to support inclusive teaching. This limits our ability to engage all learners effectively. (M3)

Similarly, a science lecturer stated:

Science teaching requires practical demonstrations and visual learning, but the lack of technological resources makes this very difficult. Most lecturers have not received enough training on how to use digital tools and assistive technologies to support students with diverse learning needs. As a result, technology is rarely integrated into classroom instruction in meaningful ways. (S4)

A quality assurance officer also explained:

We need better infrastructure and training in how to use technology in inclusive teaching. Currently, many lecturers are unfamiliar with digital platforms and assistive technologies that can support learners with special educational needs. Without adequate institutional support and investment in technology, it becomes difficult to effectively implement inclusive and sustainable teaching practices within the colleges. (QA2)

This finding underscores the need for digital inclusion as a key component of sustainable education systems.

Sub - Theme 1.6. Imbalance between Theory and Practice. A notable concern among respondents is the disconnect between theoretical training and practical application. Lecturers reported that the curriculum is heavily theoretical, with limited opportunities to practice inclusive teaching strategies in real classroom contexts. A mathematics lecturer explained:

Most of the training we receive on inclusive education focuses heavily on theories and policy discussions, but there are very few opportunities for practical engagement. In mathematics education, lecturers need hands-on experiences and classroom demonstrations to understand how to adapt lessons for students with different learning needs. Without practical exposure, many lecturers struggle to apply inclusive strategies effectively. (M2)

Similarly, a science lecturer commented:

Our training is too theoretical. We don't get enough opportunities to apply inclusive teaching strategies in real classroom settings, especially during science practical lessons. As a result, many lecturers complete their training without developing the confidence and practical skills required to effectively support learners with diverse educational needs in inclusive classrooms. (S3)

A quality assurance officer also noted:

There is a noticeable gap between what lecturers learn during professional training and what actually happens in the classroom. Although inclusive education policies are discussed during workshops and seminars, there are limited practical sessions that allow lecturers to experiment with inclusive teaching methods. This imbalance affects the effective implementation of inclusive and sustainable education practices within the colleges. (QA1)

Sub - Theme 1.7. Non-Participatory Teaching Methods. Finally, the findings indicate a continued reliance on lecture-based teaching methods, with minimal use of participatory and collaborative approaches. Respondents acknowledged that such methods do not adequately engage learners or support diverse learning needs. A mathematics lecturer noted:

Our teaching is still very lecture-based, especially in mathematics lessons where lecturers focus mainly on solving problems on the board while students listen passively. We need to engage students more actively through discussions, group activities, and collaborative learning approaches

so that all learners can participate meaningfully and develop confidence in the learning process. (MA2)

Similarly, a science lecturer explained:

Most science lessons are still dominated by teacher explanations with limited opportunities for students to actively participate in practical activities and collaborative discussions. This affects inclusive learning because some students learn better through interaction, experimentation, and peer support. Without participatory teaching methods, many learners become disengaged during lessons. (S1)

A quality assurance officer also remarked:

Many lecturers continue to rely on traditional teaching approaches because they are familiar and easier to manage in large classrooms. However, these methods do not support inclusive and sustainable education since they limit student engagement and interaction. Lecturers need to adopt more learner-centered and participatory strategies that encourage collaboration, dialogue, and active involvement of all students in the classroom. (QA2)

This suggests that pedagogical transformation is necessary to foster inclusive and sustainable classroom environments.

4.1.2. Theme 2. Strategies to Promote Inclusive Mathematics and Science Classroom Practices

This section presents findings related to the second research question, focusing on strategies proposed by participants to enhance inclusive classroom practices. These strategies reflect practical pathways toward achieving sustainable inclusive education and are categorized into five main themes: professional development, integration of inclusive strategies, collaborative learning, curriculum reform, and improved resource access.

Sub - Theme 2.1. Enhancing Professional Development. Respondents emphasized the importance of continuous professional development as a critical strategy for improving inclusive teaching practices. Regular workshops and training programs were identified as essential for equipping lecturers with the necessary skills and knowledge. A mathematics lecturer explained:

Professional development programmes should be organized regularly to help lecturers improve their understanding of inclusive teaching practices. In mathematics education, teaching students with different learning abilities requires specific instructional approaches, but many lecturers have not received enough training in this area. Continuous workshops and mentoring opportunities would help us become more effective and confident in inclusive classroom settings. (M3)

Similarly, a science lecturer stated:

Science education is constantly evolving, and lecturers need ongoing training to learn new inclusive teaching methods and technologies that can support diverse learners. Most of the training opportunities available are limited and sometimes too theoretical. Regular practical workshops would help lecturers develop the skills needed to effectively manage inclusive science classrooms. (S2)

A quality assurance officer also remarked:

We need ongoing training, not just one-time workshops, to ensure that lecturers can continuously improve their approach to inclusive teaching. Sustainable inclusive education requires constant updating of knowledge and teaching strategies. Without regular professional development and institutional support, lecturers may find it difficult to effectively implement inclusive practices in their classrooms. (QA1)

This highlights the role of sustained capacity building in promoting the long-term effectiveness of inclusive education.

Sub - Theme 2.2. Integration of Inclusive Strategies. The adoption of differentiated instruction and assistive technologies was identified as a key strategy for addressing diverse learner needs. Respondents stressed the importance of adapting teaching methods and materials to ensure that all students can participate meaningfully in classroom activities. A mathematics lecturer explained:

Inclusive teaching in mathematics requires lecturers to use different instructional approaches

because students understand concepts at different levels. Some learners need additional explanations, visual illustrations, or practical examples before they can fully grasp mathematical ideas. Lecturers therefore need to adapt lessons and assessment methods to ensure that every student can participate actively in the learning process. (M1)

Similarly, a science lecturer noted:

Differentiating instruction is key. We need to adapt our lessons to reach every student, whether through simpler explanations, practical demonstrations, or technology that helps students learn better. In science education, learners have different strengths and abilities, so lecturers must be flexible in the way they teach and engage students during lessons. (S3)

A quality assurance officer also explained:

The successful implementation of inclusive education depends largely on lecturers' ability to integrate flexible and learner-centered teaching strategies into classroom instruction. Lecturers should be encouraged to use multiple teaching approaches, assistive technologies, and varied assessment methods to support students with different learning needs and improve participation in the classroom. (QA2)

This approach aligns with sustainable education principles by promoting equity and accessibility in learning.

Sub - Theme 2.3. Collaborative and Dialogical Learning. Respondents highlighted the effectiveness of collaborative learning and dialogical teaching methods in fostering inclusivity. Group work and peer interaction were seen as valuable tools for enhancing engagement and supporting diverse learners. A mathematics lecturer observed:

Group work and discussion-based learning foster inclusivity because they encourage students to interact, share ideas, and support one another during lessons. When students collaborate in mathematics activities, those who struggle with certain concepts can benefit from explanations and guidance provided by their peers, which improves participation and confidence in learning. (M2)

Similarly, a science lecturer explained:

"Science lessons become more inclusive when students are allowed to work together during practical activities and classroom discussions. Collaborative learning helps students to exchange ideas, ask questions freely, and support classmates who may have difficulties understanding certain concepts. This creates a more engaging and learner-centered classroom environment." (S4)

A quality assurance officer also remarked:

"Dialogical and collaborative teaching approaches are important for promoting inclusive and sustainable education because they encourage active participation from all students. Lecturers should move away from teacher-centered instruction and create opportunities for interaction, teamwork, and peer learning. These approaches help students develop confidence, communication skills, and a stronger sense of belonging in the classroom." (QA1)

These strategies promote social interaction and shared learning, which are essential for inclusive and sustainable education.

Sub - Theme 2.4. Curriculum Reform. Curriculum adaptation emerged as a critical strategy, with participants advocating for linking content to students' lived experiences and diversifying assessment methods. This approach enhances relevance and accessibility, particularly for learners with different abilities. A mathematics lecturer explained:

The curriculum should connect with students' daily lives and experiences so that learning becomes more meaningful and engaging. In mathematics education, students are more likely to participate actively when they understand how mathematical concepts apply to real-world situations such as business, farming, and everyday problem-solving. A more flexible curriculum would also allow lecturers to address the needs of diverse learners effectively. (M1)

Similarly, a science lecturer noted:

Science education should focus more on practical and real-life applications that students can easily relate to within their communities. The current curriculum places too much emphasis on theory and examinations, which sometimes limits creativity and active participation in the classroom.

Curriculum reform is necessary to make science learning more inclusive, interactive, and relevant to students' experiences. (S2)

A quality assurance officer also remarked:

"The curriculum needs to be reviewed to reflect the principles of inclusive and sustainable education. Lecturers should be given flexibility to adapt content, teaching methods, and assessment approaches to meet the needs of students with different learning abilities and cultural backgrounds. A learner-centered curriculum would promote participation, equity, and meaningful learning outcomes for all students." (QA2)

This finding underscores the importance of contextualized and flexible curricula in achieving inclusive and sustainable learning outcomes.

Sub - Theme 2.5. Improving Resource Access. Respondents emphasized the need for improved access to instructional resources and assistive technologies. The provision of such resources was seen as essential for enabling lecturers to implement inclusive practices effectively. A mathematics lecturer explained:

Many mathematics lecturer struggle to implement inclusive teaching because the classrooms lack adequate instructional materials and assistive technologies. Some students require visual aids, digital learning tools, or adapted materials to fully participate during lessons, but these resources are often unavailable. Improving access to inclusive learning materials would help lecturers create more supportive and engaging classroom environments. (M3)

Similarly, a science lecturer stated:

We need access to more assistive technologies and learning materials that cater to all students. In science education, some learners need adapted practical equipment and visual learning resources to fully understand concepts during lessons. Without these materials, it becomes difficult to create an inclusive classroom where every student can participate meaningfully and benefit from the learning process. (S1)

A quality assurance officer also explained:

Resource provision is very important for the successful implementation of inclusive and sustainable education. Colleges of Education need adequate funding to provide assistive technologies, digital infrastructure, and specialized learning materials that support students with diverse educational needs. Without sufficient institutional investment in resources, lecturers will continue to face challenges in implementing inclusive classroom practices effectively. (QA1)

This highlights the critical role of resource availability in supporting equitable and sustainable education systems. Clearly, the findings reveal that while lecturers are aware of and committed to inclusive education, their efforts are constrained by significant structural, pedagogical, and institutional challenges. At the same time, they demonstrate a clear understanding of practical strategies that can enhance inclusivity. These understandings suggest that achieving sustainable inclusive education requires a holistic approach that integrates resource provision, capacity building, curriculum reform, and pedagogical transformation.

5. Discussion

This study explores the challenges and strategies associated with implementing inclusive mathematics and science teaching in Ghanaian Colleges of Education within the broader framework of sustainable education. Grounded in the principles of Social Model of Disability, the findings reveal that while lecturers demonstrate awareness of inclusive practices, significant structural and pedagogical constraints limit their effective and sustained implementation. The discussion situates these findings within the broader discourse on sustainable education, emphasizing how inclusive practices contribute to achieving equitable and resilient educational systems.

5.1. Inclusive Education as a Foundation for Sustainable Education

The findings reinforce the position that inclusive education is central to sustainable education, particularly in advancing equitable access and participation for all learners. The challenges

identified such as limited resources, inadequate training, and systemic constraints highlight the gap between policy aspirations and practical implementation. This aligns with the global call by the United Nations for inclusive and equitable quality education under Sustainable Development Goal 4 (UNESCO, 2020; United Nations, 2015). The persistence of these barriers suggests that achieving sustainable education requires not only policy commitment but also systemic transformation that ensures inclusivity is embedded in everyday teaching practices. The lack of instructional materials and assistive technologies, as reported by participants, reflects structural inequities that undermine both inclusion and sustainability (Akosah & Bonney, 2025). As noted by Akosah and Bonney (2025) resource constraints remain a significant barrier to inclusive education in Ghana. From a sustainability perspective, such limitations hinder the ability of education systems to provide equitable learning opportunities over time, thereby perpetuating cycles of exclusion.

5.2. Teacher Capacity and the Sustainability of Inclusive Practices

A key finding of this study is the inadequate preparation of lecturers for inclusive teaching, particularly in relation to differentiated instruction and classroom management for diverse learners. This supports earlier studies indicating that teachers often lack the practical competencies required for inclusive classrooms (Kowalczyk-Wałędziak et al., 2025; Abreh, 2025). Within the framework of sustainable education, teacher capacity is a critical determinant of long-term educational quality and effectiveness. Continuous professional development, as emphasized by participants, emerges as a necessary condition for sustaining inclusive practices. This aligns with the argument by Adams et al. (2018) that higher education institutions must play a transformative role in equipping educators with the skills needed to address evolving societal challenges. Without sustained investment in teacher training, inclusive education risks remaining a policy ideal rather than a practical reality.

5.3. Systemic Constraints and Institutional Sustainability

The study also highlights systemic barriers, including large class sizes and rigid, exam-oriented curricula, which limit the flexibility required for inclusive teaching. These findings corroborate earlier research by Abreh (2025), which identifies structural constraints as a major challenge to inclusive education in Ghana. From a sustainable education perspective, such rigid systems lack the adaptability needed to respond to diverse learner needs, thereby compromising long-term educational outcomes. Sustainable education emphasizes the development of flexible and resilient systems that can accommodate diversity and change (Sapayev et al., 2026). However, the dominance of standardized assessment and overcrowded classrooms constrains lecturers' ability to implement learner-centered and inclusive pedagogies. This suggests the need for systemic reforms that prioritize inclusivity and adaptability as core components of educational sustainability.

5.4. Cultural Responsiveness and Equity in Sustainable Education

The persistence of monocultural teaching practices in multicultural classrooms reveals a critical gap in achieving equity within inclusive education. Participants' experiences indicate that teaching approaches often fail to reflect the cultural diversity of learners, leading to marginalization and disengagement. This finding aligns with Bonney et al. (2026), who emphasizes the importance of culturally responsive pedagogy in promoting inclusive learning environments. From a sustainable education standpoint, cultural responsiveness is essential for ensuring that education systems are equitable and contextually relevant. Inclusive education that ignores cultural diversity risks reinforcing existing inequalities, thereby undermining the broader goals of sustainability. Therefore, integrating culturally responsive teaching practices is not only an inclusive strategy but also a sustainability imperative.

5.5. Technology Integration and Sustainable Inclusion

The findings further reveal that limited technological infrastructure and digital skills hinder the integration of technology into inclusive teaching. While technology has the potential to enhance accessibility and participation, its effectiveness depends on both resource availability and teacher competence. This observation is consistent with Abreh (2025), who identifies infrastructure, teacher preparation, and digital technology as important considerations for advancing inclusive education in Ghana. In the context of sustainable education, digital inclusion is a critical component of equitable and future-oriented learning systems. The inability to effectively utilize technology limits opportunities for innovation and inclusivity, particularly for learners with disabilities. Therefore, investment in digital infrastructure and training is essential for advancing sustainable inclusive education.

5.6. Bridging the Theory-Practice Gap for Sustainable Outcomes

The imbalance between theoretical knowledge and practical application identified in this study reflects a broader challenge in teacher education. Participants' experiences suggest that the current curriculum does not adequately prepare them for real-world inclusive teaching. This supports Akosah and Bonney (2025), who note the lack of practical training in Ghana's teacher education programs. From a sustainability perspective, education systems must ensure that knowledge is transferable and applicable in diverse contexts. The disconnect between theory and practice undermines the effectiveness of inclusive education and limits its long-term impact. Addressing this gap requires integrating experiential learning, practicum opportunities, and reflective practice into teacher education programs.

5.7. Pedagogical Transformation and Sustainable Learning Environments

The continued reliance on lecture-based teaching methods highlights the need for pedagogical transformation. Participants emphasized the importance of collaborative and dialogical learning approaches in promoting inclusivity. These findings resonate with Vygotsky's (1978) sociocultural theory, which underscores the role of social interaction in learning. Sustainable education advocates for learner-centered and participatory pedagogies that foster engagement, critical thinking, and collaboration. The shift toward such approaches is essential for creating inclusive learning environments that support diverse learners.

5.8. Implications for Sustainable Inclusive Education

The findings of this study highlight that achieving sustainable inclusive education requires a multidimensional approach that addresses structural, pedagogical, and institutional challenges. While lecturers demonstrate a clear understanding of inclusive strategies such as differentiated instruction, collaborative learning, and curriculum adaptation their implementation is constrained by systemic limitations. Importantly, the study underscores the role of teacher education institutions as key drivers of sustainable development. By equipping lecturers with the necessary skills, resources, and support, these institutions can foster inclusive practices that extend beyond individual classrooms to influence the broader education system. This aligns with the argument by Aggarwal and Agarwala (2026) that higher education plays a critical role in advancing sustainability.

6. Conclusion

In conclusion, this study demonstrates that inclusive education is integral to achieving sustainable education, particularly in contexts characterized by resource constraints and diverse learner needs. However, the sustainability of inclusive practices depends on the alignment of policy, practice, and institutional capacity. Addressing the identified challenges requires coordinated efforts in professional development, resource allocation, curriculum reform, and pedagogical innovation. By situating inclusive education within the broader framework of sustainability, this study contributes to a deeper understanding of how education systems can be transformed to promote

equity, resilience, and long-term impact. The findings provide valuable insights for policymakers, educators, and researchers seeking to advance sustainable inclusive education in Ghana and similar contexts.

7. Implications

This study contributes to the growing body of knowledge on the intersection between inclusive education and sustainable education by reinforcing the relevance of the Social Model of Disability as a transformative framework for educational practice. By demonstrating that barriers to inclusion are largely systemic rather than individual, the findings extend existing theoretical perspectives that position inclusive education as a foundational pillar of sustainable education. Furthermore, the study advances the discourse by situating subject-specific instruction particularly in mathematics and science within the sustainability agenda, an area that has received limited attention in previous research. The findings also provide empirical support for the argument that sustainable education requires not only access but also pedagogical adaptability, cultural responsiveness, and institutional resilience.

From a practical standpoint, the study highlights the urgent need to strengthen lecturer capacity in implementing inclusive and sustainable pedagogies within Colleges of Education. The findings suggest that continuous professional development, particularly in differentiated instruction, assistive technologies, and collaborative learning strategies, is essential for improving classroom inclusivity. Additionally, the study underscores the importance of integrating technology into teaching practices to enhance accessibility for learners with diverse needs. The emphasis on linking curriculum content to students' lived experiences further provides practical guidance for lecturers to make mathematics and science education more relevant, engaging, and inclusive. Overall, the study offers actionable strategies that can support lecturers in creating equitable and sustainable learning environments.

At the policy level, the findings indicate a need for stronger alignment between inclusive education policies and their implementation within teacher education institutions. While Ghana has made significant progress through the Inclusive Education Policy and the revised B.Ed. curriculum, the study reveals gaps in resource allocation, training, and institutional support that hinder effective implementation. Policymakers should prioritize investment in assistive technologies, infrastructure, and teacher training programs to ensure the sustainability of inclusive education reforms. Furthermore, curriculum policies should promote flexibility, diversified assessment methods, and culturally responsive pedagogy to accommodate diverse learners. These efforts are critical for achieving the objectives of Sustainable Development Goal 4 (SDG 4) as outlined by the United Nations.

8. Recommendations

It is recommended that Colleges of Education, in collaboration with the Ministry of Education, invest in structured and continuous professional development programmes focused on inclusive pedagogy, differentiated instruction, and the use of assistive technologies. Such training should be practical, ongoing, and aligned with classroom realities to enhance lecturers' capacity to overcome the identified challenges and sustain inclusive teaching practices. It is also recommended that curriculum developers and institutional leaders integrate flexible, learner-centered, and context-based approaches into mathematics and science curricula, including diversified assessment methods and the use of collaborative and technology-supported learning strategies. This will promote inclusivity while ensuring that teaching practices remain relevant, equitable, and sustainable.

Author contributions: All the authors were involved in the concept, design, collection of data and critically revising the article.

Data availability statement: The data supporting the findings of this research can be obtained from the corresponding author upon request.

Declaration of interest: The authors confirm that there were no conflicts of interest related to the study.

Ethical approval and consent: All participants provided written informed consent before their inclusion in the study. Consent was also obtained from the heads of departments and lecturers, as well as from the participating students, in accordance with the ethical standards outlined by the Committee and the Declaration of Helsinki. No further approval was needed to conduct the study.

Funding: No financial support was provided for the study.

References

- Abera, H. G. (2023). The role of education in achieving the Sustainable Development Goals (SDGs): A global evidence-based research article. *International Journal of Social Science and Education Research Studies*, 3(1), 67–81. <https://doi.org/10.55677/ijssers/v03i1y2023-09>
- Abreh, M. K. (2025). Inclusive education in Ghana: Enablers, barriers, and challenges of inclusion. In E. Charamba & S. N. Ndhlovana (Eds.), *Enablers, barriers, and challenges for inclusive curriculum* (pp. 329–356). IGI Global Scientific Publishing. <https://doi.org/10.4018/979-8-3373-1000-8.ch015>
- Adams, R., Martin, S., & Boom, K. (2018). University culture and sustainability: Designing and implementing an enabling framework. *Journal of Cleaner Production*, 171, 434–445. <https://doi.org/10.1016/j.jclepro.2017.10.032>
- Aggarwal, P., & Agarwala, T. (2026). Relationship between leadership, sustainable practices and green behaviour of students in higher education institutions: The mediating role of sustainability policy. *International Journal of Sustainability in Higher Education*, 27(4), 845–863. <https://doi.org/10.1108/IJSHE-08-2024-0586>
- Akosah, E. F., & Bonney, E. A. (2025). Contextualizing quality in education: Stakeholder perspectives from Ghana's colleges of education. *Interdisciplinary Journal of Innovation in Nepalese Academia*, 4(2), 1–27. <https://doi.org/10.32674/ss82jf73>
- Boakye, A. E., & Tekpertey, R. (2025). Junior high school educators' strategies for making inclusive education policy a working tool in the Kadjebe District, Ghana. *Global Journal of Human-Socialscience: G Linguistics & Education*, 3(1), 1–21.
- Bonney, E. A., Akosah, E. F., Tawiah-Mensah, J. E., Tetteh, A. A., & Kafu, G. Y. (2026). Culturally responsive pedagogy: Leveraging ethno-cultural approaches to enhance mathematics and science teaching in Ghana's early childhood development programs. *Early Childhood Education Journal*, 54(5), 3717–3734. <https://doi.org/10.1007/s10643-025-02089-1>
- Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2), 77–101. <https://doi.org/10.1191/1478088706qp063oa>
- Buabeng, I., & Amo-Darko, B. (2025). Curriculum reforms without foundation: The effects of inadequate preparation in curriculum reforms on Ghanaian teachers and the education system. *Curriculum Perspectives*, 45(2), 133–147. <https://doi.org/10.1007/s41297-025-00309-7>
- Byrne, D. (2022). A worked example of Braun and Clarke's approach to reflexive thematic analysis. *Quality & Quantity*, 56(3), 1391–1412. <https://doi.org/10.1007/s11135-021-01182-y>
- Gilbert, A., Suh, J., & Choudhry, F. (2025). Exploring the development of preservice teachers' visions of equity through science and mathematics integration. *International Journal of Science and Mathematics Education*, 23(2), 489–514. <https://doi.org/10.1007/s10763-024-10467-1>
- Glavič, P. (2020). Identifying key issues of education for sustainable development. *Sustainability*, 12(16), 6500. <https://doi.org/10.3390/su12166500>
- Husamah, H., Suwono, H., Nur, H., & Dharmawan, A. (2022). Sustainable development research in Eurasia Journal of Mathematics, Science and Technology Education: A systematic literature review. *Eurasia Journal of Mathematics, Science and Technology Education*, 18(5), em2103. <https://doi.org/10.29333/ejmste/11965>
- Kiger, M. E., & Varpio, L. (2020). Thematic analysis of qualitative data: AMEE Guide No. 131. *Medical Teacher*, 42(8), 846–854. <https://doi.org/10.1080/0142159X.2020.1755030>
- Kowalczyk-Walędziak, M., Lopes, A., Kopp, E., Tavares de Sousa, R., & Prymak, T. (2025). Preparing pre-service teachers to embrace research-informed teaching practice: A cross-national study of teacher

- educators' capabilities. *European Journal of Teacher Education*, 1–21. <https://doi.org/10.1080/02619768.2025.2509583>
- Lincoln, Y. S., & Guba, E. G. (1985). *Naturalistic inquiry*. Sage.
- Malik, R. S. (2018). Educational challenges in 21st century and sustainable development. *Journal of Sustainable Development Education and Research*, 2(1), 10–20. <https://doi.org/10.17509/jsder.v2i1.12266>
- Makramalla, M., Coles, A., le Roux, K., & Wagner, D. (2025). Mathematics education for sustainable futures: A strengths-based survey of the field to invite further research action. *Educational Studies in Mathematics*, 119(3), 535–556. <https://doi.org/10.1007/s10649-025-10389-x>
- Mensah, J. (2019). Sustainable development: Meaning, history, principles, pillars, and implications for human action: Literature review. *Cogent Social Sciences*, 5(1), 1–21. <https://doi.org/10.1080/23311886.2019.1653531>
- Ministry of Education. (2017). *National teachers' standards for Ghana: Guidelines*. https://teachertaskforce.org/sites/default/files/2023-02/2017_MoE-Ghana_National-Teachers-Standards-for-Ghana_EN.pdf
- Ministry of Education. (2020). *Mathematics common core programme curriculum (Basic 7–10)*. National Council for Curriculum and Assessment (NaCCA).
- OECD. (2021). *Education policy outlook 2021: Shaping responsive and resilient education in a changing world*. OECD Publishing. <https://doi.org/10.1787/75e40a16-en>
- Oliver, M. (1990). *The politics of disablement*. Macmillan. <https://doi.org/10.1007/978-1-349-20895-1>
- Onoshakpokaiye, O. E. (2021). Functional mathematics education: A tool for developing entrepreneurship for sustainable self-reliance of Nigerian graduates. *Contemporary Mathematics and Science Education*, 2(1), ep21003. <https://doi.org/10.30935/conmaths/9678>
- Retief, M., & Letšosa, R. (2018). Models of disability: A brief overview. *HTS Teologiese Studies/Theological Studies*, 74(1), a4738. <https://doi.org/10.4102/hts.v74i1.4738>
- Sapayev, V., Ruslan, K., Ravikumar, R. N., & Aarthi, S. (2026). Reimagining global equity agendas: Leadership pathways for inclusive schooling. In A. K. Abdallah, A. K. Akaabi, & M. Talvio (Eds.), *Advancing equity in schools through global perspectives on educational leadership* (pp. 1–32). IGI Global Scientific Publishing. <https://doi.org/10.4018/979-8-3373-7794-0.ch001>
- Schuelka, M. (2018). The cultural production of the “disabled” person: Constructing difference in Bhutanese schools. *Anthropology & Education Quarterly*, 49(2), 183–200. <https://doi.org/10.1111/aeq.12244>
- Tonegawa, Y. (2023). Education in SDGs: What is inclusive and equitable quality education? In S. Urata, K. Kuroda, & Y. Tonegawa (Eds.), *Sustainable development disciplines for humanity* (pp. 55–70). Springer. https://doi.org/10.1007/978-981-19-4859-6_4
- UNESCO. (1994). *The Salamanca statement and framework for action on special needs education*.
- UNESCO. (2020). *Education for sustainable development: A roadmap*. <https://doi.org/10.54675/YFRE1448>
- Union of the Physically Impaired Against Segregation. (1976). *Fundamental principles of disability: Being a summary of the discussion held on 22nd November, 1975 and containing commentaries from each organisation*. UPIAS/Disability Alliance.
- United Nations. (2006). *Convention on the Rights of Persons with Disabilities*. <https://www.un.org/development/desa/disabilities/convention-on-the-rights-of-persons-with-disabilities.html>
- United Nations. (2015). *Transforming our world: The 2030 agenda for sustainable development*. <https://sdgs.un.org/2030agenda>
- van Manen, M. (2023). *Phenomenology of practice: Meaning-giving methods in phenomenological research and writing* (2nd ed.). Routledge. <https://doi.org/10.4324/9781003228073>
- Vinuesa, R., Azizpour, H., Leite, I., Balaam, M., Dignum, V., Domisch, S., Felländer, A., Langhans, S. D., Tegmark, M., & Fuso Nerini, F. (2020). The role of artificial intelligence in achieving the Sustainable Development Goals. *Nature Communications*, 11, Article 233. <https://doi.org/10.1038/s41467-019-14108-y>
- Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes* (M. Cole, V. John-Steiner, S. Scribner, & E. Souberman, Eds.). Harvard University Press. <https://doi.org/10.2307/j.ctvjf9vz4>
- Yassim, K., Adamu, C. D., & Uleanya, C. (2025). University stakeholders' roles in sustainability integration: Challenges and administrative implications for sustainable development. *Frontiers in Sustainability*, 6, 1605743. <https://doi.org/10.3389/frsus.2025.1605743>
- Yu, S., Sial, M. S., Tran, D. K., Badulescu, A., Thu, P. A., & Sehleanu, M. (2020). Adoption and implementation of Sustainable Development Goals (SDGs) in China – Agenda 2030. *Sustainability*, 12(15), 6288. <https://doi.org/10.3390/SU12156288>

Yusoff, M. M. (2020). Improving the quality of life for sustainable development. *IOP Conference Series: Earth and Environmental Science*, 561(1), 012020. <https://doi.org/10.1088/1755-1315/561/1/012020>