*ORIGINAL RESEARCH ARTICLE*

INTEGRATING BLENDED AND SOCIAL-EMOTIONAL LEARNING INTO SCIENCE EDUCATION FOR QUALITY ENHANCEMENT

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ABSTRACT

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| **Aims:** Different studies have been separately carried out on blended learning and socio emotional learning. The importance of the blended learning strategies and its useful in improving learning especially science learning cannot be overemphasised, same may be said of socio emotional learning, although few studies exist in terms of its importance in science learning and science education. Importance of SEL has also been emphasised in many recent studies. This study seeks to provide a positional review on the intersects between blended learning and socio emotional learning in improving the quality of education while providing insight into past literature as regards blended learning and socio emotional learning.  **Study design:** The study adopted a review of literature while presenting the perspective of the researcher. The researcher synthesised the position from various literature to provide a comprehensive overview relating to the variables of the study. Studies carried out within the last 5 years on the variables of the study were included and used to address the nexus between blended learning and socioemotional learning.  **Results:** It is also important to note that blended learning has been regarded as one of the core approaches to improving learning outcomes. This study seeks to explore avenues for improved in quality education especially in the aspects of SEL via the approach of blended learning. It explains the importance of integrating socioemotional learning components in the teaching of science using the blended learning approach. This is expected to help develop the cognitive, affective and psychomotor components of the learners. Students can acquire the socioemotional abilities necessary for success in life by combining blended learning with social and emotional learning to create a comprehensive and successful educational approach. |

1. INTRODUCTION

Throughout history, teaching and learning have been used to explore the depth of knowledge inherent in nature, significantly impacting learners' psychological well-being. In the past centuries, educators used imitation and indoctrination to teach, causing the mind to wander and drawing learners' attention to abstract contents, thereby widening the gap between the learners and society. In recent times, different strategies have been used in teaching to promote active learning and participation of learners through procedures that set paces for utilisation of verified knowledge for learners’ benefits as well as for transformation of the society at large. Historically, one-sided stereotypes in education hindered student engagement, stifling progressive trends in knowledge utilization, as all teaching activities revolving around the Face-to-face learning used to be the norm(Demirkol, 2022), but in recent times, particularly in the last ten years, online teaching has supplanted face-to-face environments, enabling learners to learn without the limitations of physical barriers and a shortage of educational instructional materials. This combination of both face-to-face and online learning environment is referred to as blended learning. This has boosted the quality of education as a result of the advent of Information and Communication Technology (ICT). This is supported by the argument of Bahri (2020) in his explanation that the advent of information and communication technology (ICT) has helped the process of education tremendously. Combining face-to-face learning with online learning is a significant process that decolonizes information, accelerates learning, and advances global perspectives and sustainable development goals. The implementation of blended learning has the potential to establish a conducive and all-encompassing educational setting, fostering the academic and emotional growth of students.

The teaching profession is essential to national development as it cultivates individuals' skills, character, and knowledge, forming the foundation for societal progress. Additionally, the use of blended learning, which can evoke students' emotions and enhance their attitudes, is advantageous for promoting global expectations and promoting human sustainability. Teaching is a systematic approach to achieving the goal of education for sustainable development. Teaching arouses latent ability, which can enable individuals to be productive in the society, showing the intricate relationship between teaching and its appeal to the emotional wellbeing of the learners.

The social-emotional aspect of any human is a vital factor to be reckoned with in the development of individuals making it a crucial component for quality education. Developing the self-awareness, self-control, and skills essential for success in school, the workplace, and life requires social-emotional learning. Strong social-emotional abilities enable one to academically, professionally, and socially advantageably handle daily obstacles. According to Correia (2023), social and emotional competencies have a significant influence on the formation of connections within the context of the school environment, the management of behaviors in the classroom, and the promotion of participation in extracurricular activities.  According to Ohl, Fox, and Mitchell (2013) and López-Mondéjar and Pastor (2017), these competences are not only necessary for education but also for the formation of meaningful relationships, the resolution of problems, and the adjustment to the complexities of human growth. This has the potential to encourage and improve meaningful and constructive learning as supported by the constructivist theory (Ohl et al., 2013).

**2. THEORETICAL FRAMEWORK**

**2.1.1. CONSTRUCTIVIST THEORY**

Constructivism theory has strongly influenced science education over a period of a decade. The constructivist view, which refers to students' acquisition of knowledge, appears in many forms in science education literature (Good, Wandersee, & Julien, 1993). Krahenbuhl (2016) posits that constructivism is an epistemological perspective that derives knowledge through a process of meaning-making, where learners construct their own interpretations of their experiences, thereby generating thoughtful facts in their minds by active engagement in the process of learning. This is why Tomljenovic and Tatalovic Vorkapic (2020) draw a distinction between the "transmissive" or "traditional" learning approach, where students passively absorb facts from their teacher, and constructivism, which fosters transformational learning based on cognitivist and constructivist theories, encouraging "the student's active participation through exploratory, problem-based learning." According to Jones and Brader-Araje (2002), a common aspect among the various definitions of constructivism is its emphasis on the learner's active involvement in the process of creating meaning. There is a shift from viewing knowledge as a product to viewing it as a process, where "knowledge is not something that exists outside the learner". Constructivism refers to the construction of knowledge based on existing knowledge, providing guidance for students to construct viable explanations of experiences.

In number of ways, science process clings to the foundation of constructivism theory in practice. This is because, according to Adebisi (2021), students are given the opportunity to develop their own knowledge when constructivist teaching is implemented in educational settings (Shah, 2019). This helps to enhance meaningful teaching and learning in way that makes constructivist teaching become increasingly prominent in educational settings. This approach encourages students to take on active role in their learning, which ultimately results in a more thorough comprehension of the material and a greater ability to cater for specific requirements of each student. This notably addresses problem solving of science.

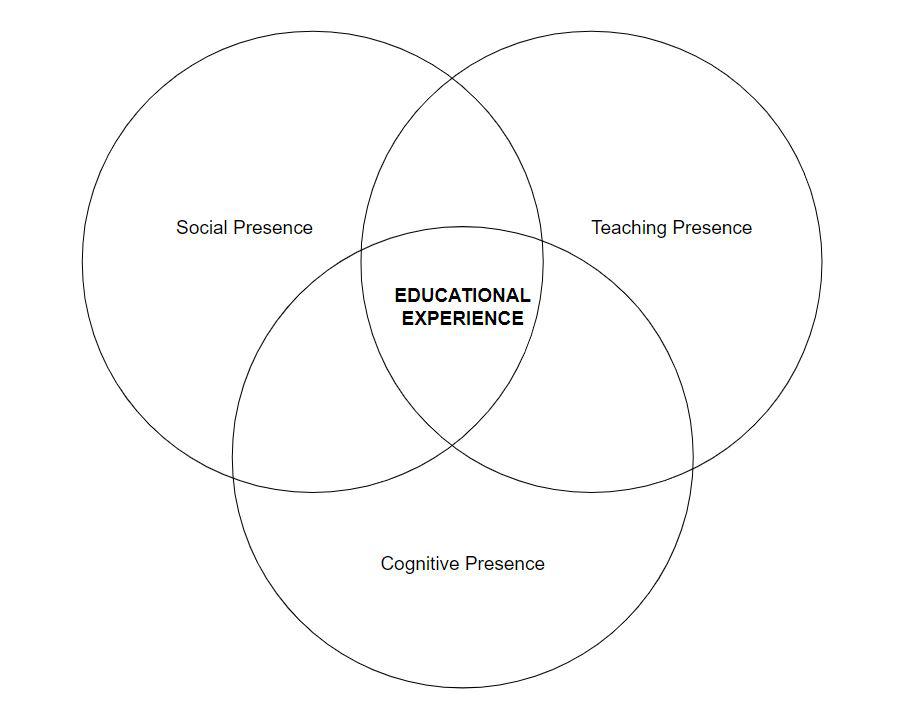
The constructivist approach to learning emphasizes the dynamic shift from dogmatism and memorisation to the acquisition of critical thinking, problem solving, and process skills in science learning. Science encompasses a wide range of activities that teachers and students engage in as part of its curriculum. Science requires the ability to connect prior knowledge with new information through social interactions, fostering cognitive development and enhancing experiential learning. As a result, meaningful learning occurs effectively within the social context in which it is conducted. The epistemological commitment and instructional model, which incorporates aspects of Piagetian, Ausubelian, and Vygotskian learning theories, contribute to the broad, intuitive appeal of constructivism. This includes the importance of determining prior knowledge or existing cognitive frameworks, as well as the use of dissonant events (relevant information) to drive conceptual change (Mustafa Cakir, 2008). Technology, specifically blended learning, can achieve this by promoting social-emotional learning. This emphasizes the importance and adoption of learning that aligns with the scope of recent trends, events, cultural and social context in a way that will make learners relevant to the society. Hence, for science students to adapt to trends of scientific development, their learning should come not only from face-to-face learning in the class but also from tapping into global resources available from the outlet of technology.

Technology has enhanced social interactions, allowing students to engage in both partial and full learning experiences. In many advanced societies around the world, schools are rapidly advancing their teaching methods to support development and modernization through blended learning. Blending learning with technology fosters the availability of comprehensive educational content, enabling teachers and students to meet the demands of the accelerated scientific age (JEP, 2023). This approach facilitates interaction between teachers, students, scientific tools, and the environment, providing valuable insights into solving daily and national problems

**2.1.2. COMMUNITY OF INQUIRY FRAMEWORK**

Advancement in research has shown that there are intricacies around social learning and learning outcomes necessitating the rise for a new theoretical approach called Community of Inquiry Framework (CIOF) which explains the interdependency between three core factors which include social presence, cognitive presence, and teaching presence with the aim of creating meaningful experiences for the learners. This theory explains the impact of the teaching experiences and models on the cognitive and social awareness of the learners.

**Figure 2.1 Community of Inquiry Framework**



According to the theory, the experiences of the teachers has an impact on students learning experiences of which socioemotional learning is a strong part of this. Zidiropoulou and Mavroidis (2019) aimed to investigate the correlation between varied student learning styles and the three components of Community of Inquiry (COI) by employing multiple instruments to survey the experiences of postgraduate students enrolled in distance learning courses at a Greek university with strong positive relationship between diverse learning styles, cognitive, teaching and social presence of the learners. These findings corroborate the premise that the strategic design of a course is crucial for enhancing student learning experiences. Thompson et al. (2017) examined the ways in which online learning platforms might either hinder or promote desired behaviours and interactions. Fiock (2020) asserts that educators must develop an online course considering the various presences of the Community of Inquiry (COI).

3. Statement of Problem

With rapid technological advancements and a growing emphasis on holistic development, science education remains a crucial driver of critical thinking, innovation, and societal progress. Yet, traditional science curricula focus primarily on content and technical skills rather than fully integrating pedagogical approaches that meet the varying cognitive, affective, and social demands of learners. Despite the demonstrated advantages of social-emotional learning (SEL), which fosters abilities like empathy, teamwork, and resilience, and blended learning, which combines digital resources with in-person instruction to customise education, these frameworks are rarely combined in science education.

The existing approach for teaching science to students are almost fixed, so the body struggles to learn through lecture-based models and does not reach out to engage the learners. The disconnect is exacerbated by the marginal-intentional delivery of SEL concepts, leaving students ill-prepared for the interpersonal/ethical hurdles they will face when conducting science outside the classroom. Simultaneously, although blended learning, which has become more popular in the past three years since the pandemic, is implemented in schools, the practice does not align with SEL goals and is ineffective at maximizing the benefits of blended learning to create sensitive and interactive learning environments.

This lack of comprehensive approach integrating SEL and blended learning in science curriculum weakens the quality of education. She argued, “Students can demonstrate academic proficiency, but they don’t take away the emotional intelligence, teamwork skills, flexibility, and adaptability needed for careers in STEM and for civic engagement.” And due to inadequate training, insufficient resources and our curriculum's inflexibility — some deputies were recently refused training they requested in these essential approaches — systemic barriers make it difficult for educators to integrate these approaches.

**4. REVOLUTION THROUGH TECHNOLOGY**

A discussion on blended learning would be incomplete without considering its role in the technological revolution. The impact of technology has elevated teaching and learning to a promising position, contributing to the global pursuit of sustainable development (Das & Barman, 2023). Modern education provides numerous benefits, including promoting a peaceful lifestyle, deepening understanding of one's surroundings, fostering healthy global competition, and equipping individuals with the skills necessary for employability in the 21st century. Researchers have observed that effectively integrating technology into face-to-face learning environments enhances practical skills, promotes collaboration, and fosters innovation among students. Students now have greater access to global knowledge through technology. This new generation of learners often struggles to stay engaged with traditional lessons but remains highly attentive when using technological tools (Hinampas, Murillo, Tan & Layosa, 2018).

In education, technology extends beyond simply having various gadgets in the classroom. According to Tryggi (2011), technology connotes distinctively interacting with computer- and network-based information and communication technologies (ICT), which include primarily cell phones and smartphones, computers, iPod- and iPad-like devices, related peripheral hardware, and software used to enhance interactive information exchange. Bahri (2020) explained that the advent of information and communication technology has helped the world of education tremendously. This becomes so as it has been highlighted that there exists a world of information and applications in cyberspace that is geared towards improving and promoting learning. Learning is said to have become easier in its application, as there is no option for sustainable learning that combines both online learning and face-to-face learning with a scientific approach. Bahra (2020) affirms that this form of learning has helped to achieve educational goals by promoting individual learning independence while allowing a good level of practical application of methods and approaches to teaching and learning. Given the increasing popularity of these technologies and the increasing inclination of the youth population towards cell phones, the internet, e-mail, websites, mobile phones, and iPods, it is necessary to integrate online teaching with traditional teaching methods, a concept known as blended learning. Blended learning is an innovative strategy that employs the advantages of both conventional teaching in the classroom and ICT-supported learning, which includes both offline learning and online learning.

Blending different learning experiences is not a new concept; however, integrating web-based technologies and other digital tools with face-to-face learning offers a promising pathway to achieving global educational goals. This approach also fosters the harmonization of diverse cultural perspectives within education (Ngalim, 2014). Furthermore, the National Policy on Education highlights the urgent need to integrate technological resources into the Nigerian education system to ensure its viability in the modern age. Prioritizing blended learning in schools represents the most effective method for achieving this integration

**5. THE DEPTH OF BLENDED LEARNING**

Blended learning, which combines online and face-to-face instruction, has gained popularity due to its ability to improve student engagement and personalize learning experiences. Tay (2016) describe this approach as an adjunct to traditional teaching, noting that physical lectures are increasingly perceived as burdensome and unengaging by many learners. Multiple researchers define blended learning as the integration of online and face-to-face instruction (Reay, 2001; Rooney, 2003; Sands, 2002; Ward & LaBranche, 2003; Young, 2002). According to Falconer and Littlejohn (2007), blended learning refers to the integration of instruction delivered both in the classroom and online, serving as a natural extension of traditional classroom learning. Blended learning is an engaging, dynamic, and versatile educational approach that has the potential to advance the pace of education due to its flexibility. It combines high-tech and low-tech tools with conventional teaching methods. Recently, research into blended learning has highlighted its potential to enhance content delivery across various disciplines. It fosters social interactions, encourages reflection, promotes higher-order thinking and problem-solving, supports collaborative learning, and enables more authentic assessments. These characteristics enhance student engagement both in the classroom and beyond, ensuring equitable access to quality education (Habib, 2018). It is then important to discuss the concept of quality education in line with this discussion. Several results provided insight into how to structure a blended learning science methods course for optimal student learning. The majority of complaints, it seemed, pertained to the blended course's online component (Vanichvasin, 2018). Thus, it is essential to address student needs and encourage meaningful interactions between students and instructors while designing online learning components, emphasizing the integration of social-emotional learning in blended learning strategies. Cooperative online assignments have been shown to be an effective way to address these concerns and reduce teachers' levels of irritation, according to research by Yilmaz and Malone (2022).

**6. THE CONCEPT OF QUALITY EDUCATION**

In today's world, education must equip students with the skills needed for a successful and fulfilling life, which can be achieved through effective teaching and an engaging learning environment. Education is the greatest tool for transforming the mind and character of an individual (Adebisi, 2019). It involves acquiring knowledge, skills, attitudes, interest, abilities, competence, and the cultural norms of a society and transmitting these to the coming generations so as to enhance the perpetual development of the society (Lawal, 2013).

The mission of education to transform the global world can be realized through teaching that addresses pressing challenges. Education plays a critical role in reshaping worldviews and values to solve humanity's ongoing issues (UNFCCC, 2015; IIASA, 2018; Trevors & Saier, 2010). As an educational innovation, blended learning offers students a platform to interact with their immediate surroundings while simultaneously gaining global insights. This approach broadens students' horizons, enabling them to critically analyse diverse contexts and values, fostering peaceful and productive coexistence.

Achieving Sustainable Development Goals (SDG) for 2030 requires education systems to be globally harmonized, dynamic, and inclusive. It must actively involve learners in collaborating locally and globally—an effort that can be effectively supported through blended learning. Owuamanam (2018) observed that curriculum content is continually evolving due to technological advancements and their applications in education. In contemporary education, quality learning is intrinsically linked to technology integration, fostering collaboration, communication, and digital literacy—essential skills for navigating the modern information landscape and workforce (Loyans, 2024).

Incorporating technology into education is not just an enhancement but a necessity for innovation and societal transformation. As part of this, schools and other educational institutions, which are tasked with preparing students for life in a "knowledge society," must adopt blended learning in their curricula (Ghavifekr, Afshari, & Amla Salleh, 2012).

**7. INTEGRATING BLENDED LEARNING INTO SCIENCE EDUCATION CURRICULUM FOR FUTURE BENEFITS**

The trend at which science has rejuvenated the world has called for its learning to be transformational and dynamic for it to prompt individuals to be pragmatic. The knowledge about science is inexhaustible and is continually repackaged through learning and researches extending to all matters of life. Science is a dynamic body of knowledge that reflects our understanding of natural systems, continuously evolving through research, expansion, refinement, and correction to benefit humanity (Duschl, Schweingruber, & Shouse, 2007). Therefore, science is a regenerating tool for knowledge acquisition, frontier for discovery, invention of new things and preservation of valuable knowledge in all ages. In recent times, science has contributed to all fields of disciplines and life’s phenomena to solve various issues of environmental crises; controversial genetic misleading; insolvable problem by humans through artificial intelligence and provision of solution to diverse agricultural and human health problems. These have drawn attention to science education.

Science education is an applied field of study that exposes learners to the organised contents as well as the procedure of acquiring scientific knowledge for practical application to life’s endeavours and humans’ survival. According to Obi Zita Chika and Obiadazie Regina Eyiuche (2014), science education is very important to everyday living because there is not one aspect of everyday life that science has not touched. Science is applied to and in domestic activities, industries, agricultural production, human health, environmental sustainability, communication technology, so we cannot avoid playing down its contents at all levels of education. The beauty of science education is that it is not limited to a specific educational level; it is studied at primary level of education, post-primary level as well in tertiary institutions. Its knowledge enhances scientific attitude and scientific literacy which are needed for personal and national developments.

According to Adebisi (2021) and Kareem (2020), Scientific attitudes should be cultivated not only among science students but across all learners, as we live in a world increasingly shaped by science, values, and character development. These studies describes some of the scientific attitudes relevant to the modern challenges to include: objectivity, curiosity, open and broad mindedness, intellectual honesty, rationality and team work**.** With these benefits of science attitude, it is very important that every child cultivates scientific attitude before adulthood for them to survive in this information age. This, in turn, helps children to have strong mind, ready to learn with others, and take responsible to their society (Halim, Abd Rahman, Zamri, & Mohtar, 2018). Scientific attitude is not only necessary for scientists. It is also important for individuals self-development (Rutjens, Heine, Sutton, & van Harreveld, 2018). To ensure a secure and sustainable future, science must be valued and integrated into the educational system, fostering a scientific attitude in children's learning. Emphasizing science and scientific attitudes leads to the development of scientific literacy. DeBoer (1991) defines scientific literacy as providing a broad understanding of science, its applications, and the rapidly evolving scientific enterprise, regardless of whether an individual pursues a career in science.

Scientific literacy is comprehensive, equipping individuals with the knowledge and skills necessary to function effectively in a world dominated by science and technology. According to Dani (2009), it encompasses the understanding of scientific concepts and processes required for personal decision-making, participation in civic and cultural affairs, and economic productivity.

‘*Scientific literacy implies that a person can identify scientific issues*

*underlying national and local decisions and express positions that are*

*scientifically and technologically informed. A literate citizen should be able to*

*evaluate the quality of scientific information on the basis of its source and the used to generate it. Scientific literacy also implies the capacity to pose and evaluate arguments based on evidence and to apply conclusions from such arguments appropriately (National Research Council, 1996, p. 22).’*

The global acceptance and usage of technology provide a valuable platform for advancing science education. With the widespread adoption of technological devices such as cell phones, laptops, flash drives, and VCDs, particularly among today's youth, teaching science using these tools offers an accessible and effective way to impart scientific values, attitudes, and literacy.

In the past, science knowledge was often dogmatically accepted by students, as teachers faced challenges in extending conceptual understanding. However, science education is now expanding and undergoing a transition to meet the evolving needs of individuals. This shift requires the adoption of new technologies and the exploration of innovative approaches, complementing traditional face-to-face classroom interactions (Lalima & Dangwal, 2017).

This transition has prompted schools worldwide to integrate hybrid models into their educational systems, combining technology with conventional instructional methods. Technology, in its broadest sense, encompasses all equipment and machinery developed through the application of scientific knowledge (Fakherji, 2019). Ensuring the effectiveness of blended learning in science education does not end with the development of contents and activities but with the use of pedagogical content through technology. It is also paramount to ensure that the evaluation of the components of teaching and learning also respects the same trends of using technology.

In science education, blended learning helps create a dynamic learning environment that promotes cognitive development by providing students access to a wide range of learning experiences. This approach also caters to individual students' needs, supporting their self-management skills and facilitating data collection and collaboration to enhance their conceptual understanding (Webb, 2008).

While blended learning offers significant advantages, including improving science teaching and learning experiences across cognitive levels, studies show potential drawbacks. For example, Jeong et al. (2018) noted that blended learning could lead to reduced engagement with challenging science concepts, particularly those perceived as abstract. Furthermore, the reduction in face-to-face interactions may hinder the social and emotional development of learners, which could be counterproductive.

To address these challenges, deliberate efforts are required to ensure that blended learning remains a structured and formal educational program. Such programs should enable students to learn partially through online content delivery, with some degree of control over their learning's timing, pace, and location. Simultaneously, these programs should include in-person instruction in a supervised, brick-and-mortar setting away from home to balance both online and traditional learning benefits (Jensen & Kim, 2024).

**8. NEXUS BETWEEN BLENDED LEARNING AND SOCIAL EMOTIONAL LEARNING** **IN SCIENCE EDUCATION CURRICULUM**

The incorporation of blended learning combined with social-emotional learning (SEL), within the science education curriculum holds significant relevance and importance for multiple reasons. Firstly, it acknowledges that students are not solely passive recipients of knowledge, but rather individuals with emotional and social requirements (Shah, 2019). Through socio emotional learning, it becomes possible to cater for the specific needs of learners making science learning to come alive. Furthermore, this integration facilitates the cultivation of fundamental life skills, including self-awareness, empathy, and responsible decision-making, which are imperative for effectively navigating real-world obstacles and fostering constructive interpersonal connections, specific for scientific contributions into the society. Finally, the integration of a supportive and inclusive learning environment that encourages collaboration, critical thinking, problem solving and inquiry cultivates a feeling of belonging and emotional well-being, ultimately augmenting students' comprehensive educational experience and positioning them for subsequent achievements.

Blended learning has the potential to serve as a progressive approach in the field of science education. In contrast to traditional face-to-face (F2F) learning approaches for science education, blended learning has effectively addressed the limitations associated with specific timeframes, physical locations, and passive instructors (Watson, 2008). By incorporating online components, blended learning could enable students to engage in learning activities beyond the confines of the traditional classroom setting, while also allowing for in-person class sessions dedicated to active learning. This incorporates every aspect of learning, improving all-round development of the learners. Several results provided insight into how to structure science methods course through blended learning for optimal students’ learning. Emotion plays a significant role in Science Education (Pekrun and Stephens, 2012; Broughton et al., 2013). Education entails the development of social and emotional competences that are essential for effectively navigating life, in addition to the transmission of academic knowledge. Education is more than only the transmission of academic knowledge. Socioemotional competences, which include self-knowledge, self-regulation, social awareness, relationship skills, and responsible decision-making, play an essential part in the management of behaviours both within and outside of the classroom (Correia, 2023; Attanasio et al., 2020; López-Mondéjar & Pastor, 2017). According to Correia (2023), social and emotional learning (SEL) is the process of cultivating fundamental socioemotional abilities, attitudes, and values. This is necessary for the acquisition of socioemotional competencies.

Social emotional learning is meant to cultivate and enhance various aspects of students' abilities, including self-awareness, self-management, social awareness, relationship skills, and responsible decision-making, hence, integrating the self-development as much as the integration of this in the environment. The incorporation of blended learning and social-emotional learning (SEL) within the science education curriculum offers students a comprehensive educational experience that promotes both academic development and emotional well-being, as well as cultivates the interpersonal competencies essential for their future and societal developments (Greenberg et.al., 2017). The need for taking into account social and cultural frameworks in science education across many cultural boundaries was emphasised by Gaskell (2003). This could inform the ways blended learning is varied and carried out by the learners, and this could also tell on the structuring of science education programme. Through procedures that maintained a secure and interesting learning environment, allowing students to interact in small groups, and emphasizing unambiguous classroom participation standards, active involvement in the curriculum was promoted. With laboratories serving as the primary locations for practical scientific investigation, the implementation of science curriculum via blended learning can promote a student identity related to active involvement and success in science.

**8.1. STUDIES ON BLENDED LEARNING AND SOCIAL EMOTIONAL LEARNING**

Different studies have been carried out to ascertain the relationship between blended learning and socio emotional learning. It seeks to show how the various learning platforms may be more inclined towards improving socioemotional learning improving the overall learning outcomes.

Teeple (2021) explained that respondents indicated that they were able to communicate with their peers online and work together in a remote learning class. frequently cited Persistence, Thinking Flexibly, Thinking About Your Thinking (Metacognition), Striving for Accuracy, and Thinking and Communicating with Clarity and Precision. The results indicate that there is a positive correlation between student social-emotional proficiency and student grades on a summative performance task. Sonnenberg & Rutledge (2024) also explained that the use of blended learning assists in building empathy strategies thereby helping platform limitations while also helping to pay attention to all students’ concerns. It was also stated that the use of blended learning approaches helps to reduce the intense labour faced in face-to-face classes. Another point raised was the importance of the blended learning in promoting diversity through the face-to-face and online strategies by allowing for better understanding of student differences and values that might not be apparent in an online environment

For Flynn et al. (2024), it was seen that adopting the integration of online strategies via blended learning had significant and meaningful impact on students’ social-emotional learning (SEL) skills. It was also believed that this act as important scaffolds for socioemotional challenges and different socioemotional learning components. Conversely, another study that Charmaine et al. (2024) explored the different variables found in blended learning and its relationship with different socioemotional learning skills variables. The findings of the study showed no significant relationship between the blended learning environment and the socio-emotional skills of the students. This may be as a result of the intricacies that occur between the different sub variables of socio emotional learning.

The need for integrating blended learning in the development of SES of learners was more emphasized by the studies of Zhao & Song (2022) as there is a difference in the learners positive and negative emotions of those exposed to face-to-face and online learning especially in terms of degree of difficulty, readiness before class, workload, and interaction which are aided when BL approaches are adopted.

For Chen, Luo, Feng & Li (2023), their findings indicate that technology acceptability is both directly and indirectly associated with satisfaction in blended learning. The mediation study identified two significant mediating pathways from technological acceptance to blended learning satisfaction: one via higher-order thinking, and the other through serial mediation including emotional experience, social belonging, and higher-order thinking.

This shows that blended learning if well utilized may be a good avenue for promoting socioemotional learning competencies and skills of learners

**9**. **DEVELOPMENT THROUGH BLENDED LEARNING AND SOCIAL EMOTIONAL LEARNING**

Development is a multifaceted goal pursued globally. It is not merely an abstract concept but a process that enables individuals to contribute to societal advancement. Development is not meant for an object but for the people to develop the society. According to Sanda as cited by Akukwe (1988), the development of the society is both normative and organizational changes in the society resulting into:

1. the improvement and expansion of the mental horizon of the population arising from functional education and ;
2. the sustenance of positive and highly functional values, customs, practices relating to all aspects of the living.

The implication of the definition of development here is profound and wide in coverage to economic, scientific, religion, political which could not have been achieved except through education and this type of education should make the learners to learn under a wide scope of detailed instructions in order to bring all learners to a collaborative room for the meaningful contribution `to the society. Conventional mode of teaching has witnessed untold interruption many times in the developing countries of the world and this should not be so for the society to witnessed transformation. In his submission, Adebisi and Olu-Ajayi(2022) affirmed that education is dynamic and continuous in life; any attempt to disrupt it or halt for any reason is a big attempt to disorganise the polity of the society.

The extended school closures in 2020 due to the COVID-19 pandemic severely disrupted education, especially for students with special needs or learning difficulties, jeopardizing their academic progress. This disruption underscores how halting education impacts broader economic growth and productivity. To address such challenges, blended learning emerges as a viable solution, leveraging technology to ensure continuous learning for all students.

In today’s technology-driven world, the integration of computers into education and the widespread use of the internet have culminated in the concept of blended learning. This approach relies on technology to deliver educational content effectively, fostering human development and bridging the gap created by traditional barriers to learning (Nisreen, 2016). Education must be an ongoing process that fosters cultural and societal sustainability through innovative teaching and learning, supported by technological advancements. The prevailing viewpoint in the developed societies is that the school has no choice but to adapt to the information means of blended learning because this adjustment has become necessary for continuous survival and progress (Bani Hamad, 2011). Education entails the development of social and emotional competences that are essential to effectively navigate life, in addition to the transmission of academic knowledge. Education is more than only the transmission of academic knowledge. One area of knowledge which researchers have had doubts about, particularly in low- and middle-income countries had been in the effectiveness of the application of blended learning approaches to scientific learning development, especially when it comes to executing aspects of science like the practical components of specific subject areas that demands experimentation. This has been demystified with the advent of technological tools like animated visuals, visualized learning and concept mappings that can be used or virtual demonstrations while students can practically infuse the visualized concepts in real life experiences. In fact, the opportunity that blended learning avails is that there can be amalgamation of online and real-time experiences which can make blended learning acceptable and applicable for attainment of science educational goals, hence allowing for physical interactions that helps to promote social and emotional learning.

The utilisation of BL has demonstrated numerous advantages in various contexts, including science education. Notably, BL enables students to engage in self-paced learning (Caulfield, 2011; Linder & E., 2017), resulting in enhanced academic performance, heightened student engagement (Baepler, Walker, & Driessen, 2014), and increased student satisfaction (Martínez-Caro & Campuzano-Bolarín, 2011). These benefits are among the many advantages associated with BL implementation. This is expected to allow learners understand themselves in a way that they can regulate their learning.

Yilmaz and Manon (2020) explained that educators have the opportunity to enhance their contents knowledge and pedagogical knowledge through the online component of blended learning. The utilisation of online learning platform would increase the amount of time and accessibility to engage in the implementation of inquiry-based science teaching and modern methodologies during class. In the present context, within a conventional face-to-face science class, the allocated time is primarily dedicated to imparting scientific content and pedagogical content knowledge, thereby limiting opportunities for practical engagement with hands-on inquiry methods. Blended learning will undeniably provide an opportunity for this, hence, improving the possibility of enhancing human development which can also extend to national development. The human development capabilities of blended learning is such that leaners may gain knowledge about the world around them, learning within the confines of their understanding, scaffold knowledge thought by taking extra courses as well as application of learning in different contexts, thus helping to improve the cognitive and affective components of the learners.

Schonert-Reichl (2017) states that education plays an essential part in developing students' social and emotional competence. Their personal level of social-emotional competence and sense of well-being is a crucial factor in the outcomes for their studentship. Extensive research shows that kids who participate in effective SEL programmes have positive growth, a reduction in problem behaviours, greater academic achievement, and improved life outcomes (Durlak et al., 2011). According to Schonert-Reichl (2017), it is essential to cultivate social and emotional learning (SEL) skills by providing students with opportunity to practise these skills and a learning environment that is both secure and helpful.

Using innovative learning approaches then stands as a strong scaffold for improving this learning as it has the ability to transform the perception of the learners. This was buttressed by Kallou et al. (2023), as they explained the use of digital learning tools as instruments to encourage transformative learning. According to these authors, using transformative learning tools via digital technologies as used in blended learning would serve as an effective tools especially for adult learners which will help in the advancement of knowledge, skills and attitides which are expressed in socio emotional learning. The utilisation of TL as an educational instrument for development will help improve the proficiency in emotional intelligence of learners as against the traditional teaching methods which will also influence learning effectiveness and shifts in learners' views. Hence, digital technology and tools will be employed to enhance the teaching and learning processes, facilitating access for learners who can receive training from any location.

10. Conclusion

Integrating blended learning with social-emotional learning creates a comprehensive educational framework, equipping students with essential skills for lifelong success. These competencies encompass self-awareness, self-regulation, social awareness, relationship development, and responsible decision-making. The role of educators is crucial in fostering social and emotional learning competencies and cultivating pleasant school environments. Blended learning, in conjunction with constructivist teaching approaches, enables students to engage actively in their education and cultivate a deeper understanding of the subject matter. The prioritisation of integrating social and emotional learning into the curriculum is essential for educational institutions to cultivate competent and well-rounded individuals, providing them with transformational and positive experiences. When the science curriculum incorporates social and emotional learning (SEL) competencies, students can critically evaluate their perspectives, formulate personal objectives, and cultivate healthier interactions with others and the natural environment (Ingram et al., 2021). Cuming et al. (2008) and Morgan (2012) assert that integrating cognitive, emotional, psychomotor, and conative abilities into blended learning is crucial for developing adaptive behaviours and enhancing student engagement.

Further research should employ robust data collection methods to validate the integration of social-emotional learning into blended learning, enhancing its impact on science education. More studies can be carried on effect of blended learning on socio emotional learning of students in science education to provide a comprehensive understanding on the need to integrate the components.

Disclaimer (Artificial intelligence)

Option 1:

Grammarly was used by the author(s) during the production of this work to assist with sentence wording and offer grammatical and stylistic recommendations, therefore guaranteeing effective and succinct delivery of study results. Following their use of this tool or service, the writers checked and corrected the material as necessary and accept full responsibility for the publishing content.

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