

BLENDING TVET WITH GREEN SKILLS TOWARDS PREPARING TECHNICAL EDUCATION STUDENTS FOR FOURTH INDUSTRIAL REVOLUTION (4IR) IN NORTH CENTRAL UNIVERSITIES IN NIGERIA

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Abstract

The study was objectively written to ascertain the green skills and Fourth Industrial Revolution (4IR) technologies required to be integrated with Technical Vocational Education and Training (TVET) in the North Central Universities. Descriptive survey research design was adopted for the study. Structured questionnaire was used to elicit response. 41 participants including nine curriculum experts, six HODs and 26 Lecturers were randomly selected from Federal University of Agriculture Makurdi, University of Jos and University of Ilorin. The questionnaire yielded a reliability of .84 using Cronbach's Alpha coefficient. Findings revealed three major groups of green skills required to be integrated into TVET curriculum; employee productivity skills, green technologies, and education skills. The fourth Industrial Revolution technologies included; artificial intelligence, internet of things, and 3D printing among others. It was concluded that Green skills are essential to ensuring a transition into a low-carbon economy and innovation of Fourth Industrial Revolution. To ensure the productivity of TVET graduates, green skills are needed for the current and future industry. It was recommended that policy makers should take the necessary actions such as promoting basic skills, and green skills so that well-equipped graduates can meet the challenges of sustainable development towards 4IR in their work place.

Key words: Green skills; Fourth Industrial Revolution; TVET; Green technologies; educational skill.

Introduction

As the Fourth Industrial Revolution (4IR) gathers pace, innovations are becoming faster, more efficient and more widely accessible than before. Technology is also becoming increasingly connected. In particular, a merging of digital, physical and biological realms is on the increase. New technologies are enabling societal shifts by having an effect on economics, values, identities and possibilities for future generations (Schwab, 2017). 4IR is characterized by a fusion of advances in artificial intelligence (AI), robotics, the Internet of Things (IoT), 3D printing, genetic engineering, quantum computing, and other technologies. It's the collective force behind many products and services that are fast

becoming indispensable to modern life collectively referred to as cyber-physical systems (McGinnis, 2018).

Fourth Industrial Revolution is different from the Third for two reasons: the gap between the digital, physical and biological worlds is shrinking, and technology is changing faster than ever. In extension, students, companies, governments and individuals are struggling to keep up with the fast pace of technological change (Lee, Yun, Pyka, Won, Kodama, Schiuma, and Yan, 2018). Characteristics of 4IR in view of ASSURESOF (2019) requires TVET students to acquire the relevant knowledge to enable their

fitness in this system otherwise they would lose their future Jobs. This paradigm shift calls for germane TVET curriculum in order to blend TVET with Green skills.

TVET plays a vital role in economic development of a country. According to UNESCO (2013); Nungse and Dung (2017), TVET is a comprehensive term referring to the study of technologies and related sciences, knowledge, skills and attitudes relating to occupations in various sectors of economic and social life. The combination of TVET with green skills will mean success in the fourth industrial revolution. TVET teachers who in this study are referred to as lecturers need to intensify efforts toward teaching the TVET students the basic 4IR and green skill contents. TVET lectures have of recent resorted to use of ICT facilities in Teaching TVET, thought curriculum as a course and involved in curriculum planning at different levels which made them curriculum experts (Olaitan, 2003). The curriculum experts who are experienced lectures and HODs design suitable and germane curriculum for TVET programme. Head of departments are of the administration cadre and are in better position to suggest the inclusion of 4IR and Green skills in TVET curriculum.

Blended TVET curriculum include 4IR skills such as digital economy, artificial intelligence (AI), the Internet of Things (IoT) among others. Hence, green skills are so important and needed for the 4IR to be a sustainable revolution. Where does this technology place the technical education students'? Ogbuanya & Udougo, (2015) affirmed that technical education students in the Universities are currently faced with

cumbersome curriculum that consists of technical, vocational, educational and other generic knowledge. This curriculum places a lot of workload on the students which need to be streamlined. It is hopeful that with the shift from Third Industrial revolution to 4IR, the TVET curriculum will gain a better shape with contents that will make them fit in the next generation. The need for technical education students to acquire both the 4IR and Green skills is paramount.

Green skills are amongst the strategic thrusts that enables Nigeria to combat environmental challenges and opportunities in a fast-changing global and political landscape. CEDEFOP (2012) explained green skills as knowledge, skills, values, attitudes as supported by Thirupathy and Mustapha, (2020) to mean soft skills necessary for life in societal development, support the creation of a sustainable and efficient resource management for energy saving initiatives. (Kamis, Che, Rahim, Nur, Zakaria, & Mohd., 2017; Buntat and Othman, 2012) professed that green skills, also known as Green Soft Skills, are meant to complement Green Jobs and Green Career. Green Skills Agreement (2010-2011) and OECD (2016) affirmed that green skills are the technical skills, knowledge, values and attitudes needed in the workforce to develop and support sustainable social, economic and environmental outcomes in business, industry and the community. In this study, green skills are soft skills which saves energy and prepare TVET students for 4IR. AGREE 2015, Buntat, 2012, & Aluwong Ezekiel & Nungse, Nuhu Iliva Affang, (2018) asserted that the essence of striving to blend TVET with green skills is for the preservation of TVET programme to achieve sustainable development including curbing

poverty and economic development. Ramli identified three major needs of green skills for 4IR to include employee productivity, Green technology skills and Educational skills.

Green technologies include skills in material wastage, automation, smart manufacturing, and innovation. Green Technology is knowledge based interactive regulated processing of materials for our continuous comfortable existence. In conclusion, educational skills should include skills for green economy, up-skilling, and social skills. The preceding skills are therefore advocated to be emphasized for its inclusion in TVET curriculum to prepare TVET students toward curbing the challenges of employment in the 4IR era. These skills according to CEDEFOP, (2012) are also known as sustainability skills. One of the tenets of SDG 4 emphasized the inclusion of information communication Technology in to the TVET curriculum which serves as an introduction to the 4IR. This ensure inclusive and equitable quality education as well as promote lifelong learning opportunities for all (Sobhi, Margarete, & Huang, 2016).

Statement of the problem

The fourth industrial revolution is characterized by a range of new technologies that merge the physical, digital and biological worlds, impacting on all disciplines, economies and industries, and even challenging ideas about what it means to be human. Some of the most important repercussions are in the employment area since a large number of jobs will be lost as a result of robotization and mechanization of tasks. The present TVET curriculum seems not sufficient to provide TVET students with 4IR and green skills

needed for sustainability of green economy and curbing job challenges in the industries. Training of TVET student to code in new coding languages is still at the lower level.

This study therefore, become imperative to identify both 4IR and Green skill for inclusion in TVET curriculum to enable students code in new coding languages as well as attain a mix of digital skills. The preceding inclusive curriculum blends TVET with both 4IR and Green skills that will prepare TVET students in North Central Universities to face the reality of the Fourth Industrial Revolution.

Purpose of the study

The general purpose of this study concerns blending TVET with Green skills towards preparing Technical Education Students for Fourth Industrial Revolution (4IR) in North Central Universities in Nigeria. Specifically, the study sought to identify

1. Green skills required for inclusion in TVET curriculum
2. Fourth Industrial Revolution technologies required to be included in TVET curriculum for technical education students in the North central states

Research questions

1. What are the green skills required for inclusion in TVET curriculum?
2. What are the Fourth Industrial Revolution technologies to be included in TVET curriculum?

Hypothesis

H₁. There is no significant difference in the mean response of Lecturers, Head of Departments and

Curriculum experts on Green skills required for inclusion in TVET curriculum

H₂. Significant deference does not exist between the mean response of Lecturers, Head of Departments and Curriculum experts on Fourth Industrial Revolution technologies required for inclusion in TVET curriculum

Methodology

Descriptive survey design was adopted for the study. According to Gall, Gall and Borg (2007), descriptive survey is a method of using questionnaire or interview(s) to collect data from a sample that have been selected to represent population to which the findings of the data analysis can be generalized. The study was conducted in the three Universities in North Central Nigeria offering TVET. These institutions have experienced TVET teachers who have been in the practice of teaching Technical and Vocational Education for a long time. The participants were 41 respondents consisting of nine curriculum experts, six HODs and 26 Lecturers randomly selected from the department of Vocational and Technical Education, Federal University of Agriculture Makurdi, University of Jos and University of Ilorin. The entire population was considered appropriate for this study hence, used because of its manageable size. The instrument was face validated by three experts, two from the University of Jos and one from Plateau State Polytechnic, Barkin Ladi. The experts were

requested to determine the suitability of the instrument in the areas of content coverage and grammatical expression. To ascertain the internal consistency of the instrument, 12 copies of the questionnaire were administered to 12 Lectures in Technical Education section, University of Jos through research assistants. Reliability of .84 was established using Cronbach's Alpha coefficient. The data was collected after administration of questionnaire to respondents with the help of the same research assistants in the study area.

Procedure

Questionnaire titled Green skills Questionnaire (GSQ) was used for data collection. It was made up of items of blended teaching competency. The items were rated by the respondents on a four point responses options of highly required (HR) 4.00, required (R) 3.00, moderately required (MR) 2.00, Not required (NR) 1.00. The data collected from the respondents were analyzed using Statistical Package for Social Sciences (SPSS) version 23. Mean was used to answer the research question while ANOVA was used to test the hypotheses at .05 level of significance. The responses were agreed or not agreed based on 2.50 decision rule for the research questions. The hypothesis of no significant difference was rejected for any value whose probability value $p \leq .05$. The hypothesis of no significant difference was accepted for any item whose probability value $p \geq .05$.

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Findings

Table 1: Mean and standard deviation of respondents on Green skills needed to be integrated in TVET curriculum

S/N	Item statement	$\bar{x}$	SD	RM
	Employee productivity skills			N
1	Re-employment	2.44	.91	NR
2	Green job opportunities	3.04	.73	R
3	Wage	2.08	1.07	NR
4	Reduce unemployment	3.00	1.22	R
	Green technologies			
5	Material wastage	2.60	.86	R
6	Automation	2.76	1.09	R
7	Smart manufacturing	3.48	.87	R
8	Innovation	3.44	.50	R
	Education skills			
9	Green economy	3.00	.76	R
10	Up-skilling	2.72	1.30	R
11	Social	2.76	1.30	R
12	Environmental	3.56	.86	R

The data presented in Table 1 showed that items 1 and 3 had their mean values less than 2.50 cut off point while the remaining items were above the cut off point of 2.50. It depicts that re-employment and wage were the Green skills not required to be integrated in the TVET curriculum while the remaining items were much needed for inclusion in TVET curriculum in the Universities.

Table 2: Mean and standard deviation of respondents on Fourth Industrial Revolution technologies needed to be integrated in TVET curriculum

S/N	Item statement	$\bar{x}$	SD	RM
13	Artificial Intelligence (AI)	3.20	.86	R
14	Digital economy	3.20	.81	R
15	Internet of Things (IoT)	2.72	1.06	R
16	Cloud computing	2.68	1.14	R
17	Virtual reality	2.76	1.09	R
18	Biotechnology	2.84	.80	R
19	Robotics	2.64	1.32	R
20	3D printing	2.52	1.12	R
21	Cross boarder e-commerce	2.12	.83	NR
22	Autonomous Vehicles	2.64	1.11	R
23	Nanotechnology	2.92	1.28	R
24	Quantum computing	2.56	1.15	R
25	Energy storage	2.96	.73	R

Table 2 showed that item 21 had its mean value less than 2.50 cut off point while the remaining items were above the cut off point of 2.50. It depicts that cross boarder e-commerce was not required as fourth generation skill to be integrated in the TVET curriculum

needed for inclusion in TVET curriculum in the Universities

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Table 3: Summary of ANOVA on Green skills required to be integrated in TVET curriculum

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	1.119	2	.560		
Within Groups	4.117	38	.110	5.08	.011
Total	5.298	40			

Table 3 shows the ANOVA test for the Green skills required to be included in the TVET curriculum in the University in North Central Nigeria. Findings of table 3 indicated a Sig. value of $.011 < .05$, indicating a statistical significant result. The hypothesis of no significant difference is rejected. This depict that the respondents had different opinions on the green skills to be integrated in to the TVET curriculum.

Table 4: Summary of ANOVA on the Fourth Industrial Revolution technologies to be include in TVET curriculum

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	.586	2	.293		
Within Groups	1.716	38	.045	6.489	.00
Total	2.302	40			

Table 4 showed the ANOVA test for the Fourth Industrial Revolution technologies required to be included in the TVET curriculum in the Universities in North Central States. Findings of Table 4 indicated a Significant. value of $.00 < .05$, indicating a statistical significant result. The hypothesis of no significant difference is rejected. This depict that the respondents had different opinions on the Fourth Industrial Revolution technologies to be integrated in to the TVET curriculum

Discussion of findings

Findings in Table 1 showed that all Green skills identified were required except for re-employment and wage which fall short of the Green skills required to be integrated in the TVET curriculum in the Universities. This finding was in consonant with the findings of Sern, Zaime, and Foong, (2018) who of recent affirmed that both technical skills and generic skills are important for getting a job. However, this scenario has changed. Technical skills and generic skills are no more sufficient for TVET students to secure a job. Sustainable Development is the biggest challenge to the 21st century and transition to 4IR. Thus, green skills become a key of transforming into a low-carbon

economy and innovation of 4IR as asserted by Ramli, Rasul, & Affandi, (2018). This study in effect identified three basic groups of Green skills for TVET students in the North central Universities to include; employee productivity skills, green technologies, and education skills for green economy, social and environment. ACET, (2015) supported this finding since One of the 4 out of 8 agendas in the declaration of Kuala Lumpur is to integrate green skills for the preservation of the TVET program to achieve sustainable development including curbing poverty and inclusive of economic development.

Table 2 identified 12 Fourth Industrial Revolution technologies required for integration

into TVET curriculum. Cross boarder e-commerce was not found essential at the time of this study. Among the identified 4IR technologies were artificial intelligence, internet of things, robotics, 3D printing and cloud computing. The study conducted by Xu, David, and Kim, (2018) supported the findings of this study where their findings showed that fourth industrial revolution now involves computer generated product design and 3D printing, which can create solids object by building up successive layers of materials. Some of the most important repercussions will be in the employment area since a large number of jobs will be lost as a result of robotization and mechanization of tasks. Schwab (2019) also suggested that the revolution could lead to greater inequality, particularly in its potential to disrupt labor markets. Furthermore, the job market may become increasingly segregated into low-skill/low-pay and high-skill/high-pay roles, which could escalate social tension. The bottom line is that the present jobs will diminish and open way for new jobs for those who are willing to key in to the 4IR. The need for restructuring the TVET curriculum to capture all this technologies is imperative.

Findings of hypothesis 1 in Table 3 depict that $p < .05$ at $p = .011$. This significant result depicts that there was a variation in the opinions of the respondents concerning the green technologies required to be integrated with the TVET curriculum. Kamis, Alwi and Yunus, (2017) have earlier identified similar green skills needed to be included in TVET curriculum.

Mustapha (2015); McGrath, and Powell, (2016) agreed that those elements of sustainability or green skills should be included in the curricula of

schools, Universities and skills training centers to provide human resources that are conscious of the environment. In the year 2012, the International Centre for Technical and Vocational Education and Training (UNEVOC), set out the content of Green Technical Vocational Education and Training (TVET), which included these elements: education that enhances problem-solving skills in the daily lives (skills manage life), education in sustainable development in life and entrepreneurship education. The preceding arguments confirmed the need for blending TVET with green skills for meeting the challenges of 4IR.

Findings of the study on hypothesis 2 Table 4 showed $p < .05$ at $p = .00$ which was significant meaning that the respondents had different opinions concerning the 4IR technologies to be included in TVET curriculum. This is a confirmation of controversies in the paradigm shift from third industrial Revolution to 4IR. Lee, Yun, Pyka, Won, Kodama, Schiuma,... and Yan, (2018) clearly postulated that the Fourth Industrial Revolution represents a paradigm shift with a new wave of innovations characterized by the digitization of business, society, and our lives.

Conclusions

Green skills are essential to ensuring a transition into a low-carbon economy and innovation of Fourth Industrial Revolution. To ensure the productivity of TVET graduates, green skills are needed for the current and future industry. This is important to reduce unemployment, increase wage, green job opportunities and reemployment in new businesses. Green skills are also needed for developing appropriate technologies so that it

will realign to the smart manufacturing, automation, material shortage, and innovation. TEVT plays the major roles to develop skills for green economy, up skilling 4IR, social skills and environmental skills. Therefore, integrating sustainability education into the TVET curriculum and any training institute, particularly the green skill element, will benefit mankind, environment and economy.

Findings of the study revealed that three major groups of green skills were required to be integrated into TVET curriculum. These were; employee productivity skills, green technologies, and education skills for green economy, social and environment. The fourth Industrial Revolution technologies included; artificial intelligence, internet of things, robotics, 3D printing and cloud computing among others.

Recommendations

- Policy makers should take the necessary actions such as promoting basic skills, and green skills so that well-equipped graduates can meet the challenges of sustainable development towards Fourth Industrial Revolution in their work place.
- Coherent policies must be introduced and there should be coordinated implementation of education and training for sustainable development in Fourth Industrial Revolution.
- Universities should collaborate with Companies so that they will provide the education and skills for training University students to code in new coding languages, but also to change their mix of social skills

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