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Incorporating Current Issues Into Senior High School Science Education– An Opinion Paper

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Abstract:- This study focuses on incorporating current global issues into science education at Senior High School level. The continued expansion of these current issues such as globalization, artificial intelligence (AI), digitalization and other technology advancements necessitates integrating them into science teaching and learning at the Senior High School level. There are common view by many that media and use of smart devices have negative influence on students at the Senior High School level. This study supports the view that incorporating these areas will better prepare students for the demands of the modern world, ensuring that students gain relevant skills and information required for prospering in an increasingly linked and technology-driven society. Adopting AI tools, digital platforms, and global scientific viewpoints will help students at the Senior High School acquire critical thinking, problem-solving abilities, and adaptability necessary for future jobs in science, technology, engineering, and mathematics (STEM). Integrating these concerns also enhances diversity, individualized learning, and cross-cultural collaboration. Upon considering the merits and impact these current issues on science education and students learning, it is concluded that educational policymakers and stakeholders should embrace these advancements, as their inclusion in science education is beneficial for cultivating scientifically literate and future-ready citizens.

Keywords:- *Incorporate, Current, Digitalization.*

I. INTRODUCTION

The quick transformation of the contemporary world in technology advancements, globalization, artificial intelligence, and digitization has profoundly altered all aspects almost every field of study. Science education at the Senior High School level must evolve to maintain relevance and equip students for modern problems and possibilities (OECD, 2018). Bybee (2013), the conventional science curricula which is centered on fundamental concepts, are becoming insufficient for meeting the challenges posed by contemporary situations. Globalization has resulted in a more integrated globe, merging economies, cultures, and scientific methods across nations. This interdependence necessitates that students perceive science as a collection of abstract ideas, as well as a practical field that engages with diverse cultural and economic situations (Olaniran, 2020). Global concerns, like climate change, pandemics, and resource management, necessitate coordinated scientific answers. Incorporating elements of globalization into Senior High School science teaching will enhance students' understanding of the global nature of scientific information, preparing them to participate in international scientific discussions and activities. Artificial intelligence is a transformational force altering companies, economies, and educational environments (Brynjolfsson & McAfee, 2014). AI-driven solutions, like intelligent tutoring systems and data-driven learning platforms, are transforming student engagement with scientific concepts, enhancing personalization and efficiency in learning (Holmes et al., 2019). Incorporating Artificial Intelligence into the science curriculum at the senior high school level will boost students' comprehension of advanced technologies and equip them to navigate a future where AI is integral to scientific research, problem-solving, and creativity. Technological developments, particularly in disciplines like biotechnology, nanotechnology, and renewable energy, have dramatically altered the landscape of scientific research and industry (Harari, 2018). These breakthroughs have made it important for students to gain a more practical understanding of science that extends beyond textbook theories. By integrating modern technological applications into SHS science instruction, students will get insights into the dynamic nature of science, learning to think critically about the ethical, environmental, and societal implications of technological growth. Digitalization, which entails the integration of digital technologies into everyday life, has altered the way we access, process, and share scientific knowledge (Selwyn, 2016). The use of digital technologies, such as virtual laboratories, simulations, and online learning platforms, promotes students' engagement and comprehension of scientific concepts, making learning more dynamic and accessible. By effectively incorporating digital literacy into scientific education, SHS students can become more adept at using these technologies, thereby preparing them for a world where digital competence is vital (Redecker, 2017). Incorporating these issues into scientific education at the Senior High School level has numerous benefits. It creates students' awareness of the intricacies of the current world and also enhances students' critical thinking, problem-solving, and adaptation skills. Equipping students with the knowledge and tools to manage globalization, Artificial Intelligence, technological developments, digitalization, and scientific education will play a crucial role in developing the next generation of

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scientists, innovators, and educated citizens capable of addressing global concerns. The discourse in this article centres on globalization, artificial Intelligence and digitalization.

II. GLOBALIZATION IN SCIENCE EDUCATION AT SHS LEVEL

Globalization, characterized by the greater interconnection and interdependence among nations, has dramatically impacted several fields, including economics, culture, technology, and science. In the context of Senior High School science education, globalization provides both difficulties and opportunities, altering the way science is taught and studied. Altbach (2015), for students to prosper in a world where scientific investigation is increasingly collaborative and international, it is necessary to integrate characteristics of globalization into the science curriculum.

Globalization has altered the traditional concept of science, promoted cross-border collaboration and making scientific knowledge more accessible. The rise of global communication networks and the quick transmission of scientific information have enabled researchers, educators, and students to access scientific knowledge from many locations and cultures (Castells, 2010). For example, programs such as the Human Genome Project and the Large Hadron Collider involve worldwide teams working together, illustrating how scientific research has become a global enterprise (Kumar & Chubin, 2000). By integrating globalization into SHS science teaching, students gain exposure to multiple scientific views, boosting their awareness of how global collaboration accelerates innovation and problem-solving. Globalization also underscores the necessity of cultural variety in science education. Historically, science has frequently been depicted as a Western-centric field, however globalization indicates that scientific contributions originate from a wide spectrum of cultures and civilizations (Nisbett, 2003). For instance, substantial improvements in mathematics, medicine, and astronomy arose from the Arab world, China, India, and Africa, illustrating that science is a cumulative process molded by numerous cultural influences (Subbarayappa, 2013). Incorporating this intercultural dimension into science education at the SHS level creates an appreciation for the global aspect of scientific investigation, encouraging a more inclusive perspective of scientific knowledge.

A. Advantages of Incorporating Globalization into SHS Science Education.

One major advantage of introducing globalization into SHS science education is the development of cross-border collaboration and knowledge sharing. Through globalization, students and educators gain access to a variety of scientific materials, enabling them to engage in worldwide science contests, exchange programs, and collaborative research initiatives (Altbach & Knight, 2007). Programs like the International Science and Engineering Fair (ISEF) and the Global Learning and Observations to Benefit the Environment (GLOBE) Program allow students to collaborate with peers from different countries, enhancing their critical thinking, problem-solving, and teamwork skills (Friedman, 2016). These collaborative experiences expose students to multiple scientific approaches, preparing them to interact with global scientific concerns. Moreover, globalization helps solve global concerns by integrating themes such as climate change, pandemics, food security, and sustainable development into the scientific curriculum (Steger, 2017). By exposing students to real-world situations with global ramifications, scientific education becomes more relevant and engaging, promoting a feeling of global duty and citizenship. This equips students with the abilities needed to contribute to finding answers to critical concerns that transcend national boundaries.

B. Why Incorporate Globalization into at the Senior High School Science Education

Scientific advances such as CRISPR gene-editing technologies and renewable energy innovations, have far-reaching effects that extend across national borders (Doudna & Sternberg, 2017). Adding globalization into SHS science education guarantees that students get a thorough grasp of how scientific information is produced, communicated, and implemented on a worldwide scale. Additionally, globalization encourages cultural competence and empathy among students, which is necessary for nurturing future scientists capable of functioning in heterogeneous situations (Banks, 2009). When students learn about the scientific contributions of many cultures and regions, they gain an understanding for the diversity of thinking in scientific investigation, helping them to interact more effectively in international settings. Incorporating globalization within Senior High School scientific curriculum also prepares students for the demands of a worldwide workforce. As sectors become more interconnected, employers increasingly seek workers with the skills to work well in multicultural teams and address global challenges utilizing scientific knowledge (Friedman, 2005). By integrating globalization into the curriculum, educators can help students gain crucial qualities such as cross-cultural communication, critical thinking, and adaptation, which are vital for success in a globalized world.

C. Challenges in Incorporating Globalization in to SHS Science Education

Integration of globalization within SHS science education brings various benefits, however, it also creates certain problems. One notable obstacle is the gap in access to scientific resources and opportunity between developed and developing countries (Altbach & Knight, 2007). Although digital platforms have democratized access to knowledge, students in under-resourced places may still encounter challenges to getting high-quality scientific education. Governments and international organizations must therefore collaborate to promote fair access to scientific resources and opportunities, closing the knowledge gap between different regions (UNESCO, 2021). Another issue arises in appropriately educating educators to teach international science. Teaching science from a global viewpoint needs teachers to have a strong awareness of international scientific challenges and the ability to tackle these themes in a culturally sensitive manner (Banks, 2009).

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Professional development programs that equip educators with the skills and knowledge to integrate globalization into their teaching practices are vital for the successful adoption of globalization into the science curriculum (Zeichner, 2018).

III. ARTIFICIAL INTELLIGENCE (AI) IN SHS SCIENCE EDUCATION

Artificial Intelligence, in short AI, is transforming education in a very significant way, notably in the field of science, and holds tremendous potential for increasing the learning experience in Senior High School science instruction. Luckin (2018), artificial intelligence involves the replication of human intellect by machines, enabling them to learn, reason, and make autonomous decisions. When AI is integrated into SHS science education, it can alter the way students engage with scientific knowledge, solve issues, and develop critical thinking skills, preparing them for a future dominated by AI-driven scientific and technical advances. In SHS science education, AI solutions such as intelligent tutoring systems, adaptive learning platforms, and automated assessment technologies can tailor learning experiences and deliver focused feedback (Luckin, 2018). Incorporating AI-driven training, students will receive individualized guidance, helping them to learn scientific concepts more efficiently. Holmes et al., (2019), adaptive learning platforms analyze students' replies in real-time and change the difficulty and substance of the lectures, ensuring that each student develops at their own speed. This approach is particularly useful in topics like physics and chemistry, where complicated problem-solving and conceptual comprehension are crucial. AI can also assist SHS students in acquiring computational thinking and data literacy abilities, which are crucial for scientific research in the 21st century. Engaging with AI-powered simulations and virtual experiments will help students investigate scientific phenomena in a controlled, interactive environment. De Jong et al. (2013), virtual laboratories allow students to imitate experiments that might be too expensive, unsafe, or time-consuming to conduct in a physical lab, thereby giving them with valuable hands-on experience.

A. Advantages of Incorporating Artificial Intelligence into SHS Science Education

Personalized learning is one of the key advantages of Artificial Intelligence in SHS science teaching. Unlike traditional teaching approaches which generally employ a one-size-fits-all approach, AI technology can adjust to individual students' learning styles and pace (Luckin, 2018). An AI-based teaching system can provide extra guidance to a student struggling with a physics subject while challenging another student who has mastered the concept with more complex questions. This tailored education optimizes learning outcomes by ensuring that each student receives the advice they need to succeed. AI also boosts assessment and feedback procedures. Automated assessment technologies can analyse assignments, quizzes, and lab reports, providing students with rapid, detailed feedback on their work (Roll & Wylie, 2016). Timely feedback is invaluable in science education, since comprehending mistakes is critical for improvement. This not only enhances the learning process but also enables teachers to identify areas where students may need further guidance. In addition, Artificial Intelligence facilitates collaborative learning by boosting teamwork and peer-to-peer interactions. AI-driven platforms can examine group contributions, assuring equal participation and encouraging collaborative problem-solving (Roschelle et al., 2013). For example, during a group project on ecological sustainability, AI may monitor each student's contribution, ensuring that all team members participate meaningfully, which enhances their problem-solving skills and fosters a spirit of scientific inquiry. AI-powered simulations also play a crucial role in science teaching since they enable students to conduct experiments virtually. This is particularly important in SHS settings where access to laboratory equipment may be limited. For instance, students can simulate chemical reactions, analyze the impact of different variables in physics experiments, or model biological systems using AI-driven simulations (De Jong et al., 2013). These virtual experiences help students grasp abstract scientific topics and build practical abilities.

B. The Need to Incorporate Artificial Intelligence into SHS Science Education

As technology continue to advance, including artificial intelligence into SHS science teaching and learning becomes increasingly crucial. AI is already altering several scientific domains, such as genetics, climate modeling, and medical research, through the analysis of complicated datasets and the acceleration of scientific findings (Topol, 2019). Chui et al., (2018), introducing Senior High School students to AI principles and applications will them develop significant abilities that are crucial for future scientific professions, including coding, data analysis, and algorithmic thinking. Integrating artificial intelligence also teaches students for ethical considerations when employing it. Students must be educated to critically examine the societal and ethical implications of AI applications, such as data privacy, algorithmic prejudice, and autonomous decision-making. Including these ideas in science curricula creates a broader knowledge of how AI might be utilized ethically in scientific research and in society (Bostrom, 2014).

C. Challenges of Incorporating AI into SHS Science Education

Despite the numerous benefits of integrating artificial intelligence into SHS science teaching, some problems must be addressed. A key difficulty is the digital divide, which refers to discrepancies in access to AI technologies among pupils in different countries. While AI tools are becoming more prevalent, many schools may lack the infrastructure or funding to implement these technologies effectively, especially in developing regions (Selwyn, 2016). Governments and educational institutions must work collaboratively to provide equitable access to AI resources to ensure that all students benefit from AI-enhanced science education. Another problem is ensuring that educators are sufficiently trained in deploying AI technologies. To successfully integrate AI into science education, teachers must be educated about AI applications and good at guiding conversations on ethical issues. Professional development

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programs concentrating on AI in education can assist teachers obtain the necessary skills and knowledge (Luckin, 2018). Moreover, there is a concern regarding over-reliance on AI in education. While AI can enhance learning experiences, it is crucial to maintain the role of human educators in guiding, mentoring, and assisting students (Holmes et al., 2019). A balanced approach, where AI serves as a tool to complement human instruction, ensures that kids acquire a full science education.

IV. DIGITALIZATION IN SCIENCE EDUCATION IN SENIOR HIGH SCHOOLS (SHS)

Digitalization is redefining the landscape of science education in Senior High Schools, drastically altering how science is taught, learnt, and assessed. Digitalization in SHS scientific education means incorporating digital technologies into the teaching and learning processes to produce a more interesting, flexible, and successful environment for both students and teachers. It is not only changing the way knowledge is accessed but also influencing curriculum delivery, teaching methodologies, and assessment methods. This change from traditional pedagogical approaches to digital-based learning has altered how science is perceived and learned in SHS contexts. According to Schwab (2016), digitalization involves transferring information into digital representations and employing technology in everyday activities, which corresponds nicely with the digital change in SHS scientific education. In this context, SHS teachers and students are increasingly adopting digital resources such as e-textbooks, online learning platforms, interactive simulations, and virtual labs, which make scientific concepts more accessible and understood. Punie, (2013), the digitization of textbooks and educational resources has widened access to knowledge beyond the classroom, allowing SHS students to engage with content interactively and multimedia-richly. A key component of digitalization in SHS scientific teaching is the introduction of Learning Management Systems (LMS) like Moodle and Google Classroom. These platforms enable teachers to arrange course materials, track student progress, and conduct assessments smoothly, enabling an interactive learning environment (Smetana & Bell, 2012). For instance, students can execute experiments in virtual laboratories, which provides a secure and controlled place for practical science activities, hence boosting experiential learning.

A. Advantages of Incorporating Digitalization in to SHS Science Education

Means et al., (2013), one of the major advantages of digitalization in Senior High School scientific education is the democratization of knowledge, which helps overcome the educational gap between rural and urban students. Digital tools make scientific information more available, guaranteeing that students, irrespective of their geographical location or socioeconomic level, have equitable access to quality science education. For example, students from rural places can receive online tutorials, digital textbooks, and virtual lab simulations, which might otherwise be unavailable due to inadequate physical resources in their schools. Digitalization also encourages individualized learning, which is particularly crucial in science education, as students typically struggle with abstract concepts. Through adaptive learning technologies, SHS students can receive individualized feedback and advance at their own pace, addressing individual learning obstacles more efficiently (Johnson et al., 2016). This tailored method ensures that students get a deeper comprehension of scientific fundamentals, consequently increasing their overall performance. Additionally, digitization enhances student participation and motivation in SHS scientific education. Interactive techniques such as virtual reality (VR) and gamification make learning more immersive and fun. Students can utilize virtual reality to comprehend difficult scientific phenomena like the structure of atoms or biological processes, making abstract concepts more tangible (Merchant et al., 2014). Again, gamified learning experiences reward students for their achievement, enhancing their interest and participation in science courses (Deterding et al., 2011). Collaboration is another significant benefit of digitalization in SHS scientific teaching. Digital platforms enable students to collaborate on projects, share data, and engage in group discussions, emulating the teamwork necessary in scientific research. Tools like Zoom and Microsoft Teams encourage peer connection, allowing SHS students to collaborate with classmates even outside the classroom, thus increasing their communication and teamwork skills (Wang, 2009).

B. The Importance of Incorporating Digitalization into SHS Science Education

Incorporating digitalization into SHS science education is vital for educating students for a technology-driven future. As scientific areas increasingly rely on digital tools for data gathering, analysis, and experimentation, SHS students need to learn digital literacy abilities to excel in these domains (Selwyn, 2016). Abilities in data analysis, coding, and using digital tools have become fundamental components of modern scientific inquiry and are very relevant in today's labor market. Furthermore, digitization encourages an inquiry-based approach to learning, encouraging SHS students to explore scientific challenges autonomously. Digital technologies such as simulations and online research databases enable students to perform experiments and inquiries, strengthening critical thinking and problem-solving skills (Bybee, 2006). This method gives SHS students with the skills needed to become autonomous learners, which is crucial for their future academic and professional interests. The COVID-19 pandemic has highlighted the importance of integrating digitalization into SHS science education to ensure learning continuity during disruptions (Zhao, 2020). During the epidemic, SHS schools that had embraced digitization managed to move to online learning smoothly, underlining the necessity for a robust education system that can adapt to changing conditions. Digitalization also fosters equity in SHS science education by allowing students from varied backgrounds access to quality instructional resources. This access minimizes gaps created by geographic, socioeconomic, or social barriers, ensuring that all students have the opportunity to flourish in science (Warschauer & Matuchniak, 2010). By incorporating digital resources, SHS scientific instruction

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becomes more inclusive, catering to the unique needs of students across different settings.

C. The Need to Incorporate Digitalization in Senior High School Science Education

Given the rapid growth of technology, integrating digitalization into SHS scientific education is no longer optional but a requirement. The Fourth Industrial Revolution demands that students possess digital literacy and technical skills to remain competitive in the job market (Schwab, 2016). As such, SHS students need to be adept in using digital tools to examine data, conduct research, and solve challenging scientific problems. For instance, competency in using software for data visualization and understanding programming languages is becoming increasingly crucial in scientific jobs (Kelley & Knowles, 2016). Moreover, digitization in SHS scientific education provides a more student-centered approach, allowing students to direct their learning experiences. This autonomy supports independent thinking and lifelong learning, critical skills for managing the fast-expanding technology landscape (Linn et al., 2014). By integrating digital technologies into the SHS science curriculum, students are better prepared to meet the problems of the digital economy and contribute effectively to society.

V. CONCLUSION

Incorporating current concerns such as globalization, artificial intelligence (AI), and digitalization into senior high school science instruction is a progressive decision and a vital step toward preparing students for the challenges of the 21st century. The dynamic character of the world today necessitates an education system that is flexible, forward-thinking, and capable of giving students the information and skills needed to flourish in a quickly evolving society. This paper clearly supports the integration of these topics into the SHS scientific curriculum, underscoring their unquestionable importance in developing a more relevant, interesting, and effective science education. The global interconnection generated by globalization mandates that SHS science education transcends traditional classroom borders and exposes students to varied scientific concepts and concerns. Students must be able to understand scientific concepts from a global viewpoint, knowing that challenges such as climate change, health pandemics, and environmental sustainability are not isolated to one nation but require collective global actions (OECD, 2019). Introducing these topics into the curriculum would help create a feeling of global citizenship and responsibility among students, making them more conscious of their role in tackling global challenges.

Artificial Intelligence on the other hand has already begun to transform several industries, including healthcare, engineering, agriculture, and environmental management. Including AI principles into SHS scientific teaching will help students acquire exposure to cutting-edge technology and develop problem-solving abilities that are necessary for the current workforce. Kelley and Knowles (2016), AI integration in education helps students to understand and employ AI tools, enabling them to adapt to future technological breakthroughs. This information is crucial, as AI is anticipated to play an even greater role in industries, making it a vital component of any comprehensive science education. Technological innovation gives an unprecedented potential for immersive and inquiry-based learning, which is vital for cultivating curiosity and critical thinking among SHS students (Bybee, 2006). The use of virtual laboratories, simulations, and interactive multimedia allows students to undertake experiments that might otherwise be too costly, unsafe, or time-consuming in a physical lab. This not only promotes their knowledge of scientific ideas but also nurtures creativity and originality, two crucial traits for scientific inquiry and discovery (Smetana & Bell, 2012).

Schwab (2016), highlights that digitalization has become integral to every area of life, and its implementation in scientific education will ensure that students gain the digital literacy skills required for the digital economy. Digitalization democratizes education, making learning resources more accessible and affordable, reducing the gap between students from diverse socioeconomic backgrounds (Means et al., 2013). The integration of Learning Management Systems (LMS), virtual laboratories, and digital assessment tools delivers a more personalized, engaging, and inclusive learning experience that caters to varied learning needs (Johnson et al., 2016). Therefore, digitalization is a technology and a transformational force that redefines how scientific education might be provided, making it more relevant and flexible to today's learners.

It is clearly seen that incorporating these current global issues into Senior High School science education is both useful and vital for nurturing well-rounded, knowledgeable, and future-ready people. The quick pace of technology and scientific breakthroughs needs a curriculum that is dynamic, sensitive, and linked with the realities of our modern world. As the Fourth Industrial Revolution continues to change every part of society, it is vital that scientific education evolves to educate students with the skills, abilities, and mentality required to navigate and contribute effectively to this changing landscape (Selwyn, 2016). Failing to integrate these topics into Senior High School scientific instruction would mean failing to educate students for a future that is already here. Hence, embracing these developments is the best way to ensure that Senior High School students are not only passive consumers of knowledge but active contributors to scientific progress and innovation.

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