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Soulful Science: A Journey into Integrating Religious and Moral Values in STEM Education in Ghana

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ABSTRACT
In recent years, Ghanaian students have exhibited a concerning trend of drifting away from the values integral to sustaining and preserving Ghanaian norms, culture and societal well-being. This shift has led to a proliferation of immoral behaviour among students, prompting widespread concern among Ghanaians. This decline is often attributed to the perceived prioritization of Science, Technology, Engineering, and Mathematics (STEM) education in the current curriculum. There is an urgent need to tackle this issue to ensure students' moral development is not overlooked in favour of STEM education. In light of this challenge, the approach proposed in this article was the "Soulful Science" approach. The study explored the feasibility and impact of soulful science in Ghanaian STEM education. The researchers employed a descriptive survey design for this study. Interviews were used to collect data from 50 participants (Senior High School (SHS) teachers, students, and parents in Sefwi Wiawso Municipality). It was established that the proposed soulful science approach is achievable with its accompanying methods like inclusive curriculum pedagogies, interdisciplinary projects, case studies, and the incorporation of religious perspectives into STEM lessons. However, challenges such as potential conflict between religious beliefs and scientific principles were identified. It was recommended that adequate efforts should be made to develop a curriculum that successfully integrates religious and moral education with STEM subjects while respecting the diversity of beliefs. In conclusion, the soulful science approach creates an inclusive, culturally relevant learning environment that enhances students' religious and moral development, employability and fosters sustainable economic growth. This study's contribution is significant for the fields of moral and STEM education, and curriculum development, as it advocates for a more holistic approach to education that prioritizes moral development alongside technological proficiency.

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INTRODUCTION

In recent times, Ghana's basic and senior high-level educational framework has undergone a strategic shift, with a pronounced emphasis on Science, Technology, Engineering, and Mathematics (STEM) education. This shift is in response to the evolving priorities of the global community, which recognises the profound significance of STEM disciplines in shaping the future of societies and economies. This signifies that STEM education plays a pivotal role in shaping the future of individuals and societies by fostering critical thinking, problem-solving skills, and technological literacy.

In an increasingly complex and interconnected world, the significance of STEM cannot be overstated. Science, Technology, Engineering, and Mathematics serve as the foundation for innovation and progress in various fields, driving advancements in medicine, communication, and energy, and also cultivating a mindset that encourages curiosity and continuous learning. It is the key to addressing global challenges, such as climate change and public health crises, and propels economies forward by producing a workforce capable of navigating the rapidly evolving landscape of technology and scientific discovery.[1] Therefore, emphasizing STEM education ensures that individuals are prepared to contribute meaningfully to the development and improvement of society, ultimately fostering a brighter and more sustainable future.

Nevertheless, in contemporary Ghana, a discernible decline in religious and moral values, spirituality, cultural sensitivity and value among students across various educational institutions and communities has become evident. This trend is attributed to the prevailing emphasis on STEM education, potentially sidelining the crucial aspects of moral and spiritual development among students. Setting the stage for the training of "intelligent criminals" in the country.[2] The prevailing argument suggests that the current direction of education neglects the integration of Ghanaian social and cultural values into the curriculum, focusing primarily on STEM education, driven by the global demand for technological proficiency. Advocates for cultural integration assert that a curriculum that neglects indigenous values may contribute to a sense of cultural alienation among students. Scholars such as Molefi Kete Asante and Kwame Gyekye emphasize the importance of incorporating African cultural perspectives into education to foster a stronger sense of identity and promote holistic development.[3] While the push for STEM education is undoubtedly crucial for technological advancement, there is a growing recognition that a balanced curriculum should also reflect the cultural context of the students. Striking this balance is essential for producing well-rounded individuals equipped with technical skills rooted in their cultural identity.

In response to this evolving educational landscape, it is imperative to investigate innovative approaches that harmonize the realms of religious beliefs, spirituality, and cultural values with modern scientific knowledge. Therefore, Ghana, with its rich cultural and religious tapestry, stands at the crossroads of tradition and modernity. According to Samuel Adu-Gyamfi et. al, the educational system in the country is deeply rooted in its cultural heritage.[4] This suggests the necessity to formulate an approach that concurrently emphasizes STEM education while integrating religious and moral education. This integrated approach is coined as the Soulful Science approach. The approach of Soulful Science offers a unique opportunity to bridge the gap between age-old beliefs and contemporary scientific understanding. The infusion of religious values into STEM curricula is posited as a transformative strategy to not only enhance students' comprehension of scientific principles but also to nurture their holistic development, fostering ethical decision-making and cultural sensitivity.

This suggests the need to shed light on the feasibility and impact of Soulful Science within the context of Ghanaian STEM education. Through a meticulous analysis of existing educational practices, cultural contexts, and religious influences, the research endeavours to provide comprehensive insights. By investigating the potential benefits and challenges associated with the integration of religious values into STEM education, this research aspires to contribute to the ongoing discourse on educational reform in Ghana. Through an exploration of these dimensions, the research aims to contribute to the development of educational strategies that transcend the traditional boundaries of STEM education, encompassing a more holistic and culturally sensitive approach.

The interplay between STEM education and the decline in religious and moral values among Ghanaian students underscores the urgency of adapting educational practices to address this societal shift. By exploring the concept of Soulful Science, this research seeks to offer a nuanced understanding of how

[1] Bryan Edward Penprase, *STEM Education for the 21st Century* (Springer Nature, 2020), 14.
[2] Christian Yalley, "STEM Education without Morals, Spiritual Values Breed Intelligent Criminals' – Opuni-Frimpong," MyJoyonline, March 10, 2022, https://www.myjoyonline.com/stem-education-without-morals-spiritual-values-breed-intelligent-criminals-opuni-frimpong/.
[3] Molefi Kete Asante, *The African American Intellectual Tradition: A Historical Reader* (Pennsylvania: Temple University Press, 2007), 18; Kwame Gyekye, *African Cultural Values: An Introduction* (Accra: Sankofa Publishing Company, 1996), 2-3.
[4] Samuel Adu-Gyamfi, Wilhemina Joselyn Donkoh, and Anim Adinkrah Addo, "Educational Reforms in Ghana: Past and Present," *Journal of Education and Human Development* 5, no. 3 (2016): 158–72.

religious and social values can be seamlessly woven into STEM curricula. The ultimate goal is to foster a more inclusive and culturally relevant educational approach that not only aligns with Ghana's cultural and religious diversity but also promotes holistic growth and ethical reasoning among students. The findings are expected to resonate not only with educators and policymakers in Ghana but also with those navigating the intersection of science and spirituality on a global scale. In essence, this research serves as a vital step towards the creation of educational frameworks that go beyond conventional boundaries, embracing the transformative potential of Soulful Science for the benefit of Ghanaian students and beyond.

LITERATURE REVIEW

STEM Education: Definitions and Characteristics

STEM education, an acronym for Science, Technology, Engineering, and Mathematics, is a holistic approach to learning that integrates these four disciplines into a cohesive learning paradigm. The primary goal of STEM education is to prepare students for the rapidly evolving technological landscape, foster critical thinking, and equip them with the skills necessary for success in a modern, knowledge-driven economy.[5] As integration of disciplines, STEM education breaks down traditional subject silos, fostering an integrated learning environment where students can explore the interconnected nature of science, technology, engineering, and mathematics. This integration mirrors the real-world scenarios where these disciplines collaborate to solve complex problems. One hallmark of STEM education is its emphasis on hands-on, experiential learning. Students engage in projects and activities that simulate real-world challenges, encouraging problem-solving skills and creativity.[6]

STEM fields often require collaborative efforts to address complex issues, and promote teamwork, communication, and collaboration, mirroring the collaborative nature of professional work environments.[7] Students learn to work effectively in groups, sharing ideas and leveraging each other's strengths. Students use a variety of tools and technologies to conduct experiments, analyze data, and develop solutions.[8] As societies continue to advance, the importance of STEM education in fostering a scientifically literate and technologically competent citizenry becomes increasingly evident.

Religious and Moral Education in the Context of Ghana

Religious and moral education encompasses the systematic instruction and exploration of religious beliefs, practices, and ethical principles. It is a field of education that aims to foster a deep understanding of various religious traditions, their moral teachings, and their impact on individuals and societies.[9] It seeks to instill moral values and ethical reasoning, encouraging individuals to reflect on their own beliefs, values, and behaviours in the context of a broader spiritual and ethical framework. Religious and moral education plays a crucial role in promoting tolerance, empathy, and a sense of social responsibility among children in Ghana, contributing to the holistic development of individuals by addressing both their spiritual and ethical dimensions.

In Ghana, renowned for its vibrant cultural tapestry, Religious and Moral Education (RME) holds notable importance. The country boasts a diverse religious panorama that includes Christianity, Islam, and traditional African religions, weaving a rich historical fabric where spirituality intricately intertwines with daily life.[10] Therefore, the curriculum encompasses Christianity, Islam, African Traditional Religion, and Moral Education.[11] The roots of RME in Ghana can be traced back to the pre-colonial era when traditional African religious practices were an integral part of daily life. With the advent of colonialism, there was an

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[5] Judy Anderson and Li Yeping, *Integrated Approaches to STEM Education* (Cham: Springer International Publishing, 2020), 11. https://doi.org/10.1007/978-3-030-52229-2.

[6] Helen Douglass, "Integrated and Innovative STEM Education: The Development of a STEM Education Minor ," in *Enhancing Entrepreneurial Mindsets Through STEM Education* (Cham.: Springer International Publishing, 2023), 249.

[7] Rodger W Bybee, "The Case for STEM Education: Challenges and Opportunities," (NSTA Press, 2013), 64.

[8] Alice Amegah, "A Non-Conformist Choice: The Lifeworld of Young Women Pursuing STEM-Related TVET in Upper Secondary Technical Institutes in Ghana " (University of Cambridge, 2023), 51.

[9] Solomon Appiah, "Pedagogical Knowledge Base of Religious and Moral Education Teachers in Assessing Students' Academic Performance," *Open Journal of Educational Research*, 2022, 262–73.

[10] Kwasi Wiredu and Kwame Gyekye, *Person and Community: Ghanaian Philosophical Studies* , vol. 1 (Washington, D.C.: The Council for Research in Values and Philosophy, 2010), 28.

[11] Solomon Appiah and Joseph Mfum-Appiah, "Appraisal of Religious and Moral Education (RME) Curriculum: Pedagogical Knowledge Practices in Junior High Schools (JHSs) in Ghana," *Journal of Social Sciences and Humanities* 5, no. 1 (2019): 10–16.

introduction of Christianity and Islam, shaping the religious landscape of the region. Post-independence, Ghana recognized the importance of integrating religious and moral values into formal education to foster a sense of national identity and moral consciousness. The 1987 Education Reform Act officially introduced Religious and Moral Education into the national curriculum, acknowledging the need for a holistic educational approach that addresses both intellectual and moral development.[12]

The expectation for schools to provide religious and moral education rooted in indigenous approaches is deeply embedded in the country's cultural values and societal norms.[13] For instance, in many Ghanaian schools, there is an emphasis on teaching students about the cultural and moral values enshrined in proverbs, folktales, and traditional rituals. George Sefa Dei argues that the integration of indigenous religious practices, such as libation ceremonies, into the educational framework, reflects the broader societal belief in the importance of maintaining a strong connection to Ghana's rich cultural heritage.[14] This approach instills moral values and nurtures a sense of national pride and cultural awareness.

In Ghanaian societies, religious and moral education is deeply ingrained as a communal responsibility, reflecting the collective values and cultural ethos of the people. The traditional African concept of *Ubuntu*, emphasizing interconnectedness and community, is evident in the way Ghanaians approach the education of religious and moral values.[15] Community elders, religious leaders, and extended family members actively participate in the upbringing of the younger generation, imparting ethical principles and religious teachings through oral traditions, storytelling, and communal rituals. Gyekye highlights the communal nature of moral education in African societies, emphasizing the role of community in shaping individual character.[16] The Ghanaian educational system has incorporated religious and moral education into the curriculum, further emphasizing its importance at the national level. In essence, the communal responsibility for religious and moral education in Ghana is not only a cultural norm deeply rooted in the fabric of society but also a recognized and formalized aspect of the national educational framework.

Soulful Science: Proposed Approach to STEM Education

This is a proposed approach that involves incorporating religious values into the teaching and learning of Science, Technology, Engineering, and Mathematics (STEM) subjects in Ghanaian education. The idea is to blend traditional religious beliefs and values with STEM education to create a holistic and culturally relevant approach to learning. Given Ghana's rich cultural and religious diversity, this approach offers a promising opportunity to reconcile traditional values, beliefs, and modern scientific knowledge within the educational system. By bridging the gap between these two realms, the educational system can foster a holistic development that nurtures both intellectual acumen and moral integrity among students. The effectiveness of this approach or any teaching method requires that the teacher understand and can articulate what he or she wants students to know and be able to do.[17] This concept reflects an effort to make STEM education more inclusive and culturally sensitive, recognizing the diverse perspectives and values within Ghanaian society. The term "soulful" suggests an emphasis on nurturing not just intellectual development but also moral and ethical aspects, aligning with the idea of a living soul representing moral uprightness. Therefore, the proposed approach recognizes the significance of religious and cultural values in the lives of Ghanaian students and seeks to bridge the gap between modern scientific education and traditional beliefs.

The approach recognizes Rich Feller's argument that education should not only equip students with technical skills but also instil values that contribute to their personal development and ethical decision-making.[18] Therefore, by intertwining religious or spiritual values with STEM education, the goal

[12] Akwasi Kwarteng, Amoako-Gyampah, *Education in Ghana: History and Politics* (Oxford: African Books Collective, 2023), 21.
[13] David Baidoo-Anu, "Classroom Assessment Culture in Ghana's Education System " (Queen's University Canada, 2023), 61.
[14] George J Sefa Dei, "Learning Culture, Spirituality and Local Knowledge: Implications for African Schooling," *International Review of Education* 48 (2002): 335–60.
[15] Douglas Asante and Thomas Archibald, "Beyond Ubuntu: Nnoboa and Sankofa as Decolonizing and Indigenous Evaluation Epistemic Foundations from Ghana," *Journal of MultiDisciplinary Evaluation* 19, no. 44 (2023): 156–65.
[16] Kwame Gyekye, *Tradition and Modernity: Philosophical Reflections on the African Experience* (Oxford University Press, 1997), 14.
[17] Gary D Fenstermacher, Jonas F Soltis, and Matthew N Sanger, *Approaches to Teaching* (Teachers College Press, 2015), 12.
[18] Rich W Feller, "Aligning School Counseling, the Changing Workplace, and Career Development Assumptions," *Professional School Counseling* 6, no. 4 (2003): 268.

is to produce graduates who not only excel in their technical fields but also contribute positively to society, embodying moral integrity and ethical conduct. This can only be achieved through the effectiveness of teachers and school administrators. According to John Hattie, teachers' effectiveness often depends on their ability to align instructional practices with their own expertise.[19] This approach acknowledges the interconnectedness of knowledge and values, emphasizing the importance of a balanced and comprehensive education for the students in Ghana. When used appropriately, technology can enable students to become active learners, create and share knowledge, and develop skills for the 21st-century workforce" (ISTE Standards for Students).[20]

Soulful Science Approaches: Religious and Moral Education in Context

Blending religious and moral education with STEM requires a multifaceted approach that values the interconnectedness of these disciplines. This integration aims to foster a holistic approach to learning that combines scientific knowledge with ethical values and moral reasoning. One effective method to blend religious and moral education with STEM is through the development of an inclusive curriculum and pedagogies. Educators can strategically incorporate moral and ethical discussions within STEM topics, making explicit connections between technical knowledge and broader societal implications. For instance, lessons on environmental science can be enriched by discussing the ethical responsibility of stewardship for the planet, drawing inspiration from religious teachings that emphasize the sanctity of creation. An inclusive approach to teaching STEM with religious and moral education involves recognizing and respecting diverse belief systems.[21]

Integrating religious and moral education with STEM can be facilitated through interdisciplinary projects and case studies. These initiatives allow students to explore real-world issues that require both technical expertise and ethical considerations.[22] For example, a project addressing access to clean water could incorporate elements of engineering, biology, and social ethics. This approach not only fosters collaboration among students with diverse skill sets but also encourages them to think critically about the ethical dimensions of their work.[23]

Another method involves adopting a values-based STEM pedagogy that intentionally incorporates moral and ethical principles into the teaching methodology. Educators can create learning environments that promote reflection on the societal impacts of STEM advancements. According to Elizabeth Mary Curtis, this approach is particularly effective in encouraging students to consider the broader implications of their actions and decisions. For instance, inquiry-based learning, a popular pedagogical approach in STEM education, can be adapted to incorporate religious and moral values.[24]

An alternative method is curricular integration. Educators design interdisciplinary courses that draw connections between scientific principles and ethical teachings from various religious traditions. For instance, a biology lesson may explore the ethical implications of genetic engineering, incorporating discussions on human dignity and respect for life from religious perspectives. This approach seeks to embed discussions on ethics, social responsibility, and moral reasoning within STEM courses.[25] Educators may introduce case studies that prompt students to consider the ethical implications of their scientific pursuits, encouraging a thoughtful and responsible approach to STEM disciplines.

Ethical dilemma discussions and reflection approaches can also be employed. Engaging students in discussions about ethical dilemmas related to STEM topics is a valuable method to blend religious and moral education. This approach encourages critical thinking, empathy, and a deeper understanding of the

[19] John Hattie, *Visible Learning: A Synthesis of over 800 Meta-Analyses Relating to Achievement* (London: . Routledge, 2008), 113.
[20] Mila Thomas Fuller, "ISTE Standards for Students, Digital Learners, and Online Learning ," in *Handbook of Research on Digital Learning* (IGI Global, 2020), 289.
[21] Julianne Moss and Kate Harvie, "Cross-Curriculum Design: Enacting Inclusive Pedagogy and Curriculum," in *Inclusive Pedagogy Across the Curriculum* , vol. 7 (Emerald Group Publishing Limited, 2015), 279.
[22] Melek Demirel and Yelkin Diker Coşkun, "Case Study on Interdisciplinary Teaching Approach Supported by Project Based Learning," *The International Journal of Research in Teacher Education* 2, no. 3 (2010): 46.
[23] Allen F. Repko, William H. Newell, and Rick Szostak, *Case Studies in Interdisciplinary Research* (Sage Publications, 2011), 18.
[24] Elizabeth Mary Curtis, "The Heart of Quality Teaching: A Values-Based Pedagogy for Pre-Service Teacher Education" (Queensland University of Technology, 2012), 17.
[25] Tynisha Meidl and Christopher Meidl, "Curriculum Integration and Adaptation: Individualizing Pedagogy for Linguistically and Culturally Diverse Students," *Current Issues in Education* 14, no. 1 (2011):19.

ethical considerations surrounding scientific and technological advancements.[26] Teachers can use case studies, hypothetical scenarios, or real-world examples to prompt discussions that integrate moral and religious perspectives, fostering a more nuanced and holistic understanding of STEM disciplines. Case studies and scenarios can be designed to prompt critical thinking about the ethical implications of scientific discoveries or technological advancements.[27] Students can then explore how various religious and moral perspectives approach these dilemmas, fostering a deeper understanding of the complex intersections between STEM and ethics.

The integration of religious and moral education with STEM holds immense potential for nurturing well-rounded, ethically aware individuals. Through inclusive curriculum design, case studies, service learning, and interfaith dialogue, educators can create a learning environment that seamlessly blends the technical aspects of STEM with the moral and ethical considerations inherent in religious teachings. By adopting these methods, educational institutions can contribute to developing a generation of STEM professionals who excel in their technical skills and exhibit a deep sense of social responsibility and ethical awareness.

METHODOLOGY

The researchers employed a descriptive survey design for this study. This design enabled the researchers to obtain accurate information about the potential benefits associated with the integration of religious values into STEM education; and to contribute to the development of educational strategies that transcend the traditional boundaries of STEM education, encompassing a more holistic and culturally sensitive approach. The descriptive survey was employed in the study since it sought in-depth information from students, parents and educators to bridge the gap between traditional beliefs and modern scientific knowledge.[28]

The target population for the study was made up of Senior High School (SHS) teachers, students, and parents in Sefwi Wiawso Municipality. The municipality has 5 Senior High Schools but based on their status in STEM education 4 of them were purposively selected for the study. Likewise, a purposive sampling technique was employed to select 10 teachers instructing religious and moral-related courses and 10 teachers instructing STEM-related courses. Similarly, the purposive sampling technique was utilized to choose 10 students enrolled in religious and moral-related courses and 10 students enrolled in STEM-related courses. A simple random sampling technique was employed to select 10 parents. Therefore, the participants included 10 students in religious and moral-related courses, 10 students in STEM-related courses, 10 STEM teachers, 10 teachers of religious and moral-related courses, and 10 parents, totaling 50.

Interviews were conducted to gather data from students, parents, and teachers since it has the efficacy to provide insights into the feasibility and impact of soulful science in Ghanaian STEM education through a comprehensive analysis of existing educational practices, cultural contexts, and religious influences. The results were descriptively presented, analyzed, and discussed according to the objectives of the study.

PRESENTATION OF RESULTS AND DISCUSSION

The results are presented, analyzed, and discussed in this section based on the study's objectives. These objectives include formulating methods applicable to the soulful science approach that concurrently emphasizes STEM education while integrating religious and moral education. Furthermore, the study endeavours to explore the potential benefits and challenges associated with the integration of religious values into STEM education. Therefore, the analyzed data has been interpreted to focus on integrating religious values into STEM education in Ghana. Specifically, it addresses the viability of soulful science approaches, the potential advantages of integrating soulful science into STEM education in Ghana, and the associated challenges.

[26] Matthew Bennett Wright, "The Role of Ethics in STEM Education: A Course Proposal " (Honors College, 2017), 55.
[27] Ioannis Chatzigiannakis, Georgios Mylonas, and Andrea Vitaletti, "Urban Pervasive Applications: Challenges, Scenarios and Case Studies," *Computer Science Review* 5, no. 1 (2011): 103–18.
[28] Arlene Fink, *How to Design Survey Studies* (Sage, 2003), 96.

Approaches to Soulful Science

The students perceived several methods or approaches to blend religious and moral education with STEM (Science, Technology, Engineering, and Mathematics) education. According to the students, one approach could involve integrating ethical discussions into STEM classes, where students explore the moral implications of scientific advancements and technological innovations. They emphasized that this might include considering the impact of scientific discoveries on society, the environment, and individual well-being. For instance, in biology class, students explore the ethical considerations surrounding genetic engineering and its potential impact on society. The students believe that by incorporating these discussions, they can develop a holistic understanding of the ethical dimensions associated with STEM fields.

Another method suggested by the students is extracurricular activities, such as clubs or seminars, that focus on the intersection of religion, morality, and STEM which can provide them with a platform to delve deeper into these topics. They argued that guest speakers, workshops, and discussions can help them explore the ethical considerations within their chosen STEM fields and develop a more comprehensive understanding of how their studies align with broader societal values. This is illustrated by the following comment made by a student:

> "*I believe there are numerous methods to incorporate moral values into science education. Teachers can integrate ethical discussions into STEM classes, allowing students to examine the moral implications of scientific advancements and technological innovations. Additionally, extracurricular activities such as games, clubs, or seminars can be utilized as they are based on rules and principles*."

The parents approached this issue from three main perspectives, the majority advocated for a standalone prioritized moral education and STEM education, while few of them suggested integrating values and ethical discussions within the STEM curriculum. Another method mentioned involves selecting educational materials and resources that align with Ghanaian religious and moral values.

The common approach emphasised by a few parents is the integration of values and ethical discussions within the STEM curriculum. This involves incorporating moral dilemmas, ethical considerations, and discussions about the implications of scientific advancements into STEM lessons. These parents argue that this not only helps children develop a strong foundation in STEM but also encourages them to think critically about the ethical aspects of their work. As one female parent observed:

> "*I think that incorporating values and ethical discussions into the STEM curriculum is the most effective approach given the current demands of the world today*."

In addition, some parents advocated for the inclusion of religious and moral education as a prioritized standalone component within the overall educational framework. This could involve incorporating religious teachings and moral values into regular discussions or dedicating specific time for religious and moral education alongside STEM subjects. According to these parents, such an approach allows parents to ensure that their children receive a balanced education that encompasses both technical knowledge and moral guidance. The comment below encapsulates their views;

> "*The problem is our current educational system does not prioritize moral education as we see in our schools today. In fact, the best approach to instil moral principles in our children is a prioritized standalone religious and moral education*."

It was further argued that selecting educational materials and resources that align with Ghanaian religious and moral values is another method. The parents seek out STEM materials that are compatible with their belief systems to ensure that the content promotes positive values and perspectives. This includes choosing textbooks, online resources, and educational programs that are sensitive to religious and moral considerations.

The teachers posit that blending religious and moral education with STEM education is a complex endeavour that requires thoughtful consideration and a nuanced approach. They suggested the creation of interdisciplinary projects that encourage collaboration between religious and moral education and STEM subjects. For example, students might work on projects that address real-world issues, such as sustainable

development, healthcare accessibility, or ethical considerations in technological design. The teachers argued that this approach allows students to see the interconnectedness of different disciplines and appreciate the role of values and ethics in solving complex problems.

Incorporating religious and moral perspectives into STEM curricula through case studies is another potential approach suggested by the teachers. According to them, this can be done by examining real-life scenarios, students can analyze the ethical dilemmas and decision-making processes involved in STEM-related issues. The teachers believe that this method allows for a deeper exploration of the values and principles that guide ethical behaviour in both religious and scientific contexts. The following statement by a teacher, which was shared by the majority of teachers, exemplifies their stance:

> "*From my experience as a teacher, integrating religious and moral perspectives into STEM curricula through interdisciplinary projects and case studies is a potential approach*."

Another effective method according to the teachers is incorporating religious perspectives into STEM lessons. By highlighting how different religions view scientific concepts or technological advancements, students gain a more comprehensive understanding of both subjects simultaneously. The teachers suggest that, in physics class, learners can be guided to discuss how Islamic scholars contributed to advancements in optics during the Middle Ages. The teachers believe that this not only showcased the rich history of scientific inquiry within Islam but also fostered respect for diverse cultural perspectives.
The teachers further mentioned extracurricular activities such as science fairs or robotics competitions. According to them, this can provide opportunities for students to explore real-world issues through a religious or moral lens. By encouraging projects that address societal challenges from an ethical standpoint, students learn to apply their STEM knowledge in ways that align with their values. One headteacher made the assertion below:

> "*This can be achieved by integrating religious viewpoints into STEM classes and utilizing extracurricular events like science fairs or robotics competitions in our local areas*."

The findings highlight interdisciplinary projects, case studies approach, integration of values and ethical discussions within the STEM curriculum, incorporation of religious perspectives into STEM lessons, extracurricular activities, standalone religious and moral education and integration of ethical discussions into STEM classes. The findings support Allen Repko, William Newell, and Rick Szostak's argument that schools can promote collaboration between STEM and religious and moral education by creating projects that effectively combine both areas.[29] It was discovered that incorporating values and ethical debates into the STEM curriculum is a promising strategy. Tynisha Meidl and Christopher Meidl suggest that educators can accomplish this by creating interdisciplinary courses that link scientific principles with ethical teachings from different religious traditions. They also contend that this method aims to integrate discussions on ethics, social responsibility, and moral reasoning into STEM courses.[30] This approach may encourage students to see the interconnectedness between science and morality. This involves explicitly integrating moral and ethical values into the STEM curriculum.

The respondents claim that participating in extracurricular activities such as clubs, seminars, games, science fairs, or robotics competitions provides students with opportunities to explore real-world issues from a religious or moral standpoint. This supports Julianne Moss and Kate Harvie's claim that by promoting extracurricular activities like projects that ethically address societal challenges, students develop the ability to apply their STEM knowledge in ways that reflect their values.[31] Some participants argue that prioritizing standalone religious and moral education is crucial for students' moral development as it allows dedicated time and focused attention to explore and understand religious beliefs, values, and ethical principles. This signifies that by offering a distinct curriculum for religious and moral education, educational institutions can ensure that students have the opportunity to develop a comprehensive

[29] Allen F. Repko, William H. Newell, and Rick Szostak. Case studies in interdisciplinary research, 18.
[30] Tynisha Meidl, and Christopher Meidl, "Curriculum integration and adaptation: Individualizing pedagogy for linguistically and culturally diverse students," 19.
[31] Julianne Moss and Kate Harvie, "Cross-curriculum design: Enacting inclusive pedagogy and curriculum." In *Inclusive Pedagogy Across the Curriculum*, 278; Moss and Harvie, "Cross-Curriculum Design: Enacting Inclusive Pedagogy and Curriculum," 278.

understanding of various religious traditions, ethical frameworks, and moral dilemmas. Solomon Appiah posits that this dedicated approach allows for a more nuanced exploration of diverse perspectives, fostering tolerance, empathy, and critical thinking skills.[32] Therefore, standalone religious and moral education provides a space for individuals to reflect on their own beliefs, values, and ethical convictions, contributing to the holistic development of students as responsible and morally aware citizens.

The Potential Benefits of Soulful Science in Ghanaian STEM Education

According to the students and parents, infusing soulful science holds the potential for numerous benefits. This suggests that this approach can create a more holistic and culturally relevant educational experience for students. They argue that incorporating religious and moral education into STEM subjects can enhance the cultural relevance of STEM education in Ghana and help foster a sense of ethical responsibility among students. By intertwining scientific knowledge with moral values derived from religious teachings, students may develop a strong ethical foundation that guides their decision-making processes. They believe that this can contribute to the formation of responsible and socially conscious individuals who understand the broader implications of their actions in the scientific and technological fields. As one parent explains:

> "*Soulful science approach enhances the cultural relevance of STEM education in Ghana and helps foster a sense of ethical responsibility among students*."

This suggests that soulful science can enhance the cultural relevance of STEM education in Ghana. This emphasises Curtis's claim that by integrating local beliefs, traditions, and moral principles into the curriculum, students can better relate to the subject matter.[33] This approach therefore promotes a more inclusive and diverse educational experience, acknowledging the importance of cultural context in shaping scientific understanding. This suggests that this approach may help students see the connections between their traditional values and the advancements in STEM, fostering a deeper appreciation for both.

Contrary to the assertions of the students and parents, the teachers believe that infusing soulful science into STEM education may enhance the overall engagement and motivation of students to the development of critical thinking skills and a well-rounded worldview. They perceive that by exploring the ethical dimensions of scientific advancements through the lens of religious and moral teachings, students are encouraged to think critically about the societal impacts of their work. This is illustrated by the following comment made by a teacher:

> "*I think that adding a spiritual element to STEM education could make students more interested and motivated, as well as help them develop critical thinking skills and a more complete view of the world.*"

The findings declare that integrating soulful science may enhance the overall engagement and motivation of students. Recognizing the spiritual and moral dimensions of STEM topics can make the learning experience more meaningful and personally relevant.[34] This suggests that a soulful science approach may help students find a deeper sense of purpose in their studies, leading to increased enthusiasm and dedication to their educational pursuits. Therefore, this interdisciplinary approach can lead to a more comprehensive understanding of the complex relationships between science, technology, and society. Infusing soulful science into Ghanaian STEM education has the potential to create a more ethical, culturally relevant, and engaging learning environment.

Challenges of the Soulful Science Approach

The respondents declared that infusing a soulful science approach with STEM education in Ghana poses several potential challenges. One significant concern is the potential conflict between religious beliefs and scientific principles. Ghana, like many other countries, has a diverse religious landscape, and introducing religious perspectives into STEM subjects may lead to tensions between faith-based teachings and established scientific theories. Some of the teachers believe that striking a balance between the two could

[32] Appiah, "Pedagogical Knowledge Base of Religious and Moral Education Teachers in Assessing Students' Academic Performance," 270.
[33] Curtis, "The Heart of Quality Teaching: A Values-Based Pedagogy for Pre-Service Teacher Education."
[34] Carol Ann Tomlinson, *The Differentiated Classroom: Responding to the Needs of All Learners* (Ascd, 2014), 14.

be challenging, as it requires careful navigation to avoid compromising the integrity of scientific education. The argument below was set by a teacher:

> "*My concern revolves around the potential conflict between religious beliefs and scientific principles in Ghana, which has a diverse religious landscape*."

The concern revolves around the potential conflict between religious beliefs and scientific principles in Ghana, a country with a diverse religious landscape. According to Douglas Asante, Ghana is home to various religious beliefs, including Christianity, Islam, and African Traditional Religion.[35] The fear is that incorporating religious perspectives into science, technology, engineering, and mathematics (STEM) subjects may create tensions between faith-based teachings and established scientific theories. This tension raises questions about how to navigate the intersection of religious beliefs and the pursuit of scientific knowledge in an educational context.

Practical challenges also arise in terms of curriculum development and teacher training. According to the teacher designing a curriculum that successfully integrates religious and moral education with STEM subjects requires significant effort to align with educational standards while respecting the diversity of beliefs. Additionally, adequately preparing teachers to deliver this blended education is essential to avoid potential biases and ensure a balanced presentation of both scientific and religious perspectives.

The participants added that resource allocation is another hurdle in implementing soulful science in Ghanaian STEM education. The country may face constraints in terms of funding, textbooks, and other educational materials that can seamlessly integrate religious and moral aspects into STEM subjects. Adequate investment and planning are necessary to overcome these resource challenges and ensure a smooth implementation of this blended approach. The following statement by a teacher, which was shared by the majority of parents and students, exemplifies their stance:

> "*Educational institutions are currently grappling with numerous challenges related to the availability of funding and resources and the shortage of teachers. The formulation and execution of this approach are expected to exacerbate the prevailing difficulties*."

According to the findings, educational institutions are currently facing significant challenges, including funding and resource shortages, as well as a lack of teachers. The formulation and execution of current approaches are anticipated to worsen these existing difficulties. This is possibly the reason why Rodger Bybee argues that a lack of adequate funding and resources could result in a deterioration of the standard of STEM education.[36] Educational institutions may find it challenging to furnish current materials, state-of-the-art labs, and technology, thereby affecting students' practical learning encounters. Outmoded resources may impede the acquisition of skills essential in the swiftly changing technological environment of today.

According to the parents, there is the risk of marginalizing certain groups within the student population. If the infusion of soulful science is not executed carefully, it may inadvertently exclude students who do not adhere to the specific religious beliefs being integrated into the curriculum. This could result in a less inclusive educational environment and hinder the overall learning experience for students from diverse backgrounds. As a result, the approach may face resistance from individuals who advocate for the separation of church and state. The inclusion of religious and moral elements in STEM education may be viewed as an infringement on the secular nature of public education, potentially leading to legal and ethical debates. This is illustrated by the following comment made by a parent:

> "*I think there's a possibility of marginalizing certain religious groups within the student body. As a result, the approach could face resistance from those advocating for a distinct separation between religious/moral education and STEM education*."

The incorporation of religious and moral aspects into STEM education could be perceived as a violation of the secular or religious and moral principles inherent in public education. Samuel Amponsah discovered in his research that Ghanaians place high importance on incorporating moral and cultural

[35] Asante and Archibald, "Beyond Ubuntu: Nnoboa and Sankofa as Decolonizing and Indigenous Evaluation Epistemic Foundations from Ghana," 164.
[36] Bybee, "The case for STEM education: Challenges and opportunities," 64.

values into the education system to develop responsible citizens who appreciate diversity, foster unity, and uphold the principles that define the fabric of Ghanaian society.[37] Therefore, introducing these elements into STEM education could be perceived as diminishing the significance of Religious and Moral Education (RME) in educational institutions, potentially leading to heightened tensions.

Discussion Summary

The examination of integrating religious values into STEM education in Ghana has revealed multifaceted insights from students, parents, and teachers. The diverse perspectives offered by these stakeholders underscore the complexity of navigating the intersection between religious beliefs and scientific principles in an educational context. The identified theme, encompassing approaches to soulful science, potential benefits, and challenges, has provided a comprehensive understanding of the various dimensions associated with this integration. Students expressed enthusiasm for ethical discussions within STEM classes and extracurricular activities, while parents presented divergent views on standalone moral education versus integration within the STEM curriculum. Teachers advocated for interdisciplinary projects, case studies, and the incorporation of religious perspectives into STEM lessons. The study highlights the crucial role of educators in fostering a cohesive learning environment that seamlessly merges various subjects. This can be achieved through several strategies, including the development of an inclusive curriculum and pedagogies, the implementation of values-based STEM pedagogy, and the integration of religious and moral education with STEM through curriculum integration.

The potential benefits of infusing soulful science into Ghanaian STEM education include a more culturally relevant and engaging learning experience, fostering ethical responsibility, and developing critical thinking skills. However, challenges such as the potential conflict between religious beliefs and scientific principles, curriculum development, teacher training, resource allocation, and the risk of marginalization were identified. The findings align with existing literature on interdisciplinary education, emphasizing the importance of careful planning and consideration in implementing such approaches. The integration of religious and moral values into STEM education holds promise for creating a more holistic and culturally relevant learning environment. Nevertheless, addressing the challenges identified, particularly the potential tensions between religious beliefs and scientific principles, will require collaborative efforts from educators, policymakers, and religious leaders.

RECOMMENDATIONS

Based on the comprehensive analysis of the results and discussions, the authors put forth the following recommendations:

1. In the soulful science approach, educators are encouraged to facilitate discussions surrounding moral dilemmas, promote reflection and service-learning opportunities, and engage in interfaith dialogue. These methods collectively contribute to a holistic educational experience that nurtures interdisciplinary understanding and ethical consciousness among students.
2. Educators should consider integrating Religious and Moral Education into the STEM curriculum to include ethical discussions in the absence of prioritized standalone moral education, allowing students to explore the moral implications of scientific advancements and technological innovations. This approach fosters a holistic understanding of the ethical dimensions associated with STEM fields.
3. Schools should facilitate extracurricular activities such as clubs, seminars, games, or science fairs that focus on the intersection of religion, morality, and STEM. These activities provide students with a platform to delve deeper into ethical considerations within their chosen STEM fields. This can be achieved through the inclusion of moral dilemmas, ethical considerations, and discussions about the implications of scientific advancements.
4. Teachers should develop interdisciplinary projects that encourage collaboration between religious and moral education and STEM subjects. Case studies can be employed to explore real-life

[37] Samuel Amponsah, "Akan Folklore as a Philosophical Framework for Education in Ghana," *International Review of Education* 69, no. 1 (2023): 125–42.

scenarios, enabling students to analyze the ethical dilemmas and decision-making processes involved in STEM-related issues.

5. Educators are encouraged to incorporate religious perspectives into STEM lessons, providing students with a more comprehensive understanding of scientific concepts and technological advancements from diverse cultural viewpoints. Adequate efforts should be made to develop a curriculum that successfully integrates religious and moral education with STEM subjects while respecting the diversity of beliefs. Teachers must receive appropriate training to deliver balanced presentations of both scientific and religious perspectives.
6. Educational institutions and policymakers need to address the potential conflicts between religious beliefs and scientific principles while ensuring inclusivity within the student population. Balancing these aspects requires careful navigation to avoid compromising the integrity of scientific education and prevent the marginalization of certain groups. Educational institutions and policymakers must also allocate resources and funding to support the seamless integration of religious and moral aspects into STEM subjects, promoting inclusivity and respecting diverse backgrounds.

CONCLUSION

In an era where STEM education propels global economic growth, Ghana is actively fostering its own STEM ecosystem, evident in its educational system's sharp focus on STEM subjects, alongside the establishment of specialized institutions and programs nationwide. Initiatives like increased STEM infrastructure investment, industry partnerships, and international competitions underscore Ghana's dedication to a robust STEM foundation. However, this emphasis has overshadowed religious and moral education, leading to declining moral values among students. The soulful science approach seeks to integrate religious and moral education (RME) into STEM, offering a holistic understanding of scientific concepts enriched by diverse cultural viewpoints and ethical considerations. This integration cultivates individuals with technical proficiency, ethical awareness, and cultural sensitivity, qualities prized in today's global workforce, nurturing critical thinking, problem-solving, and moral reasoning essential for tackling complex societal challenges and driving innovation across industries. By adopting the soulful science approach, educational stakeholders can create an inclusive, culturally relevant learning environment that enhances students' employability and fosters sustainable economic growth.

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