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The role of teachers' fourth industrial revolution skills in promoting entrepreneurial development in school students

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Abstract

Teachers play an essential role in preparing students for the challenges of the Fourth Industrial Revolution (4IR). This study aimed to determine whether teachers' computer literacy and problem-solving skills are related to sustaining Junior High School (JHS) students' entrepreneurial skills in the 4IR. A mixed methods research design was adopted for data collection. Quantitative data were obtained from 800 randomly selected JHS students through questionnaires while qualitative data were collected through semi-structured interviews with eight purposively selected computer studies teachers from four JHSs in Osun and Ondo States of Nigeria. The quantitative data were analyzed using inferential statistics, while qualitative data were thematically analyzed. The study's findings suggest a positive correlation between teachers' computer literacy and problem-solving skills and sustainable entrepreneurial skills among Nigerian JHS students in the 4IR. The study discusses implications for adjustments in the JHS curriculum, teacher training, school partnerships with technology providers, and support from education stakeholders.

Keywords: Entrepreneurship; High School Education; Innovation and Development; Sustainability; Teacher Education; Technology

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1. Introduction

It is concerning that the majority of parents and guardians, particularly in Western Nigeria, enroll their children and wards in ongoing classroom instruction after they have passed the National Examinations Council's (NECO) Junior School Certificate Examination (JSCE), also called Basic Education Certificate examination (BECE). Most of the time, students lack the maturity necessary for autonomy and self-participation. They have not been able to demonstrate to their parents that they can function independently with little to no guidance. Parents and educators, especially teachers and school administrators, are to blame. In contrast, most parents in Eastern Nigeria enroll their children in trade schools or encourage them to train or do part-time jobs in areas such as fashion and design, catering, interior and outdoor decorations, woodwork, and ICT. The main goals are to occupy young learners' time, instill a sense of responsibility in them, and, most importantly, set them up for early financial independence and responsibility. These youngsters will become entrepreneurs after high school, despite the severity of poverty in Nigeria. Some choose to pursue further education immediately after high school, while others prefer to stay in their field of work and attend a higher institution later. These activities are taking place in the context of the Fourth Industrial Revolution (4IR), in which machines are more powerful and have better performance than people, enabling them to work faster and more efficiently.

It is imperative that teachers have the necessary skills to support Junior High School (JHS) students' entrepreneurial talents in the context of the 4IR. Teachers are essential in adequately preparing learners for the rapidly evolving nature of the future workforce. Students can acquire the skills they need to thrive in the digital age if teachers are equipped with the knowledge and resources to nurture entrepreneurial talents. Educational institutions should adapt so that the focus is shifted towards teaching sophisticated problem-solving abilities. These skills include social and creative skills, management, leadership, change management, teamwork, critical thinking, curiosity, risk-taking, communication, marketing, and sales—all essential for entrepreneurship (Naude, 2017). These “21st-century skills” are defined by the World Economic Forum (WEF, 2015) as non-routine analytical and interpersonal skills. In light of this, some specific actions that are required include: (i) starting with retraining teachers to transition from rote learning to problem-based learning and to teach economics and management, as well as entrepreneurship concepts, at all educational levels.

1.1. Literature review

The goal of entrepreneurial education is to cultivate an entrepreneurial attitude and the abilities and proficiencies required for innovation and entrepreneurship. It emphasises developing an entrepreneurial spirit, creativity, problem-solving skills, and a willingness to take chances, going beyond typical academic knowledge (Cho and Lee, 2018). The focus of entrepreneurial education is on experiential learning, where students are urged to see and seize opportunities, create company concepts, and take the initiative to see their ideas through to successful completion. Along with financial literacy and an awareness of market dynamics, it fosters critical thinking, flexibility, resilience, and effective communication (Murat, 2024). A degree in entrepreneurship equips people to be proactive, self-motivated, and adaptive in the cutthroat and quickly evolving world of today. It gives them the skills and information needed to launch their own businesses, support the expansion of already-existing ones, and promote economic growth and innovation. Educational institutions can enable students to become self-assured, inventive, and resourceful individuals who can shape

their own futures and make significant contributions to society by including entrepreneurial education into the curriculum (Von Graevenitz et al., 2010).

Upon reviewing the literature on entrepreneurship education, a number of problems arise. Subtopics of entrepreneurship education include the history of entrepreneurship education, innovations in entrepreneurship education, programs, teaching strategies, effects of entrepreneurship education, qualifications needed for success in entrepreneurship education, and policies related to entrepreneurship education (Murat, 2024). Research suggests that a range of pedagogical approaches can be employed in the instruction of entrepreneurship. Teaching strategies include case studies, group or individual projects, business simulations, internships, and entrepreneurship lectures. A hands-on method can be used in entrepreneurship education to impart skills that facilitate the realization of entrepreneurial concepts (Lyons et al., 2023).

This study is focused on Sustainable Development Goals (SDGs) 4 (quality education) and 9 (industry, innovation, and infrastructure [SDGs 4 and 9]. Accordingly, this research is in line with SDG 4 Target 4.4, which calls for the attainment of free and high-quality primary and secondary education by 2030, as well as a steady rise in the number of young people and adults with technical or vocational training for employment, respectable jobs, and opportunities for entrepreneurship (United Nations Resolution: Transforming Our World, 2015). Undoubtedly, SDG 9 centers on expanding the availability of ICTs and ensuring universal, reasonably priced internet access in the least developed nations by 2020 (United Nations Resolution: Transforming our World, 2015).

There is still a considerable amount of illiteracy among young people of all genders in developing and least-developed countries, despite the fact that the global action frameworks and dissemination of SDG 4 and its targets have produced impressive gains in developing nations (Willard and Halder, 2003; Hilty and Hercheui, 2010). Due to their teachers' continued skill development and lack of understanding, students in high schools have not yet benefited from the tremendous advances in ICT access and knowledge. Furthermore, people's socioeconomic growth can be enhanced by the appropriate adoption and deployment of digital capabilities (Botha, 2021).

This study was based on Ackerman's hypothesis of the determinants of skills development, which emphasises the connections between performance and skills (Ackerman, 1988). Ackerman's theory demonstrates how skills develop in stages. According to Ackerman's hypothesis of the determinants of skills acquisition (Ackerman, 1992), oscillations in the connection between performance and capability address three distinct task areas: the coherence of information processing requests, task complexity, and task practice degree. Ackerman's thesis is considered noteworthy in this context since it highlights the existence of personal barriers and facilitators to skill development. Ackerman's model illustrates variability in the relationship between abilities and performance; certain factors, like complexity, consistency, and motor demands, regulate these interactions, according to Anderson et al. (2021). According to Leithwood and Jantzi (1999), there is a clear relationship between school leaders' ability levels and how consistently they carry out their duties. Considering the aforementioned, school administrators' entrepreneurial abilities grow with time and regular practice. The dynamics of the process of developing entrepreneurial abilities are made clearer by Ackerman's theory. Students cannot effectively acquire new abilities unless they engage in such empirical activities (Ademola and Kathija, 2024).

Students pursuing undergraduate degrees, especially those in their first year, may be taught the competencies needed to achieve their learning objectives. Therefore, educational institutions have a responsibility to support the success of first-year students by teaching them what and how to learn, providing opportunities for growth and development, and equipping them with the necessary tools for the workforce post-graduation. This is crucial as long-term success and workforce readiness rely on students developing 21st-century skills (Rios et al., 2020). In the workplace, sectors and professions are becoming obsolete in an era defined by automation and artificial intelligence (AI), making it educators' responsibility to prepare students for the future workforce (Rampersad et al., 2019). According to Penprase (2018), higher education will be essential in shaping education for future industrial revolutions. Therefore, for students to adapt to upcoming changes, workforce reskilling must accelerate. Rethinking education programs is necessary to empower workers to solve problems and create solutions (Cabrita et al., 2020). Additionally, changes in digital communication will impact education, highlighting the need to respond to the power of technology. The world is undergoing radical change with no signs of slowing down. According to Gwata (2019), education serves as a foundation for employment and a way to build professional connections. Amidst these upheavals, challenges posed by digitization are evident. Individuals must have multidisciplinary expertise in their field and other subjects to succeed in the workplace, making them more valuable and well-rounded to potential employers. However, workers tend to value their skills more than employers do, who believe that soft skills are lacking (Tsirkas et al., 2020). Therefore, critical thinking, ethical reasoning, and intercultural awareness are crucial components of education (Penprase, 2018), enabling the intelligent use of emerging technology. Future literacy is recognized as a strategic skill empowering youth to drive change (Battistel et al., 2020).

Gray (2016) highlights ten skills essential for future problem-solving: emotional intelligence, judgment, service orientation, flexible reasoning, critical thinking, originality, people management, and collaboration. Cabrita et al. (2020) suggest that education 4.0 focuses on developing creativity, critical thinking, and other skills needed in a transforming society. Rodny-Gumede (2019) states that transferable skills have replaced industry-specific ones. Butler-Adam (2018) adds that literacy, numeracy, and understanding the 4IR period are essential for success in the workforce and society. Academic institutions play a crucial role in shaping the 4IR, empowering individuals in the process. Battistel et al. (2020) emphasize that future employees should possess proactive communication, digital skills, and holistic abilities.

Lieu et al. (2018) and Shaltry (2020) argue that a learner's professional skills are greatly influenced by the curriculum, emphasizing the importance of curriculum alignment to convey learning outcomes to external stakeholders. The WEF (2016) suggests new training strategies and educational curricula to prepare graduates for the 4IR age. Graduates need competencies to overcome challenges in this era. Skills are categorized into physical, cognitive, basic, process, and cross-functional skills (WEF, 2016). The general education curriculum emphasizes an interdisciplinary approach, teaching soft skills valued by employers and expanding knowledge across subjects (Ramraj and Marimuthu, 2021). It is crucial to acknowledge that a significant portion of the workforce may be overeducated but lack the necessary skills for their job (Hou, 2020).

Undoubtedly, Nigeria has a significant unemployment rate, particularly among young people aged 18-40. This age group includes recent high school graduates who are struggling to find employment. Unfortunately, private companies in Nigeria that require highly skilled workers have a higher employment rate. Unlike public companies, private companies often lack the funding needed to train new hires and prefer to hire individuals who are already skilled. As a result, many school dropouts come from low-income families and may not

immediately pursue higher education. Those who do often end up joining cults or other corrupt organisations, leading to increased crime, social instability, and a depletion of human capital.

It is crucial for all stakeholders in education, including students, parents, educators, school administrators, private and corporate organisations, concerned individuals, local communities, and all levels of the Nigerian government, to work together to improve the education system. Educating JHS students is the first step towards addressing unemployment.

In order to prepare young students for future employment or self-employment in the 4IR, Nigerian teachers need to develop sustainable entrepreneurship skills. This study aims to explore the connection between teachers' proficiency in the 4IR and their ability to teach JHS students sustainable entrepreneurial skills. By identifying areas where teachers may need additional support or training, we can better equip students for the modern workforce. The study raised the following research questions: 1) What is the relationship between computer literacy and sustainable entrepreneurial skills among JHS students in the 4IR? 2) What is the relationship between problem-solving skills and sustainable entrepreneurial skills among JHS students in the 4IR? The following hypothesis was generated and tested at a significance level of 0.05: *There is no significant difference in computer literacy, problem-solving, and sustainable entrepreneurial skills among Junior High School students in the Fourth Industrial Revolution (4IR) in Nigeria.*

2. Methodology

This study utilised a mixed-method approach, combining quantitative and qualitative research techniques to conduct a correlational survey. The researcher examined associations between the variables of 4IR teachers' skills and students' entrepreneurial skills and sustainability without manipulating or modifying any variables by using a correlational design. Additionally, the researcher collected and analysed numerical data from students using quantitative research methods. Subsequently, qualitative information was obtained from selected teachers to understand their familiarity with digital tools and how they could help students develop entrepreneurial abilities.

The study population consisted of all teachers and Senior Secondary one (SS1) student in Nigeria. The sample included eight (8) teachers and 800 SS1 students in Osun and Ondo States in Western Nigeria. Although Junior High School (JHS) students were the sample, SS1 students were chosen because they had recently completed their JSCE exams and were expected to have participated in entrepreneurial skills acquisition during the long holiday. The study utilised a multistage sampling technique. In stage one, Osun and Ondo States were selected as the researcher's working and residing locations. In stage two, one public and one private high school were randomly chosen from each state, totaling four schools. Simple random sampling was used to select a smaller sample size (two States) from the larger population (36 States in Nigeria). In stage three, 200 Junior High School (JHS) students were randomly selected from each of the four schools, totaling 800 students. In stage four, all two Computer Studies teachers were purposively selected from each of the four schools, totaling eight (8) teachers. The reason for selecting only eight Computer Studies teachers is that each JHS only has two teachers instructing the subject. However, the Computer Studies teachers were chosen purposively because the subject is essential for acquiring entrepreneurial skills in the 4IR. The total number of participants in the study was 808.

Two instruments were used for data collection. The first instrument was a 32-item self-designed "Students' Questionnaire on Entrepreneurial Skills Sustainability" with sections A, B, and C. Section A focused on computer literacy, section B on problem-solving abilities for sustaining entrepreneurial skills among JHS students in Nigeria, and section C on the relationship between 4IR teachers' skills and sustainable entrepreneurial skills among JHS students in Nigeria. Responses were scored on a three-point Likert scale: "Poorly Skilled" = 1, "Moderately Skilled" = 2, and "Highly Skilled" = 3. The questionnaire was validated by two research experts in educational tests and measurement. The experts' corrections and adjustments were incorporated to modify the instrument. Subsequently, the experts' judgment was used to validate the instrument for content validity, resulting in a content validity index of 0.81. The validated instrument was then trial-tested on 80 JHS students (10% of the sample) for internal consistency reliability, yielding a Cronbach's alpha coefficient of 0.88. This trial-testing allowed the researcher to identify areas of the questionnaire that needed modification and correction. Although the JHS students used in the trial testing were different from the main study sample, they provided valuable insights into the questionnaire in terms of knowledge and understanding. Data collection was conducted by the researcher with the assistance of three research assistants over two days. A spot method of data collection was employed, with copies of the questionnaire collected immediately after respondents indicated they had completed them. Instead of administering 800 copies of the questionnaire, 980 copies were distributed. During sorting, 180 copies of the questionnaire were discarded, and only the 800 correctly completed copies were selected and entered into the computer. Data was coded in Microsoft Excel. Pearson's Product-Moment Correlation (PPMC) analysis was used to answer research questions one and two, while Multiple Linear Regression (MLR) analysis was conducted for hypothesis testing using SPSS 29.

The second instrument involved semi-structured interviews with eight selected teachers to gather detailed information about the subject matter. Teachers were purposefully chosen based on their availability and willingness to participate. The interview data was analyzed manually using thematic coding. First, the researcher hired a transcriber to transcribed the responses of the interviewees. Second, the interviewees' responses were coded into different themes based on the research questions and the answers received. However, the interviews yielded comments classified into two themes: computer literacy among teachers and problem-solving abilities of teachers.

3. Results

The results of the study are presented below based on the identified research questions and hypothesis.

3.1. Research Question One: What is the relationship between computer literacy and sustainable entrepreneurial skills among JHS students in the 4IR?

To answer this question, scores from two variables (computer literacy and sustainable entrepreneurial skills) were correlated using Pearson's analysis. According to Cramer (1998), Pearson's r, which ranges from -1 to 1, represents the linear relationship between two interval or ratio variables. The benefit of utilizing Pearson's r is that it provides an easy method of determining how closely two variables are related, including how much they correlate, whether or not they share variance (covary), and whether the relationship is positive or

negative. One of the drawbacks of using Pearson's r is that it fails to identify nonlinear correlations and can display a correlation of zero when the correlation has a nonlinear relationship. Furthermore, only a restricted range of variable types are available for evaluation (Chee, 2015).

Table 1. Pearson product moment correlation between computer literacy skills and sustainable entrepreneurial skills of JHS students

Skills	Number of Participants	Mean ($\bar{X}$)	Standard Deviation	Pearson Correlation (r)	Level of Significance (p)
Computer literacy skills ability of JHS students	800	20.19	6.95		
Sustainable entrepreneurial skills ability of JHS students	800	16.85	5.88	.99	<.05

*** Correlation is significant at the 0.01 level (2-tailed). (Source: Author's Analytical Result)*

From the results of the Pearson Product Moment Correlation coefficient (r = 0.99) in Table 1, it is evident that there is a significant relationship between computer literacy ability and sustainable entrepreneurial skills among JHS students, as the p-value is less than 0.05. The Table also indicates a strong positive correlation between JHS students' computer literacy ability and sustainable entrepreneurial skills. This suggests that the more exposure JHS students have to computer literacy skills in the 4IR, the more their entrepreneurial skills will be sustained.

3.2. Research Question Two: What is the relationship between problem-solving skills and sustainable entrepreneurial skills among JHS students in the 4IR?

Similar to research question one, a Pearson's product-moment correlation analysis was conducted to provide an answer to the association between the two variables (problem-solving skills and sustainable entrepreneurial skills).

Results in Table 2 revealed a strong positive relationship (r = 0.97) between the problem-solving skills ability of JHS students and sustainable entrepreneurial skills at $p < 0.05$. This suggests that the higher the ability of JHS students in identifying, analyzing, and effectively solving problems, the more sustainable their entrepreneurial skills are.

3.3. Research hypothesis

There is no significant difference in computer literacy, problem-solving, and sustainable entrepreneurial skills among JHS in the 4IR in Nigeria. To test this hypothesis, scores from the two independent variables (computer

literacy and problem-solving skills) were correlated with the dependent variable (sustainable entrepreneurial skills) using MLR analysis. The coefficient of multiple determination (R^2) in a multiple correlation linear regression analysis indicates how much of Y is explained by all of the X's put together (Healey, 2015). The R^2 measures the percentage of the variance in Y (the dependent variable) that can be accounted for by all of the independent variables taken together.

Table 2. PPMC between problem-solving skills and sustainable entrepreneurial skills of JHS students

Skills	Number of Participants	Mean ($\bar{X}$)	Standard Deviation	Pearson Correlation (r)	Level of Significance (p)
Problem-solving skills ability of JHS students	800	16.7113	5.79395		
Sustainable entrepreneurial skills ability of JHS students	800	16.85	5.88	.97	<.05

*** Correlation is significant at the 0.01 level (2-tailed). (Source: Author's Analytical Result)*

Table 3. MLR analysis of teacher skills in computer literacy, problem-solving, and sustainable entrepreneurial skills

Variable	R^2	F-Statistic	Unstandardized Coefficients		Standardized Coefficients Beta	Level of Significance
			B	Standard Error		
Sustainable entrepreneurial skills			-.216	.072		.003
Computer literacy skills			.655	.012	.774	.000
Problem-solving skills	.988	31695.346	.230	.014	.227	.000

a. Dependent Variable: Sustainable entrepreneurial skills of JHS students

b. Predictors: (Constatnt), Problem-solving skills of JHS students, computer literacy skills of JHS students

The results in Table 3 showed that 98.8% (R^2 = 0.988) of the dependent variable (sustainable entrepreneurial skills) was explained by the independent variables (computer literacy and problem-solving skills). The large F-statistic value (31695.345) for the R^2 demonstrates that the regression model effectively explains the variation in the dependent variable. Additionally, the statistical significance level of the dependent variable is .003 (at $p < .05$), while the statistical significance level of both independent variables is .000 (at $p < .05$). These results suggest that overall computer literacy and problem-solving skills are correlated with sustainable entrepreneurial skills among Nigerian JHS students in the 4IR.

4. Discussion

4.1. Discussion from Quantitative Study

Discussions are based on the findings from the two research questions and hypothesis guiding the study. This section of the study discusses the extent to which computer literacy and problem-solving abilities are related to the entrepreneurial skills of Nigerian JHS students for sustainability in the 4IR.

According to the first research question, there is a significant correlation between Nigerian JHS students' entrepreneurial skills and their computer literacy in the 4IR. The more JHS students engage with computer literacy in the 4IR, the longer they maintain their entrepreneurial abilities. However, it is a collective effort of all stakeholders in education including, parents, guardians, teachers, school administrators, government, civil society organizations, and other concerned citizens of Nigeria to promote this achievement in the students. The article comes at a time when computer science as a discipline is no longer considered relevant for job opportunities in Nigeria. Consequently, computer literacy can be self-learned from any part of the space without instruction from a teacher or instructor. However, poor electricity, high cost of ICT facilities and internet services, and poverty have caused prolonged hindrances toward computer literacy among high school students. While the majority of them are willing and eager to explore the internet for entrepreneurial knowledge (computer literacy), they do not have access to computers and internet connectivity, coupled with an epileptic power supply in the country. Additionally, the students are disappointed as encouragement from the school and home environments towards computer literacy is minimal. For instance, the majority of teachers and school leaders in Nigeria only provide few computers in the computer lab. As a result, five students or more take turns (perhaps one minute per student) in using one computer during practical computer studies. Some high schools in Nigeria do not even have computer labs, and those that do often do not equip them with computers. Apart from a few five-star high schools in Nigeria, there is very poor access to internet connection and facilities to encourage students and teachers in their venture for computer literacy. While it is normal to prohibit JHS students from bringing phones and other ICT facilities to school, teachers continuously subscribe for data for internet access. However, the majority of Nigerian teachers in private and government-owned schools are very poor due to low remuneration. Consequently, while access to food, shelter, and payment of school bills is prioritized among teachers, subscription to data and payment of electricity bills become trivial. Rios et al. (2020) state that computer literacy skills are essential for students' growth in the twenty-first century as they support long-term success and workforce readiness, which is consistent with this study's findings. The results also align with Rampersad et al. (2019), who argue that educators must equip students for the future labour force in an automated and artificial intelligence society. Cabrita et al. (2020) emphasize the importance of developing creativity, critical thinking, and adaptability in students to thrive in a transforming society. Penprase (2018) confirms that workforce reskilling will be crucial for students to adjust to changes in the 4IR.

The results of the second research question demonstrate a significant positive correlation between sustainable entrepreneurial capabilities and problem-solving abilities among JHS students. The study suggests that the more effectively JHS students maintain their entrepreneurial skills in the 4IR, the better they become at reqcognizing, analyzing, and solving challenges. Problem-solving has always been and continues to be a crucial skill in every profession or business, particularly in the 4IR era where humans are working alongside machines. To succeed as an entrepreneur, one must be adept at problem-solving and meeting the needs of

others. Students represent the future of entrepreneurship, making problem-solving skills essential for their growth and development. It not only ensures their path forward but also contributes to sustainable development. This finding is in line with Cabrita et al. (2020), who advocate for educational systems that enable students to innovate and create solutions. Gwata (2019) highlights the role of education in fostering entrepreneurial abilities and workplace relationships. Penprase (2018) stresses the importance of critical thinking, ethical reasoning, and intercultural understanding in education. Gray (2016) and Cabrita et al. (2020) both emphasize the need for problem-solving abilities in the future.

The study's results supporting the hypothesis demonstrate that among Nigerian JHS students in the 4IR, general computer literacy and problem-solving abilities are correlated with sustainable entrepreneurship capabilities. The relationship between problem-solving and computer literacy cannot be over stated. Computer studies deal with the study of solving problems. It is one of the subjects that expose children to problem-solving, beginning with games, cartoons, movies, and so on. Children spend most of their time imitating what they have learned on the computer and internet, applying them to solve problems in their immediate environment, including school, home, religious places, and so on. The Secondary Education Management Board (SEMB), NECO, curriculum planners, and high school leaders have failed in designing a curriculum that holistically supports entrepreneurship for JHS students after the BECE. The external examination, conducted by the State Ministry of Education for students in their final year of JHS is used for transitioning from JHS 3 of the basic education class to senior secondary school. The students write the examination in May/June in Nigeria, and have a long vacation of three months. A poor curriculum implemented in an unhealthy environment that does not support entrepreneurship and sustainable education contributes to demoralizing parents from engaging their children/wards meaningfully during the holiday. Instead, they prefer to send them to school lessons where they learn the old things they are used to. While the majority of children in this category are ready to learn a soft skill (e.g., problem solving), poverty is another factor that undermines their ambition, as their parents/guardians cannot afford to pay for them to register online or physically learn basic computer literacy skills. Examples of computer skills include coding, basic database management, graphic design, website development, video editing, manipulating spreadsheets via Microsoft Excel, managing and networking on social media, web conferencing via Zoom or Microsoft Teams, and so on. The findings align with Rodny-Gumede's (2019) hypothesis that young people possess transferable skills rather than industry-specific ones. Butler-Adam (2018) argues that youths need essential skills like reading, numeracy, and an understanding of the 4IR for sustainability in their roles as students, workers, or members of society.

4.2. Findings from Qualitative Study

The findings from the qualitative data collected through semi-structured interviews with teachers are presented in themes as identified below.

4.2.1. Theme 1: Computer Literacy among Teachers

The report of teachers suggests that sustaining entrepreneurial skills among JHS students is highly needed in Nigeria in the 4IR, and such can be achieved through computer literacy skills among teachers. Some of the responses of the interviewed Nigerian JHS teachers are presented below:

Participant 1 in school 1 expressed that:

"I am not proficient in using computers. In my school, all the teachers handwrite and submit their lesson notes in hard copies. My school does not have Wi-Fi. I source information via my cell phone. Really! The JHS students need entrepreneurial skill sustainability. This can only happen if and when the teachers are computer literate skilled or reskilled."

Participant 2 in school 1 responded that:

"Speaking of entrepreneurial skills sustainability among JHS students, it is a very good thing. After all, if both teachers and students become computer literate, it makes teaching and learning easier and faster. However, in my school, we use both chalk and marker to write on the board. Except in the school hall, there are no projectors in my school. We do not have Wi-Fi for internet connection at my school. We do not have a computer laboratory at my school. Internet connection at my school is very poor."

Participant 3 in school 2 responded that:

"My school has a computer lab that accommodates over 50% of students at a time. We have Closed-Circuit Television (CCTV) cameras in my school. The majority of our teachers and JHS students are computer literate. Teaching and learning computer studies in my school is not a stress at all."

Participant 4 in school 2 reported that:

"Frankly speaking, my school is one of the five-star high schools in the State. We have internet facility at my school. The owners of the school are in partnership. My school is like home. With the high internet connectivity at my school, computer practical teaching and learning is made easy."

Participant 5 in school 3 claimed that:

"Although my school is newly established, there are no internet facilities, electricity, and the school building is still under construction. Computer literacy among teachers and students, especially those in the JHS, is a welcoming idea. Unfortunately, I am not tech-savvy enough. The majority of the teachers in my school do not seem to be computer literate. It is affecting the students negatively."

Participant 6 in school 3 claimed that:

"Computer teaching is theoretical in my school. I wish the government can lend some support to school owners. It is not easy for them considering the high cost of transportation, building materials, general inflation in the country. After all, they are assisting the government with employment supply. Yes, teachers and students need computer literacy skills to enable them to develop their entrepreneurial skills in the current 4IR."

Participant 7 in school 4 claimed that:

> *"Yes, I have computer literacy skills. I have the skills of browsing the internet to access information for my learners. I can use any application that is useful for teaching and learning my subject. I can use many programs in ICT. I can use any design available in my school. I can install or uninstall any software application on any device. I can use MS Word, PowerPoint, Excel, and even CorelDraw. I can code. Computer literacy makes my teaching easier. I do home coaching for students. Some of the JHS students at my school are very good in coding. They are empowered."*

Participant 8 in school 4 also supported that teachers need to possess computer literacy skills to enable entrepreneurial skills sustainability among JHS students in the current 4IR. According to the participant,

> *"I do have ICT skills but I still need a workshop of how to effectively use the internet and academic electronic databases. I can create slides for learners. It makes learning easier as you display it to learners while teaching. And learners who are not in class can also benefit. In today's 4IR, coding is common among young learners. When teachers are trained for free, they pass on learning freely to their students. Developing entrepreneurial skills among JHS students in the 4IR in Nigeria is a welcoming idea. We need to catch them young."*

The qualitative findings based on the first research question show a lack of computer literacy among Nigerian teachers in the 4IR. While the majority of computer studies teachers have access to smartphones and can retrieve information through them, they lack access to desktop computers and laptops. Often, these teachers do not see the necessity of having computers and related facilities. This is due to the high cost, lack of mobility, and poor electricity supply in the Nigerian academic environment. Schools are unable to provide computers or internet facilities, and most selected schools lack computer laboratories. As a result, the teaching and learning of Computer Studies in the 4IR has shifted from being practical-oriented to theoretical. The teachers are not updated with recent computer software and applications, highlighting a need for training and retraining. The study suggests that Nigerian Computer Studies teachers are willing to receive training and sponsorship to better equip students with computer literacy entrepreneurial skills in the current 4IR.

The study aligns with previous research by Cho and Lee (2018), emphasizing the importance of entrepreneurial education in fostering an entrepreneurial mindset and necessary competencies for innovation and entrepreneurship. Educational institutions can play a crucial role in empowering students through entrepreneurial education, enabling them to contribute significantly to society. The study also supports the idea of implementing entrepreneurship education in a hands-on manner to develop skills that support entrepreneurial ambitions. Additionally, the study resonates with SDG 9 of the United Nations (2015), which advocates for expanding access to ICTs and providing affordable internet access in the least developed nations by 2020.

4.2.2. Theme 2: Problem-solving Abilities of Teachers

Responses from the participants indicate that problem-solving skills are crucial for driving entrepreneurial skills sustainability among JHS students in the 4IR in Nigeria. The reports from the interviewed Nigerian JHS teachers on theme 2 are presented below:

Participant 1 School 1

As a computer studies teacher, I have observed a strong connection between problem-solving, computer literacy, and entrepreneurial skills. Developing problem-solving skills is essential for students to excel in entrepreneurial endeavours, such as coding, which requires computer literacy.

Participant 2 School 1

Computer studies can enhance critical thinking skills and problem-solving abilities in students. Workshops on soft skills development, including problem-solving, are necessary to equip students for the future.

Participant 3 School 2

I emphasize the importance of identifying unknowns in problems and use visual aids to facilitate learning. Building a strong teacher-student relationship enhances sustainability in learning.

Participant 4 School 2

Teachers at my school receive training in soft skills, including problem-solving. I guide students in using appropriate methods to solve complex problems, fostering entrepreneurial skills early on.

Participant 5 School 3

Despite heavy workloads, assigning challenging problems as homework can help students develop problem-solving skills essential for entrepreneurship.

Participant 6 School 3

Time constraints can hinder effective problem-solving teaching. Breaking down difficult problems and providing step-by-step guidance is crucial for students' development.

Participant 7 School 4

Teachers should possess deep knowledge of computer applications and problem-solving strategies to promote entrepreneurial sustainability among students.

Participant 8 School 4

Encouraging students to explore different strategies and persevere in problem-solving can enhance sustainability in learning. Reskilling teachers in problem-solving is essential for fostering entrepreneurial skills among students.

This finding suggests that Nigerian Computer Studies teachers in the selected schools are aware that problem-solving skills are a significant teacher skill necessary for driving entrepreneurial skills sustainability among JHS students in the current 4IR. However, improvement in problem-solving skills through workshops and symposia is not encouraged among the teachers. Problem-solving skills entail strategizing the right

approach in solving difficult problems for students. Unfortunately, teachers are not motivated with incentives, welfare, and remunerations. Therefore, they leave the students to develop individual strategies towards solving difficult problems.

Ackerman's (1992) theory of determinants of skills development, which elucidates the dynamics of the process of developing entrepreneurial abilities, is supported by this study. Additional evidence for the notion came from Ademola and Kathija (2024), who added that these kinds of empirical engagements are crucial for students to acquire skills effectively. This research also supports the findings of Battistel et al. (2020), who stress the need for students to be proactive communicators in 2030 and to possess digital skills such as production automation and marketing, in addition to other holistic and multidisciplinary abilities for sustainability.

5. Conclusion, recommendations, and limitations of the study

5.1. Conclusion

The study concluded that teachers can enhance the learning process by utilizing targeted tactics and interventions based on their own skills, such as computer literacy and problem-solving abilities, to support students' entrepreneurial development. This approach can better prepare students to navigate the challenges of the 4IR and beyond. Recognizing that young learners are the future entrepreneurs, instilling effective problem-solving strategies and computer literacy in Computer Studies can lay the foundation for sustainable entrepreneurship in the Nigerian economy. Entrepreneurship is closely tied to self-reliance and independence in establishing and maintaining future businesses. It is a collective responsibility for all education stakeholders, including parents, teachers, school leaders, administrators, philanthropists, students, and the government, to engage and support students from a young age. Collaboration is essential to ensure success.

5.2. Recommendations

Based on the findings of the study, the following recommendations are made:

- The inclusion of Culture and Creative Arts (CCA) in the Nigerian basic education curriculum is well appreciated by all stakeholders in education. However, alongside the CCA program, curriculum planners should incorporate compulsory training in computer skills for all JHS 3 students during their long vacation after their participation in the BECE.
- In Nigeria today, private schools accommodate over 70% of students in primary and secondary education. However, the government and other concerned stakeholders should where necessarily support or improve teacher training programs in computer literacy by making funds accessible to private school owners, or donating ICT facilities to them.
- The majority of schools in Nigeria, especially in rural areas, lack computer labs and ICT facilities. However, school leaders and the Nigerian government should put political sentiments aside, while focusing on implementing ICT infrastructure in under-resourced schools in local areas.

- Entrepreneurship is all about partnership, which is the focus of this study. Therefore, school leaders and the government should endeavor to foster partnerships between schools and technology providers. This would encourage support for access to internet facilities such as WiFi, computers, smart boards, projectors, etc.
- All secondary school teachers, including computer studies teachers should be self-motivated in prioritizing computer literacy. Although funding may be challenging, they should make themselves available for learning or investing part of their meager income in computer skills such as coding, basic database management, graphic design, and so on. Knowledge in these skills is very lucrative in the 4IR, and can serve as a side hustle for teachers to earn more income to augment the poor salary.

5.3. Limitations of the study

In contrast, the study was limited to two Southwestern states out of a total of 36 states in Nigeria. Therefore, it is recommended that a similar study comparing high schools in Nigeria's Northern and Southwestern states be conducted. Additionally, only a small sample of eight teachers was utilized in the study. It is suggested that future studies should use a larger sample of teachers, including computer studies teachers, and teachers from other subjects, to confirm and generalize the findings more broadly.

Conflict of Interest Statement

The authors have not declared any conflicts of interest.

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Appendix

Students' Questionnaire on Entrepreneurial Skills Sustainability

S/N	Statement	Poorly skilled	Moderately skilled	Highly skilled
Computer Literacy among Students				
1	I am proficient in using computers.			
2	I do my difficult homework on the computer			
3	I do my difficult homework on the phone.			
4	My teacher uses chalk to write on the board.			
5	My teacher uses markers to write on the board.			
6	There is no projector in my classroom.			
7	My school has a computer lab that accommodates 25% of students at a time.			
8	I bring a laptop to school for my computer class.			
9	In my school, only senior students are allowed to bring computers for their computer practical.			
10	I use the computer system provided by the school for my practical work.			
11	We do not have Wi-Fi for internet connection at my school.			
12	In my school, teachers sometimes provide online instruction.			
Problem-Solving Skills of Students				
13	I prefer solving easy problems.			
14	I prefer solving difficult problems.			
15	I may struggle with patience when faced with challenging tasks.			
16	My teacher encourages me to try different strategies and persevere when solving difficult problems.			
17	My teacher encourages me to leave difficult problems and move on to simpler ones if needed.			
18	My teacher assists me in choosing the best problem-solving strategy.			
19	My teacher ensures that students identify the unknowns in every problem.			
20	My teacher uses concrete examples, diagrams, and charts to illustrate ideas.			
21	My teacher emphasizes the importance of using appropriate units and symbols in problem-solving.			
22	Before tackling a problem, my teacher prompts students to consider the nature of the answer they are seeking.			
Sustainable Entrepreneurial Skills among Students				
23	In my school, entrepreneurship is compulsory for all junior students.			

24	In my school, you do not pay separately for entrepreneurship as the payment is added to the school bill.			
25	In my school, we do Computer Studies practical once every week.			
26	In my school, we do Home Economics practical once every week.			
27	My school's community bring people to do ICT practical for us every term.			
28	My school's community bring people to do Home Economics practical for us every term.			
29	To my parents, I do not need entrepreneurship now, I will learn it later.			
30	My parents registered me for entrepreneurial skill acquisition during the long holiday.			
31	I applied the knowledge I had from my teacher in my entrepreneurship skill acquisition during the holiday.			
32	Money was an issue as my parents could not afford to pay for me to learn entrepreneurship during the holiday.			