Innovations

Leveraging Blended Learning Strategy for the Teaching and Learning of Science

[1]Olu-Ajayi, F. E., [2]Akinwumi, I.O, [3]Falemu, F.A. and [4]Kenni, A. M
[1,2,3,4]Department of Science Education, College of Education, Bamidele Olumilua University of Education, Science and Technology, Ikere-Ekiti, Nigeria.

Abstract
This paper discusses the concept Blended Learning, and its significance for science learning. It has been observed that the conventional teaching and learning of science seems inadequate in yielding the desired expectations in science Education, and has been discovered to be teacher-centred, hence non-engaging for learners, thus resulting in a passive, non-participatory classes which has a negative effect on students' interest, attitude and performances. The need to supplement the conventional teaching method then arises, if the expectations of the society from the modern science classrooms will be met. A paradigm shift to an interactive, participatory education involving supplementing the conventional way of teaching with technology-mediated instruction into learning is thought to be the ideal for learning science in the contemporary world. This paper purposes to present blended learning as a better alternative and interactive method of learning science as it enables the use of multiple senses by learners, and present teaching in an interesting way for proper learning and retention. The paper also pointed out the challenges and disadvantages of Blended learning and discusses the remedies to pit-falls in the use of BL.

Keywords: *Blended learning, paradigm shift, science, teaching, learning*

Introduction

In the ever-evolving landscape of education, the integration of technology has revolutionized traditional teaching and learning approaches, paving the way for innovative pedagogical strategies. With the advancements of Technology round the World, the inadequacy of traditional teaching and learning has become an issue that require an urgent reformation. Science education stands at the forefront of preparing students with the critical thinking skills, scientific literacy, and problem-solving abilities necessary to navigate an increasingly complex and interconnected world.

However, traditional approaches to teaching science often face limitations in catering to diverse learning styles, addressing individual student needs, and

providing opportunities for hands-on experimentation and inquiry-based learning. The modern science classroom requires a variety of instructional strategies and facilities (UNESCO, 2020) that would add value to the traditional method of teaching like; interactive-learning, group collaboration, demonstration among others. The need to integrate today's techno logy into learning therefore becomes imperative. Available number of emerging technologies to support the teaching and learning of science increases daily as Annemieke et al., (2012) has proposed and should be learned and utilized. Blended learning, a hybrid instructional model combining face-to-face instruction with online learning activities, has emerged as a powerful tool for enhancing student engagement, promoting personalized learning experiences, and fostering academic achievement across various disciplines. It is observed that students use technology daily, more for social activities: facebook, WatsApp, chatting, e-mail, advertising rather than learning. The adoption of blended learning in science education holds the potential to transform traditional classroom environments into dynamic hubs of inquiry and discovery. By leveraging digital technologies to supplement face-to-face instruction, educators can personalize learning experiences, differentiate instruction, and provide timely feedback to students, thereby fostering deeper understanding and mastery of scientific principles. Moreover, blended learning facilitates student-centred approaches to learning, empowering learners to take ownership of their learning journey, engage in self-directed inquiry, and collaborate with peers to construct knowledge collaboratively.

There are many expectations from the Science classrooms to meet with technology development, thus different countries presently seek means to develop their education to meet with the dynamism of contemporary world. Blended learning offers a promising solution by seamlessly integrating face-to-face instruction with digital resources, interactive simulations, virtual laboratories, and collaborative online platforms, thereby enriching the learning experience and empowering students to explore scientific concepts in a dynamic and interactive manner.

Generally observed also, is the under-placed attitude towards Science learning among the Youth. It has been observed that students, especially in developing Countries, avoid learning Science. Researchers' findings of students learning view Science as uninteresting and difficult compared to the learning of Social Sciences and Arts subjects. There is reduction in students' interest towards Science, and this has affected attitudes and performances in Science subjects (Olu-Ajayi, 2017). In this article, we explore the application of blended learning strategies in the context of science education, aiming to elucidate its potential benefits, challenges, and best practices for educators and learners alike.

Financing Science Education in Developing Countries according to Marinna, Firth et. al. (2015) is also an issue needing attention. Innovations in Science education is now being welcome for the development of students'

interest in Science through activity based learning (UNESCO, 2020). The avoidance of the use of computers in recent time is not feasible. However the combine use of computer with traditional instruction can motivate the required interest and participation of students towards learning Science.(Beams, 2017; Akyol & Garrison, 2011).

Thus a paradigm shift in Science Education, from traditional 'face to face' chalk and talk method, to a better students' engaging one through e-learning, becomes necessary in order to meet the high expectations from the Science classrooms (Garrison, 2016; Bates, 2015; Chakraborty & Nafukho, 2015; Chen et.al. 2005).

However, the successful implementation of blended learning strategies in science education requires careful planning, thoughtful design, and ongoing support from educators, administrators, and stakeholders. Various challenges, such as digital equity, technological infrastructure limitations, and teacher professional development must be addressed to ensure equitable access to blended learning opportunities and support educators in effectively integrating technology into their teaching practices.

Moreover, considerations surrounding curriculum alignment, assessment practices, and pedagogical approaches necessitate careful attention to ensure that blended learning experiences are aligned with learning objectives and promote meaningful learning outcomes. This article hopes to explore the key components of a blended learning strategy for the teaching and learning of science. By examining the potential benefits, challenges, and considerations associated with blended learning in science education, it aims at providing educators with actionable recommendations for leveraging this innovative instructional model to enhance student engagement, promote scientific inquiry, and foster a deeper understanding of scientific concepts. Ultimately, the article purpose is to empower educators to embrace blended learning as a transformative tool for enriching science education and preparing students for success in the 21st-century knowledge economy.

What is Blended Learning?

Blended learning is an education strategy that features multiple teaching methods to help students learn more effectively than one method on its own. In most cases blended learning combines a mix of traditional classroom instruction and digital learning. Researchers have it that, Blended learning, also known as technology-mediated instruction, web-enhanced instruction, or mixed-mode instruction, is an approach to education that combine online educational materials and opportunities for interaction online with physical place-based classroom methods (Lothridge, Karen et. al. 2013; Bonk & Graham, 2012). Blended learning is an emerging paradigm in Science Education, but has not been rigorously assessed especially in African Countries (Marrinan, Firth et. al., 2015) BL can be described as a type of learning which gives the learner opportunity to learn,

using both face-to-face and online technology. It has been defined by Stockwell et. al. (2015); Graham, et. al. (2013) as a cohesive blend of instruction, which is usually formal, and involve in-person and online learning having some element of learners' control over location, time, pace and or direction.

A study defined blended learning as a mixture of online and in-person delivery, a concurrent form of instruction delivery, where the online part effectively take up some of the face-to-face contact time rather than supplementing it (Lothridge, Karen, et. al. 2013). BL is an educational strategy that combines conventional education with online learning. For example, someone could take an online course to learn the basics of a topic but then attend an in-person seminar to engage with experts and up their skills directly. It is an educational strategy that combines conventional with online learning.

In blended learning, students attend schools, with teacher's presence, and the face-to-face classroom practices are combined with computer-mediated activities with consideration to content and delivery (Strauss, 2012). A student could take a course online to learn the fundamentals of a subject topic and concurrently attend in-person class to learn from experts. BL can also be used in professional development and training settings (Lothridge, Karen; et al. 2013). The process of Blended learning combines personalised learning with differentiated instruction (Saritepeci, et al., (2015).

Blended Learning is designated by the range of learning possibilities presented by combining Internet and digital media with established classroom forms that require the physical presence of teacher and students Friensen (2012). BL is gaining popularity in the recent times in African countries as notably transition is recorded in the personal as well as professional life in the wake of Covid 19 pandemic. Education sector of the economy, in order to move forward will need to adopt blended learning as an educating strategy.

Challenges of Blended Learning

Despite the promising potentials of blended learning strategies in science education, there are impinging challenges that needs to be addressed in order to ensure effective implementation and maximization of its benefits for both educators and learners, these include:

Digital Divide: Disparities in access to technology and internet connectivity among students and schools pose a significant barrier to the adoption of blended learning strategies. Students from underserved communities or regions with limited technological infrastructure may lack the necessary resources to fully participate in online learning activities, hindering their ability to benefit from blended learning approaches.

Technological Infrastructure: The effective implementation of blended learning requires robust technological infrastructure, including reliable internet

connectivity, adequate hardware and software resources, and technical support systems. However, many educational institutions, especially those in rural or economically disadvantaged areas, may lack the necessary resources and infrastructure to support seamless integration of technology into teaching and learning practices.

Teacher Professional Development: Educators play a crucial role in the successful implementation of blended learning strategies. However, many teachers may lack the necessary training, skills, and confidence to effectively integrate technology into their teaching practices. Professional development programs tailored to the specific needs of educators are essential to ensure that they are equipped with the knowledge and competencies required to leverage blended learning effectively.

Curriculum Alignment: Blended learning approaches must be aligned with curriculum objectives and learning standards to ensure that they support the attainment of desired learning outcomes. However, integrating technology into existing curricula and instructional practices may require careful planning, collaboration among stakeholders, and ongoing evaluation to ensure coherence and effectiveness.

Pedagogical Considerations: Effective implementation of blended learning requires careful consideration of pedagogical approaches, instructional design principles, and student engagement strategies. Educators must balance traditional face-to-face instruction with online learning activities in ways that promote active learning, collaboration, and critical thinking skills development while addressing individual student needs and learning preferences.

Addressing these challenges requires a multifaceted approach that involves collaboration among educators, administrators, policymakers, and technology providers. By addressing issues related to digital equity, technological infrastructure, teacher professional development, curriculum alignment, and pedagogical considerations, it is possible to overcome barriers to the effective implementation of blended learning strategies in science education. Ultimately, by harnessing the potential of blended learning, educators can create dynamic and engaging learning environments that empower students to explore scientific concepts, foster curiosity and inquiry, and develop the skills needed to thrive in the 21st-century knowledge economy.

Purpose of the Study

The purpose of this study is to investigate the potentials of blended learning strategies in addressing the challenges and enhancing the effectiveness of science education. Specifically, the study aims to:

i. Examine the Efficacy of Blended Learning: Evaluate the effectiveness of blended learning approaches in science education by assessing their impact on student engagement, academic achievement, and attitudes towards science learning. This involves conducting a comprehensive review of existing literature, research studies, and empirical evidence on the outcomes of blended learning implementations in science classrooms.

ii. Identify Best Practices and Implementation Strategies: Identify best practices and effective implementation strategies for integrating blended learning into science education. This includes exploring innovative pedagogical approaches, technological tools, and instructional design principles that optimize the blended learning experience and promote positive learning outcomes for students.

iii. Address Challenges and Barriers: Identify and address challenges and barriers to the successful implementation of blended learning strategies in science education. This involves examining issues related to digital equity, technological infrastructure, teacher professional development, curriculum alignment, and pedagogical considerations, and proposing actionable recommendations for overcoming these challenges.

iv. Explore Opportunities for Innovation: Explore opportunities for innovation and improvement in science education through the integration of blended learning strategies. This includes investigating emerging technologies, pedagogical models, and instructional practices that have the potential to enhance student engagement, promote inquiry-based learning, and foster deeper understanding of scientific concepts.

v. Inform Policy and Practice: Provide insights and evidence-based recommendations to inform policy-making processes, educational reforms, and instructional practices in science education. By synthesizing research findings, practical insights, and best practices, this study aims to contribute to the development of guidelines, standards, and initiatives that support the widespread adoption and effective implementation of blended learning strategies in science classrooms.

This study roundly proposes to advance our understanding of the role of blended learning in science education and its potential to enhance student learning outcomes, promote scientific literacy, and prepare students for success in the 21st-century knowledge economy. By investigating the efficacy, best practices, challenges, and opportunities associated with blended learning in science education, this study seeks to empower educators with the knowledge and tools needed to leverage blended learning effectively and create dynamic and engaging learning environments for their students.

Requirements for implementing blended learning initiatives

Factors that influence the design of blended learning programs are observed to include teachers, technology, individual learning styles, and desired

outcomes for learning. A key challenge is to adapt to the blended learning environment, which requires learners to have a high level of self-regulation, responsibility, and digital literacy. Learners need to be able to plan, monitor, and evaluate their own learning, as well as to use the online platforms and tools appropriately (Barak & Zuckerman, 2020).

Competence, motivation and discipline are required of students to complete a fully virtual, online program, which is not applicable to all students. Nevertheless, the blended learning solutions present a pleasant combination of traditional classroom learning with an online component part (Vallee et.al., 2020). To ensure a successful implementation of BL, some requirements that needed to be considered includes; basic infrastructure issues like broadband which ensure internet connectivity speed; power that ensure constant operation of the computers networking equipment management; these are necessary for Technology is dynamic and management of facilities, for there may be need for structural adjustment of facilities (Ferreira-Meyers, 2019; Baldwin-Evans, 2006; Garrison & Vaughan, 2008). Some significant challenges to blended learning models also include the expense of technology, inadequate training, technological issues, the need to adapt content for blended learning, decreased motivation, and weakened relationships between students and teachers. School enrolment should be also considered in order to align with the capacity requirement of facilities (Cleveland-Innes, 2017; Ferreira-Meyers, 2018).

To redeem the challenges, there is the need for the teacher to always **a**lign the goals and methods of teaching, balance online and offline elements., communicate the expectations and instructions, engage learners and foster interaction, also evaluate course and seek feedback.

Advantages of BL in the African/Nigerian schools

Blended learning offers personalized instruction. Teachers can have time to attend to students individually, contrary to the 'one teacher faces all students' style of conventional teaching method where a teacher teaches in front of the classroom, carrying everyone along at the same pace. The teachers may streamline instructions to assist individual students to reaching full potential (McGee & Reis, 2012; Means, et. al. 2009; Pappas, 2015). It improves student motivation and performance, promotes participation, self-learning and teamwork, opens new forms of interrelation between teachers and students, allows greater flexibility, boosts digital intelligence and the acquisition of digital skills (Barak & Zuckerman, 2020).

BL permit students to work at their own pace, ensuring they understand a new concept before proceeding. However the teacher using BL is required to offer a form of initial program orientation to students, before introducing BL strategies, to build students' confidence in navigating the different components and developing a stronger sense of independence (Cleeveland-Innes, 2017). The teacher must effectively address a range of learning styles in a variety of settings

and situations. Blended learning can help personalize education for each of the unique students you teach, while making lessons more effective. Costs of learning materials can also be reduced when blended learning is used. By putting classrooms in the online space, pricey textbooks are replaced by e-textbooks, which can be digitally accessed. Blended learning is a significant way to enhance student learning outcomes and cater to various types of learners. The opportunity for data collection and the customization of instruction and assessment are two major benefits of this approach.

Although, there are some argument that physical classroom learning is less expensive than blended learning (Alexander, 2010). Often, Blended learning includes software that are capable of collecting students' data and calculating academic progress automatically, and enable teachers, students and parents have access to detailed students' data. It automatically score tests and give an immediate feedback.

However, BL has some disadvantages which according to researches include a possible lack of motivation to engage in technology, a temporary increase in the workload during the transition phase), a requirement for basic technical knowledge, and the plagiarism/credibility problem (Yul, 2020; Voogt et. al. 2018; Lee, 2022). Access to technology and reliable internet is necessary for blended learning, lack of which could be a barrier for some students. Self-discipline is required of student in a reduced face-to-face interaction. An example of Blended Learning is the modular distance learning adopted by the Department of Education in the Philippines which has several disadvantages with the challenges faced by teachers to include technical problems, distribution and retrieval difficulties, student utilization issues, and unreliable assessment results (Tanucan, Alejandro., & Corcino, 2023; Abbas, 2021). Students also encounter challenges such as struggles with self-learning, limited contents of the module, poor access to the internet, and lack of vocabulary and grammatical knowledge . Additionally, there are credibility issues in answering activities in the worksheets, negative perceptions of students towards teachers' feedback, and too many workloads affecting the consistency of module release and retrieval.

The modular distance learning approach may also lead to a lack of student motivation and the inability to express ideas effectively. Despite these challenges, it was discovered in the studies of Tanucan, Alejandro., & Corcino (2023); Abbas (2021) that in modular distance learning can be an efficient alternative to traditional face-to-face education, especially during the times of crisis.

Significance to Science Learning

Science learning is activity based and students are supposed to be interested and actively engaged in a participatory class to enable learning and retention. Attributes of some excellent BL programs include; "facilitating student learning, communicating ideas effectively, demonstrating interest in learning,

organizing effectively, showing respect for students, and assessing progress fairly". Blended instruction is reportedly more effective than purely face-to-face or purely online classes; there is the possibility of quick high level students' achievement rate in Blended learning when compared with the conventional, face –to-face learning (Saritepeci, et al. 2015).

Blended learning enables students to personalise their work with new concepts. Schools with blended learning programs may also choose to reallocate resources to boost student achievement outcomes (Jacob, 2011). Blended learning is significant to quality students' learning as it maximise in-person opportunities and resources. BL can be for an improved personal and group learning, though there are setbacks that the developing Countries of the world need to consider. Reflections on the use of Blended Learning revealed three important outcomes; increased engagement, accountability, and adaptability that may inspire teachers across all curriculums and across grade levels to incorporate blended learning into their student-centred classrooms.

Hindrances to adoption of Blended Learning in Developing Countries

There are several hindrances to implementing blended learning. Some significant challenges to blended learning models include the expense of technology, inadequate training, technological issues, the need to adapt content for blended learning, decreased motivation, and weakened relationships between students and teachers. Proper funding is a main hindrance to BL in developing societies. Though BL offer students the ability to go online when the need arises and from anywhere, there is no guarantee of access to the tools needed by students to learn on the computer. Getting adequate funding to purchase computers is a main problem. Another problem that may arise is unreliable internet; this is also associated with finance and vital in the bid to incorporate Blended Learning into pedagogical strategy. The internet may be down most times, and when the students do not have access to the same tools, the teacher will be unable to keep the class on the same page. Thus a learning gap will be created within classrooms. Until the education system is able to ensure reliable internet and provide computers to all students, Blended Learning may not possibly be an effective alternative to conventional education.

Inconsistent power supply may sound elementary, but important when determining the feasibility of implementing Blended Learning. To implement BL, a classroom needs sufficient computers, which also require electrical power in order to operate. An extension cord with many linked cables can be an electrical hazard, which can cause fire outbreak and may not be appropriate. Unavailability of proper networking equipment and management is another hindrance. Wireless access points should be addressed as well as on-going and continuous network management, but due to cost of equipment and staffing, may be impossible.

Digital illiteracy can serve as a significant barrier for students attempting to get access to the course materials, thus making the availability of high-quality technical support paramount. There could be barriers related to technology; such as access, infrastructure, hardware and software issues. Difficulty in finding high-quality content and software programs that can be integrated well in the curriculum.

Improper Integration of Information Systems is another hindrance to successful Blended Learning. There should be provision of resources to integrate instructional systems with student information systems. A single sign into the system should be able to provide instructional content, opportunity for interaction, report generation, and grading capabilities which could be accessible by students, Educators and parents.

Conclusion

The significance of Blended learning to the teaching of Sciences cannot be over-emphasized. BL is a better alternative to conventional teaching method to engage multiple senses of students for a participatory Science class. It is capable of promoting students attitudes and performances by providing a computer enhanced active learning environment. Blended learning is gaining popularity in recent time as every aspect of personal and professional life transit to the online world in the wake of the COVID-19 pandemic. Moving forward, companies and other parties tasked with educating people will need to adopt a blended learning strategy to account for this shift. The use of Blended learning should be a welcome transformation for impartation of knowledge to students in science generally and those in other disciplines. It is thus concluded that the study on blended learning strategies in science education has shed light on the effectiveness, best practices, challenges, and opportunities associated with integrating digital technologies into the teaching and learning of science as stated below.

- Effectiveness of Blended Learning: Blended learning approaches have demonstrated promise in enhancing student engagement, academic achievement, and attitudes towards science learning. By combining face-to-face instruction with online learning activities, educators can create dynamic and interactive learning environments that cater for diverse student needs and preferences.
- Best Practices and Implementation Strategies: Effective implementation of blended learning requires careful planning, thoughtful design, and ongoing support for educators. Key best practices include leveraging technology to personalize learning experiences, promoting active learning strategies, and providing opportunities for collaboration and inquiry-based exploration.
- Challenges and Barriers: Despite the potential benefits of blended learning, challenges such as digital equity, technological infrastructure

limitations, provision and maintenance of power supply and teacher professional development remain significant barriers to implementation. Addressing these challenges requires collaborative efforts among educators, administrators, policymakers, and technology providers.

- Opportunities for Innovation: Blended learning presents opportunities for innovation and improvement in science education. Emerging technologies, pedagogical models, and instructional practices offer exciting possibilities for enhancing student engagement, promoting deeper learning experiences, and preparing students for success in the 21st century.

Recommendations to implementing Blended Learning for the Teaching and Learning of Science

Generally, there should be a move towards meeting with the basic requirements of using blended learning in schools; ICT literacy should be encouraged in schools, workshops and seminars on Blended learning should be organised for science teachers as well as those in other disciplines. Constant power supply is paramount and should maintain in schools. Furthermore, based on the conclusions drawn from the study, the following recommendations are proposed to support the effective integration of blended learning strategies in science education:

1. There should be tangible investments into Teacher Professional Development. Educators should be provided with ongoing professional development opportunities to enhance their skills and confidence in integrating technology into their teaching practices. Offer training programs, workshops, and mentorship opportunities focused on effective instructional design, digital literacy, and technological fluency.
2. Digital Equity Concerns should be addressed: Ensure equitable access to technology and digital resources for all students, regardless of socioeconomic background or geographical location. Invest in initiatives to bridge the digital divide such as; providing devices, internet connectivity, and technical support to underserved communities.
3. Collaboration and Knowledge Sharing should be encouraged: Facilitate collaboration among educators, researchers, policymakers, and technology providers to share best practices, resources, and innovative approaches to blended learning in science education. Foster communities of practice and online networks to support ongoing professional growth and knowledge exchange.
4. There should be emphasis on Pedagogical Innovation: Encourage educators to explore innovative pedagogical approaches, such as inquiry-based learning, project-based learning, and flipped classroom models, that leverage the affordances of blended learning to promote deeper understanding and engagement in science.

5. There should be provision of adequate support for research and evaluation: Invest in research and evaluation efforts to assess the impact of blended learning strategies on student learning outcomes, teacher practices, and institutional effectiveness. Conduct longitudinal studies, case studies, and action research projects to generate evidence-based insights and inform decision-making processes.

By implementing these recommendations, stakeholders can harness the potential of blended learning to enhance science education, empower educators, and prepare students for success in an increasingly digital and interconnected world. By embracing innovation, collaboration, and continuous improvement, we can create dynamic and inclusive learning environments that inspire curiosity, foster creativity, and cultivate lifelong learners in science.

References

1. *Abbas, K.D.A (2021). Factors influencing students reading comprehension difficulties amidst the use of modular distance learning approach in Mindanao State University Sulu - senior high school. Open access Indonesia journal of social sciences, 4(6), 581-602.*
2. *Akyol, Z. & Garrison, D. R. (2011). Understanding cognitive presence in an online and blended community of inquiry: Assessing outcomes and processes for deep approaches to learning. British Journal of Educational Technology, 42(2), 233–250.*
3. *Alexander, S. (2010). "Flexible Learning in Higher Education". In Penelope Peterson; Eva Baker; Barry McGaws (eds.). International Encyclopedia of Education (Third ed.). Oxford: Elsevier. pp. 441–447. ISBN 9780080448947.*
4. *Baldwin-Evans, K. (2006). Key steps to implementing a successful blended learning strategy. Industrial and Commercial Training, 38(3), 156–163.*
5. *Barak, M., & Zuckerman, O. (2020). Virtual labs in the online biology course: Student perceptions of effectiveness and usability. Journal of Science Education and Technology, 29(4), 618-630.*
6. *Bates, A. W. (2015). Teaching in a digital age: Guidelines for designing teaching and learning. Tony Bates Associates Ltd. Retrieved from: opentextbc.ca.*
7. *Beams, T. (2017, July 12). How to build a successful blended learning model. The Journal. Retrieved from: thejournal.com.*
8. *Bonk, C.J. & Graham, C.R. (2006). The handbook of blended learning environments: Global perspectives, local designs. San Francisco: Jossey-Bass/Pfeiffer. 5.*
9. *Chakraborty, M., & Nafukho, F. M. (2015). Strategies for virtual learning environments: Focusing on teaching presence and teaching immediacy. Internet Learning, 4(1), 2.*

10. *Chen, N. S., Ko, H. C., Kinshuk, & Lin, T. (2005). A model for synchronous learning using the Internet. Innovations in Education and Teaching International, 42(2), 181–194.*
11. *Cleveland-Innes, M. (2017). Facilitation and teaching presence: Using the community of inquiry in blended and online learning environments. Invited presentation.KTH Royal Institute of Technology, Faculty Development Course, Stockholm, Sweden.*
12. *Ferreira-Meyers, K.A.F.(2019). Book review: Guide to Blended Learning by Martha Cleveland-Innes with Dan Wilton. Journal of Learning for Development, 6(2) .*
13. *Friesen, Norm (2012). "Report : Defining Blended Learning"*
14. *Garrison, D. R. (2016). E-learning in the 21st century: A community of inquiry framework for research and practice. New York, NY: Routledge.*
15. *Garrison, D. R., & Vaughan, N. (2008). Blended learning in higher education. San Francisco, CA: Jossey-Bass.*
16. *Graham, C. R., Woodfield, W., & Harrison, J. B. (2013).A framework for institutional adoption and implementation of blended learning in higher education. The Internet and Higher education, 18, 4–14.*
17. *Jacob, Anna M (2011). "Benefits and Barriers to the Hybridization of Schools" (PDF). Journal of Education Policy, Planning and Administration. 1 (1): 61–82. Archived from the original (PDF) on September 27, 2013.*
18. *Jem Cloyd. M. Tanucan, Blanca A. Alejandro., & Roberto, B. Corcino (2023). Towards an enhanced implementation of printed modular distance learning in the Phillipines: a meta-synthesis. International Journal of learning teaching and educational research, 22(3),*
19. *Lee, Timothy (2022). "Blended (online and in-person) Women's Health Interprofessional Learning by Simulation (WHIPLS) for medical and midwifery students". ANZJOG, 62(4), 596-604.*
20. *Lothridge, Karen; et al. (2013)."Blended learning: efficient, timely, and cost effective". Journal of Forensic Sciences, 45(4), 407–416.*
21. *Marrinan, H., Firth, S., Hipgrave, D., & Jimenez-Soto, E. (2015). Let's take it to the clouds: The potential of educational innovations, including blended learning, for capacity building in developing countries. International Journal of Health Policy and Management, 4(9), 571. Retrieved from: www.ncbi.nlm.nih,gov .*
22. *McGee, P., & Reis, A. (2012). Blended course design: A synthesis of best practices. Journal of Asynchronous Learning Networks, 16(4), 7–22.*
23. *Means, B., Toyama, Y., Murphy, R., Bakia, M., & Jones, K. (2009). Evaluation of evidence-based practices in online learning: A meta-analysis and review of online learning studies. Washington, DC: US Department of Education.*
24. *Olu-Ajayi, F.E. (2017). Effects of Mentoring in the Utilization and Improvisation of Biology Learning Resources on the Performance of Senior*

Secondary School Students in South West Nigeria. European Scientific Journal, 4(13), 270-278. (Republic of Marcedonia)

25. *Pappas, C. (2015a). Synchronous vs asynchronous learning: Can you tell the difference? Retrieved from: elearningindustry.com.*
26. *Pappas, C. (2015b). The history of blended learning. Retrieved from: elearningindustry.com.*
27. *Strauss, Valerie (September 22, 2012). "Three fears about blended learning". The Washington Post.*
28. *Saritepeci, Mustafa. & Cakir Hasan,. (2015). "The effect of blended learning environments on student motivation and student engagement: A study on social studies course". Education and Science vol40,177 pg 203-216.*
29. *Stockwell, B. R., Stockwell, M. S., Cennamo, M., & Jiang, E. (2015). Blended learning improves science education. Cell, 162(5), 933–936. Retrieved from: www.sciencedirect.comscience.*
30. *UNESCO. (2020). Education for Sustainable Development Goals: Learning Objectives. unesdoc.unesco.org.*
31. *Vallee, A, Blacher, J, Cariou, A, Sorbets, E. (2020). Blended Learning compared to Traditional Learning in Medical Education: Systematic review and meta- analysis J Med Internet Res 22(8): e16504 0063*
32. *Voogt, J., Knezek, G., Christensen, R., & Lai, K. W. (2018). UNESCO ICT Competency Framework for Teachers (ICT-CFT). Educational Technology & Society, 21(3), 63-74. YUL (2020). Report York University Libraries*