Refocusing TVET Instructional Delivery in Nigerian Schools in the Digital Era

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Introduction

First of all let me commend the organizers of this conference for choosing the theme "Refocusing TVET Instructional Delivery in Nigerian Schools in the Digital Era". Let me also take off from the tail end of that theme"the Digital Era". What really is the digital era? This is an era or time of incredible technological changes, which is synonymous to information or computer era. In the words of Rosen (2004) cited in Gallardo-Echenique, Marqués-Molías, Bullen, and Strijbos (2015), noted that this era can be divided into four distinct generations of which time holds a very different meaning for each of them. The generations also differ in learning styles. For instance, those born before 1946 (72 years old and above) make up the "***silent generation***." Next to that is the "***Baby Boomersgeneration"***, which is a generation of those born between 1946 and 1964 (between 53-72 years old). Following this is the "***Generation X"***, that is, a generation of those born between 1965-1980 who may be between 37-52 years old. The next is the "***Net Generation"***, which is the generation of those born after 1980 (from 37 years and below today). In all these four generations, each has different approach to technology and life.

Peculiarities of the Unfolding Generations

In most developed countries, students who were born roughly between 1980 and 1994 (23 or 20 years and below) represent the first generation to grow up with this new technology and have been characterized by their familiarity and confidence with respect to Information and Communication Technologies (ICTs). They spent most of their lives surrounded by digital communication technology. They use the Internet, text messaging, and social networking, but primarily for social and entertainment purposes. According to Gibbons (2007), they communicate differently and use a different written language (e.g. text and instant messages), interact and socialize differently (e.g. via avatars in online games and Facebook), and have a different sense of authorship (e.g. Flickr and personal blogs). In the late 1990s, based on the works of Tapscott (1998, 2009) and Prensky, (2001a, 2001b) social psychologists have indicated that people are categorized according to the digital literacy/usage era namely: "Digital Natives", "Digital Immigrants" or "Digital Aliens. The digital natives are those within the Net Generations and Generation X, whereas the digital immigrants may be those within the Baby Boomers. The digital aliens may be the

silent generation (Palfrey & Gasser, 2008) as shown in Table 1.

Table 1: Generational Characterisation and Learner Behaviors

The *Silent Generation* 1946 (72 years old +) *Digital Aliens*	• Was raised without what we would call modern technology • More enmeshed in their profession if they have not yet retired • Technology is foreign to them and they have had to learn a whole new language and skill late in their careers. • They defined themselves by their career and family often took a back seat to work.
Baby Boomers 1946-1964 (72-53yrs. old), *Digital Immigrants*	• Formed the first technological generation with computers on the horizon. • Have a single job throughout their working career, are fiercely loyal to their job, work to live and avoid making waves. • Boomers learned technology after their schooling and prefer face-to-face, process-oriented meetings. • Like routines • Boomers are auditory and visual learners • When Boomers get a new gadget their first step is to read the manual.
Generation X 1965-1980 (52-37 yrs. old) *Digital Natives*	• Were the first to be computer literate • Will hold multiple jobs with most working for upwards of 7 different companies. Because of their mobility they tend to challenge authority rather than simply follow company directives. Work is not the most important part of their lives and they value their personal time. • Are results oriented and since they grew up with technology, they prefer electronic communication. • Like spontaneity • Have little tolerance for time-intensive activities and feel strongly that meetings are a waste of time. They want their boss to give them a job and stand back and let them do their work. • Are tactile learners • When they get a new gadget they just start hooking up wires and pressing buttons. • To them Manuals are for "old folks." • If you have Gen X clients they may prefer to communicate technologically. • They will want to see your web site before they have their initial session. • If you don't have one they may feel that you cannot possibly connect on their level. • They will ask you immediately for your e-mail address and if encouraged at all will send e-mail messages between class sessions.
The Net Generation 1980 (37 yrs. and below) *Digital Natives*	• Cut their teeth on computers, video games and the Internet. • This Generation has been entangled with technology from birth. • The average age that they started using a computer is 3 and most sent their first e-mail before they entered kindergarten. • They live on instant messaging and communicate with friends more on IM than any other way. • They multi-task constantly with the average teen talking to 3 people at once on IM plus doing several other tasks at the same time. • They get bored easily and change jobs and careers often. • Net Generations are tactile learners. • When they get a new gadget they just start hooking up wires and pressing buttons. • To them Manuals are for "old folks." • If you have Net Generation clients they may prefer to communicate technologically. • They will want to see your web site before they have their initial class session. • If you don't have one they may feel that you cannot possibly connect on their level. • They will ask you immediately for your e-mail address and if encouraged at all will send e-mail messages between class sessions.

Source: Gibbons (2007); Palfrey & Gasser (2008)

Refocusing TVET and its Delivery Mode in Nigeria

Technical and Vocational Education and Training (TVET) popularly known and referred to by UNESCO, ILO and other International agencies, is concerned with the acquisition of knowledge and manipulation of employability skills for the world of work. However, in other countries for instance the United State, TVET is known as Career and Technical Education (CTE), which is meant to prepare youths & adults for a wide range of high-wage, high-skill, and high demanding careers. In Germany and Australia on the other hand, it is commonly called Vocational Education (VE), whereas in the UK it is referred to as Employability or Workplace Skills. In Nigeria, TVET has many names ranging from Technology and Vocational Education, Industrial Technical Education (ITE), Technical and Vocational Education (TVE) etc. Irrespective of the name or acronym it bears, the major career clusters or trade areas in form of academic offerings in TVET within the Nigerian context include Agricultural Education, Automobile Technology Education, Building Technology Education, Business Education, Electrical and Electronics Technology Education, Metalwork/Mechanical Technology Education, Woodwork /Construction Technology Education, Food and Home Economics Education among numerous others. Often these technical trades are delivered as individual entities (silos) to learners, not in any integrated form. Besides, the traditional way of learning TVET in Nigeria is predominantly teacher-centered, which often take place in the four corners of a building (classroom or workshop/laboratory). Teaching and learning in such cases are often characterized with the "chalk and talk", "lecture methods", and associated practical or hands-on training. The assessment often time is 'paper and pencil' type with heavy emphasis on the theoretical component, and often less on the practical performance of the learners. This simply means that assessment is not usually *Competency-Based.* Most often, students' projects are teacher-designed or teacher-influenced. Similarly, the delivery of other related subjects to TVET such as the Sciences, Engineering and Mathematics has been predominantly based on discrete or individual disciplines as standalone silos each one being delivered at a time and in its own unique way.

What is Really Wrong With This?

This approach has been widely criticized as not helping learners enough to develop problem-solving skills in a broad and integrated form, as it is the case in real world situations. According to Reeves (2015), TVET through its real-world applications is an ideal vehicle through which Science, Technology, Engineering and Mathematics (STEM) can be delivered and strengthened. Thus, in order for TVET to be effective, it must be highly valued, well funded and effectively implemented. Because TVET is connected with STEM, it ought to be delivered in an integrated form such that, all elements of each of the four disciplines (Science, Technology, Engineering and Mathematics) are put to use. In the USA for instance, CTE is highly valued and have numerous advantages. For instance, High School CTE Students are more engaged, perform better and have higher graduation rates (Reeves, 2015). Besides, States that invest in CTE see big returns for state economies, addresses the needs of high-growth industries and help in closing up the skills gap. TVET/CTE educates students for a range of career options through several Career Clusters and pathways.

Although TVET in the 21st century is generally faced with numerous challenges as seen with digitization and automation, many developed economies are very much on top of these challenges. The TVET system in the developing economies like Nigeria are faced with these numerous challenges, and other pressing issues such as quality assurance, access and lack of

development of the type of skills that can outlast the shifts in the world of work. To ensure that quality, access and purpose of TVET in the context of these shifts are met by current TVET systems in place, there is the need to carefully re-evaluate and refocus the current modalities of delivering TVET in Nigeria. Realizing these kind of issues ahead of time, may have made Treadwell, (n.d.), a renown education Consultant and author of the critical friend of PLANE, asserted that "there is soon going to come a collision of 3 great storms called the perfect storm", and that these storms according to him are "the arrival of the new technology and the shift to the Internet, the understanding of learning how to learn, and the ability for young people to build their own creativity as they learn, do research, and be able to take their learning to the next level, and be creative with it" (Treadwell, (n.d).

In the same vein, UNESCO–UNEVOC the International Centre for TVET based in Bonn, Germany, realizing that, the demand for high level skills due to transformative nature of job and requisite industry needs is in the future likely going to result to high unemployment rate among TVET graduates, and the risk of social exclusion in the 21st century if the education system of training are not refocused for the better. The UNESCO–UNEVOC (n.d.) states that "every day more people worldwide gain access to basic education, and this has sparked career expectations and raised hope for better futures amongst many young people, yet, these hopes are not satisfied", and as such "there is high job insecurity, skills mismatched and growing youth unemployment". These challenges according to UNESCO-UNEVOC, are putting increasing pressure on education systems to provide relevant education for the world of work, and the unanswered question remains "how do we deal with these challenges?"

Again, the three mega storms Mark Treadwell forecast and cautioned against collided in this 21st Century seeing that, learning is no longer about the units or volumes of work with its versed content, rather the focus should be on "learning how to learn" and not how much content is learned. In this generation, what young people need to learn is how to be Life Long Learners (LLL). TVET teachers of this era have far more challenges spanning the demands; these are inclusive of those relating to the National Curriculum, the New Teaching Technologies in schools, and how we can build our capacities to meet these 21st century challenges. Thus, the expectation of this conference in Nigeria is that, participants will tap into and explore the opportunity to refocus their instructional delivery practices in the light of current global trends and the shift in the education industry generally, and TVET education in Nigeria in specific. For the most part of these three days, we shall be interacting and reflecting on the theme and the various sub-themes of this conference, which we are confident, will invoke in-depth academic discourse during the technical sessions. It is expected that at the end, we would have gotten enough justifications and tools to enable us refocus our delivering approaches and transform the TVET system generally in Nigeria and beyond.

Why Refocus TVET Delivery Approach?

For any meaningful transformation to take place in TVET system there must be a justification for it. It is common knowledge that, the tools with which TVET was delivered 10 years ago are no longer the same tools being used for delivering it today in many developed countries. If it is not the case in your institution, then this is a misnomer. Today the Technological Pedagogical Content Knowledge (TPACK) of TVET, the learners' cognitive disposition and skills capabilities have also changed. The way learning is taking place today is not in any way the same with what took place 10 years ago in many countries. Thus, we need to acquaint ourselves with some of these changes that affect TVET in

our case (Nigeria). It may interest us to note some of the technologies that have or are changing the education system today. Think about the Robotics and Drones Technologies in schools, the 3D Printing and modeling Technologies, Virtual Realities, Cloud and Cyberspace Technologies, Biometric and other security related (finger print and eye tracking) Technologies among others. Do we have such advanced technology contents in our TVET curriculum?

Massive Changes and Challenges in TVET System

The rapid technological changes and increased complexity of today's world presents new challenges and put new demands on the education system globally. Generally, there has been a growing awareness of the necessity to change and improve the preparation of students for productive functioning in the continually changing and highly demanding environment (Hampson, Patton & Shanks, 2016). In confronting these challenges especially in our TVET system, it is necessary to consider some of these changes that have occurred and the problems this has brought to the system, which we ought to address.

Considering some of the changes that have occurred due to the paradigm shifts in education in the last decade, Yalams (2016a) enumerated a few major ones as follows: Changes in the educational structure and content, delivery methodology, assessment processes, learning approaches, learning environments, learning climates and the learning technologies. These changes became more outbursts according to him in the digital era. It is common knowledge now that pedagogically, attention has now shifted from the 'teacher' who is usually infront of the classroom to the "learners" who are usually at the back of the classroom seated in rows and columns passively taking notes. Thus, the concept 'learner-centered' approach to instructional delivery. It is also worth noting that, in this contemporary era, when formulating instructional or learning objectives, either in developing a course or writing a lesson plan, the focus have had to change from 'content-based' to 'performance or outcome-based. Similarly, in this era, the lesson delivery approaches and learning environments have been diversified and modernized. With the advent of eLearning, distance, online or virtual learning paradigm, learning no longer just take place within the "four corners of a brick and mortar structure called a "classroom" but does happen even more effective outside. The advent of e-Learning has revolutionized education and pulled down many barriers to learning (geographical, class size, distance, race/ethnic nationality, gender differences etc.) Furthermore, the learning devices are so numerous in this digital era, ranging from the traditional Black Board (BB) to White Board (WB), and now to SMART Board, or even No Board (i.e. Screens of digital/mobile devices (such as Computers, Laptops, iPods, iPads, Tablets, Smart Phones, Digital wrist watchesetc.)

In this era, the assessment and evaluation of learning outcomes and learner performances have also changed from knowledge or content-based assessments to authentic or performance-based assessments; also most examinations have changed from paper-and-pencil to Computer-Based Testings. The assessment has also shifted significantly from just the product assessment to both Process and Product or Competency-Based Assessment. In especially TVET system, the delivery is fast changing from "Time-based Education and Training (TBET) to Competency-Based Education and Training (CBET), and the awards for achievement are also changing from traditional certificates and diplomas used in the past to National Vocational Qualifications (NVQ). The list is unending as the era of lengthy lectures, copying from text book or teachers' old notes are also fast giving way to several other electronic or digital transfer

approaches. The contemporary pedagogical approaches such as the Constructivist, Problem/Project-based learning (PBL) and several other instructional delivery approaches are gradually replacing the 'traditional lecture' or 'chalk and talk' methodologies in modern classrooms.

These new learning approaches are also necessitating changes in the sitting arrangements in the learning environments/classrooms from the 'pew & pulpit' or 'row and column' to the contemporary 'round table' or 'group interaction seating patterns'. Social media is now one of the platforms for learning than many physical classrooms. This is perhaps why Houghton Mifflon Harcourt (n.d.) in his work on Global Education Challenge indicated that, "our children receive more information on cell phone in their pockets than in the classroom". Virtual laboratories are gaining more popularity and taking the place of physical laboratories or workshops in some academic disciplines, TVET is gradually joining too. Today, more open-education source materials are available than in the last 5 years. For instance, the Massive Open Online Courses (MOOCs) and the application of Learning Management Systems (LMS) is revolutionizing access to education generally and TVET in particular. Also, through the use of Cloud-Computing and Web-based learning systems, quantum educational materials are deposited which learners at their convenience can access more than the traditional hardcopy ones. Thus, learners can complete their assignments, store them or send to their teachers virtually for grading without any physical or direct contact with the teachers (Yalams, 2016b). The developments of digital learning Apps and Technologies, Instructional Packages (IP) and Computer/Web-based Software Applications for enhancing TVET learning very much abound now than in the last five years. Thus, we can now pride of having virtual or cloud-based electronic laboratories for almost all aspects of TVET in which product modeling and simulation of the real practical instructions take place. Medical surgery and other health services take place using electronic/virtual technologies in developed countries in this era. All these therefore, must send a message to us that classroom teaching is not the only means through which students learn in this era. Thus, whatever we should do in our instructional delivery must be sound and relevant to get the attention of the learners. The question is where does TVET in Nigeria stand in this entire continuum of educational changes and development?

Teachers' Tasks in Refocusing TVET Delivery Approaches

In order for us as TVET teachers in this digital era to be able to deliver instruction in TVET very effectively, we need to acquire additional skills and competencies. Palmer (2015) has enumerated 15 different characteristics of such skills which every 21st Century TVET teacher should possess, and these include: Becoming a learner-centered teacher, a lifelong learner, some one determined to learn the new learning technologies, one who thinks globally, and who possesses the ability to use Smart Digital devices, a teacher with the ability to collaborate effectively with others. Such a person should also be a potential user of and taking advantage of the social media for educational purposes, one who has verse network and a member of digital learning communities, an innovator and a PBL strategist. Additionally, according to Hampson, Patton and Shanks (2016) such a teacher should have the ability to think outside the classroom box, get personal, tap into students' digital expertise, get involved and be real with projects, expect (and help) students to become teachers, help (and expect) teachers to become students as well. Some one who measures or assesses what matters most in his/her subject area, works with parents as well as their wards, and be a source of empowerment to the students among others and not their source of sorrows and ordeals. Additionally, such a

person needs to be a critical thinker, a researcher and problem-solver. The list is unending, but the key question here is, how many of the TVET teachers amongst us here possess 50% and above of these required qualities? How many of us are determined to possess even just 30% of these necessary contemporary skills? If the answers to these questions indicate low numbers, then our jobs and the subject we teach (TVET) may be in great jeopardy and may be facing serious threats, considering the changing demands of work place and industry skills/competencies required. The future of our children lies with our quality and the ability to effectively deliver them in line with the 21st century workplace demands. Therefore, one may not be out of place to advocate that change should begin with us (Buhari, 2016) and right here at this conference.

Refocusing TVET Instructional Delivery Through the Constructivist's Approach

In the Nigeria TVET system currently, the general practice is that instructional delivery are done using predominantly the traditional approach where the teacher is seen as "the owner and sole giver of knowledge" whereas the students are seen as "passive receivers and non-owners of the same knowledge". With this approach, when assignments or tasks are given, students are expected to work as lone/individuals to show their capabilities. This, they do by relying heavily on textbooks, teacher's notes/instructions and very little research or consultations with others. The teacher gives most of the information and expects correct answers to validate students' lessons. Learning is achieved through repetition with much emphasis on basic content, concepts or routine skills sets. The teacher adheres strictly to exhausting particular content area of the curriculum. In this delivery approach, assessment is viewed as a separate entity from the teaching task, and is mostly paper-and-pen kinds of assessment. But in well-advanced, transformed global settings, with the new paradigm shift in education, the practice has changed. The instructional delivery in most cases has adopted the Constructivists approach to instructional delivery. With the Constructivists approach, learners are active creators of their own knowledge and understanding of the world. They are encouraged to use active and interactive learning techniques (experiments, real-world problem solving etc.) to create more knowledge and reflect on what they are doing and how their understanding is changing. The focus is on what the learners can create with little facilitation from the teacher. The Constructivist teachers encourage students to constantly assess how the activity is helping them (students) gain understanding. By questioning themselves and their strategies, students in the constructivist classroom ideally become "expert learners." Thus, gain the tools to keep learning, and "Learn-How-to-Learn".

Characteristics of the Constructivist Delivery Approach

Some of the Characteristics of the Constructivist delivery method include:

1. Students work primarily in groups and are seen as critical thinkers.
2. The teachers merely mediate the learning and are considered as facilitators.
3. Learners are actively and constantly involved/engaged in the process.
4. The environment is democratic and the activities are interactive.
5. The emphasis is on the 'big concepts' not 'limited contents'.
6. The teacher prompts and facilitates the lesson, while students create their own knowledge and understanding using primary resources with manipulative and interactive materials.
7. Lessons are driven by students' responses as teachers inquire about students' understandings of concepts before adding their own comments to it.

8. The teacher seeks students' point of view in order to understand students' learning style often by asking them open-ended questions.
9. In this approach, assessments of students are interwoven in the teaching, and this occurs in many different ways.
10. Assessment of the process of the knowledge is just as important as the product, thus both ***learning and assessment*** are embedded in an authentic rich environment, and are done simultaneously and continuously.
11. Assessment is not only based on test, but on observation and student's point of view focusing much on realistic approaches to solving real world problems.

Refocusing TVET- Delivery Approach Through the PBL Concept

In the Nigerian context of TVET teaching, we are fond of "using old weapons to fight new battles". We must stop using old tools, knowledge and abilities to teach new skills to 21st Century Learners. Training new generation of learners using new technologies, methodologies and new approaches help learners thrive on cooperation and problem solving. Project-based/Problem-based learning (PBL) teaches students the collaborative and critical-thinking abilities they need to compete with in their places of work later in their chosen career. It is about time we rethink the delivery of TVET from content-based to problem/project-based (scenario-based). For one reason, the PBL is an approach that develops creativity, innovation and critical thinking among learners. It is a systematic instructional delivery approach that engages students in learning essential knowledge and life-enhancing skills through an extended student-influenced enquiry structured around complex authentic questions and carefully designed products and tasks. Through this approach, students go through an extended process of inquiry in response to a complex situation, case, scenario, question, problem, or challenge. While allowing for some degree of students' "voice and choice," rigorous projects are carefully planned, managed, and assessed to help students learn key academic content, practice 21st Century skills such as: collaboration, communication, critical thinking, and create high-quality, authentic products or solutions to some problems and at the same time make presentation to peers or wider campus communities (Palmer, 2015).

The PBL as one of the most favored delivery approach among the 21st Century learning skills has the following key features:

Real-World Connection - It connects learners to what the real world problems are. With PBL, there are no false assumptions, and imaginary project scenarios are not encouraged.

Core Learning –This approach teaches learners on how to learn a concept by exploring the real content.

Structured Collaboration – The approach employs group work. Students work together and enjoy the group dynamics as they approach the problems with diverse thinking, diverse ideas and diverse concepts. Roles are assigned to each individual to execute in the project.

Student Driven- Students take control of their learning while the teacher becomes the facilitator, guiding learners through the scaffolds of the learning content as planned.

Multi-faceted Assessment – Assessment of the learner outcome is integrated throughout the learning activity, using various tools and methodologies. Mostly the assessments are authentic and formative in nature. The focus is not so much on precision or actual functioning and working capability of the project, but the concepts, processes and creativity built into the work, and the group as well as individual participation in the project.

In the traditional classrooms, students typically work on simple assignments that emphasize short-term

content memorization; they work alone, write for the teacher alone, and rarely make presentations. But with PBL, the learning is by contrast, deep, complex, rigorous, and integrated. With this approach, TVET teachers will build their instruction around eight Learning Outcomes: Content standards, Collaboration, Critical thinking, Oral communication, Writing communication, Career preparation, Citizenship and ethics, and Technology literacy which they embed in all projects, assessments, and grade reports.

Instructors using the PBL start each unit by throwing students into a real-world or realistic project that engages interest and generates a list of things they need to know. Projects are designed to tackle complex problems requiring critical thinking. The school's strategy is simple, and these are: in order for the students to learn collaboration, they are made to work in teams. In order to learn critical thinking, they take on complex problems and are tasked to handle. To learn oral communication, they are engaged in making presentations. To learn written communication, they are tasked to develop writing skills. To learn technology, they are pushed into using Information and Communication Technology (ICT). To develop citizenship, they take on civic and global issues. To learn about careers, they do internships. To learn content, they conduct research and do all of the above.

Fundamentals of the PBL Delivery Approach

The PBL has five stages that are critical, these are:

1. The teacher should create teams of three or more students to work on an in-depth project for three to eight weeks as the case may be.
2. Introduce a complex entry question that establishes what students' need to know, and scaffold the project with activities and new information that deepens their work.
3. Schedule the project through plans, drafts, or timely benchmarks
4. Arrange for the team's presentation to an outside panel of experts drawn from stakeholders, parents or the immediate community.
5. Provide timely assessments and/or feedback on the projects for content, oral and written communication, teamwork, critical thinking, and other important skills.

Examples of PBL Scenarios/Challenges

These may include presenting a proposal to the National Assembly on solving the insurgency issues in North East Nigeria, or addressing the Niger-Delta oil crisis, or even the Nomadic/Fulani Herdsmen and Farmers' crises in the country, and the contributions that TVET system of education can play on these.

You will be surprise the outcome of the learning. Note that PBL goes hand in hand with integrated STEM and Constructivist methodologies among others. The PBL put students into a students-as-workers setting, where they learn collaboration, critical thinking, written and oral communication, and the values of the work ethic while meeting state or national content standards. (e.g. the case of Illuminated Instruction Board (IIB) for IDPs and the Nomadic Mobile Learning Unit (Compact Desk & Chair) being ATBU students' PBL Outcomes.

Refocusing TVET Instructional Delivery Approach Through the iSTEM Concept

The acronym "STEM" stands for Science, Technology, Engineering and Mathematics. Science as we all know is the study of the natural world, which includes the laws of nature associated with physics, chemistry and biology. It is known as a body of knowledge that has been accumulated over time and a process (i.e. scientific inquiry) that generates new knowledge (Reeves, 2015). Technology on the other hand is considered as modifying the natural world to meet the needs and wants of people (ITEEA, 2015). From another perspective, technology is human innovation that involves the generation of knowledge and processes to develop

systems to solve problems and extend human potential. On a general note, technology can be categorized as a complete system such as the motorcar or an air conditioning system. It can also be regarded as a capability such as 'Wireless Technology' or 'Robotic Technology'. From another angle, technology could be just a specific device such as the Computer, Smartphone, or Closed Circuit Television (CCTV). Engineering in this case is considered as the application of Mathematics and Science to create Technology. Engineering is about problem solving which uses the Engineering Design Process to create products or systems that would solve problems. Engineering is about designing, making, producing or building of structures, models, products, devices, processes and systems for the comfort, convenience and protection of humans (i.e. their needs and wants), be they in the areas of economy, social, environment or some others. Mathematics as it is commonly known, is a language of numbers, operations, patterns and relationships. It is used in Science, Engineering and Technology to meet human needs and wants. Integrating the four disciplines together forms the acronym 'iSTEM'. But the situation currently in the Nigerian TVET delivery system is such that, institutions teach each and related disciplines in 'Silos'. This approach does not help the 21st Century learners to think critically and devise sustainable solutions to existing problems as against an integrated approach. An integrated STEM (iSTEM) education is a teaching and learning approach in which Science, Technology, Engineering, and Mathematics are purposely integrated and delivered. STEM can be integrated into most subjects such as TVET, Humanities and the Arts etc. When the arts or humanities are included, it forms the acronym 'STEAM'.

Imperatives of Integrated STEM (iSTEM) Delivery Approach in TVET

In today's globalized world of new inventions and innovations where most developments involve Science, Technology, Engineering and Mathematics, a STEM education workforce is needed to stay relevant and competitive. Thus, for a country to fully develop, it will need to incorporate the integrated STEM approach at all levels of education and instructional delivery. The importance of iSTEM education therefore in TVET needs not be overemphasized.

1. This approach enables learners to respond to numerous problems facing humanity in a more realistic or authentic way.
2. It has high relevance to TVET, and its potentials in enhancing national and economic developments.
3. It promotes students' interest in Science, Technology, Engineering and Mathematics careers and, also hands-on problem solving and learning of the 21st century skills.
4. It enhances understanding about how the disciplines Science, Technology, Engineering and Mathematics are connected and how this connection impacts and shapes our daily lives.
5. It encourages career awareness and allows in-depth career exploration by TVET students.
6. Since TVET is about career preparation and skills for the world of work, students are shown how their careers are connected to STEM in TVET, bearing in mind that many of the skills most needed to compete in the global market of the 21st century are technical/vocational in nature.
7. The integration of STEM education into TVET helps build students' interest and deepens their understanding by making mathematics and science more relevant in what they are doing in Technology/Vocational Education and Engineering Education.
8. It also help students grow the TVET-STEM workforce pipeline as

it encourages and promotes communication, collaboration, critical and creative thinking, invention and innovation through using the 21st century learning skills.

Refocusing Instructional Delivery Approach Through the Greening TVET Concept

In all aspects of education as an industry, TVET inclusive, three cardinal points of great interest are the People, the Gains/Profits of the system, and the Planet/environment (PPP- People, Profit, and Planet (PPP). Based on this consideration, the UNESCO-UNEVOC (2014) has advocated an approach for transforming TVET institutions globally from a non-sustainable (Red) into a more sustainable (Green) one. The Greening TVET (GTVET) is an emerging concept emanating from UNESCO-UNEVOC as part of fulfillment of UN's decade for education for sustainable development (ESD). Majumdar (2010) describes it as "a way of thinking in a sustainable manner as it relates to acquiring, consuming and disposing of utilities, proactive actions aimed at improving human well-being and social equity while significantly reducing environmental risks and ecological scarcities."

The GTVET concept is aimed at transforming our schools/campuses, changing societal attitudes, land spaces, people's culture and lifestyles towards becoming more environmentally friendly. The Greening TVET focuses on positively changing the direction and emphasis of Technical, Vocational Education and Training. Within the GTVET framework, the emphasis is on waste management; renewable energy; environmental protection; community service programmes among others. According to Majumdar (2010), Greening TVET has been introduced to play an important role in the transition to green growth and green societies; and to create a sustainable future. Also, a green economy requires a workforce with the appropriate skills and training, but at present, skills development is lagging behind the needs of the labour market especially for the emerging sectors, such as renewable energy, energy efficiency, waste management etc. GTVET therefore contributes in closing these skills gap with respect to decent work and social welfare. The GTVET Framework according to Majumdar (2012), consists of five layers as follows:

Green Campus: This aspect is concerned with managing of the campus resources, technology deployment, environmental monitoring and others, so as to reduce the carbon footprint of such an institution, college or school as the case may be.

Green Curriculum: Refers to promoting sustainable development via the use of cleaner technology, defining green learning outcomes, integrating education for sustainable development (ESD) across the curriculum, introducing teacher professional development among others in this direction. The expectation is that all TVET institutions should review their curricular to include elements of greening in them.

Green Research: This concerns, fostering research activities for instance on renewable energy, water treatment, green innovations, waste recycling etc. among faculties and departments of every institution at all levels of education.

Green Community: Simply refers to adapting and impacting the wider community, especially those neighboring communities to the existing institutions via capacity-building, renewable technology adoption, resource support, unique practices and other means. In this case, the institution has a role to interface with the community to inculcate or interchange greening ideas or dimensions as the case may be.

Green Culture: Refers to promoting the people's culture via inculcating green values, green attitudes, green ethics, green practices etc into the communities. In all they do, let greening issues become part of

the system. Green culture can take place through effective green community services.

Expected Levels of Involvement of Stakeholders in Greening TVET

For any TVET institution to implement the "Greening Concept" fully, three levels of involvement of the stakeholders are necessary, and these are:

1. **At the institutional level** it is necessary to transform the institution/occupational practice/educational frameworks, strengthen local initiatives and develop capacity.
2. **At the National level**, what is required most is, to establish coherent and coordinated policies for green growth and give it a good backing through setting up a national sustainable development strategy, and strengthening partnerships between stakeholders.
3. **At the international/global level**, much is expected through sharing evidence-based research ideas, policies and practices among different countries and regions of the world, as well as facilitating inter-agency collaborations, cooperation and support capacity-building and research initiatives.

Call to Action for TVET Stakeholders in Nigeria

One of the challenges faced in integrating TVET with STEM education in many countries in the past, and Nigeria in particular has been the disconnection and the much crave for identity among the policy makers and stakeholders of these independent disciplines. In the past each discipline prides on self, and strives to feature as the most prominent, most relevant or most accepted career, thus none of them was interested in identifying or compromising its fame with the other. Each strand of both the TVET and STEM disciplines were typically taught in Silos. In the past, if one hears of terms like 'critical thinking', 'problem solving', 'creative and innovative thinking' etc. the disciplines that first come to mind use to be Mathematics and the Sciences or Science Education. Seldom does it refer to Technology and Engineering Education disciplines. The good news is that, this misconception has begun to change the world over. Integrated STEM education and TVET is the most desired marriage of convenience for development and rapid industrialization of every country that needs to move forward. STEM education is interconnected with Technical and Vocational Education and Training in many senses. For one, TVET has long been in the act of integrating high-level academic engineering and technology-related disciplines. While Science, Technology, Engineering and Mathematics Education promote integration; TVET does, and should do. By its nature, the TVET programmes require students to integrate content from multiple subject areas. Contrary to the notion that, only Science, Technology, Engineering and Mathematics Education encourage problem solving, TVET does, and where necessary should do problem solving through its programmes, which provide students with authentic "hands-on" learning activities and experiences. The only emphasis here, will be to do it in a more integrated form, not devoid of the other strands or disciplines. The Project-Based Learning approach which aims at developing real-life learning experiences that enable students to explore real-world problems and challenges must be embraced and sustained in the teaching and learning of TVET with integrated STEM Education for speedy economic development of our country. The need for refocusing TVET instructional delivery system does not need to be overemphasized. If we must be transformed as TVET practitioners, the discipline be relevant and productive, our students be endowed with 21st Century skills, our country thrives economically and our industries develop and be sustainable, then we need to change our mentality and approach to delivering instructions in TVET. Among several other things, we

need to learn-how-to-learn the importance of iSTEM education and apply it to TVET and related Careers; we need to start teaching our students to use 21st Century Skills; we need to start trying innovative teaching methods; developing real-world Project-Based Learning experiences and activities; developing understanding of and ensure sustainable TVET education for sustainable national economic development.

Conclusion

In conclusion, what we may need to go home with from this conference if we do not remember any thing else is that, a lot of changes have taken place and they continue to happen in all facets of human existence and development. These changes have underlying implications to the viability and survival of TVET system in Nigeria. As 21st Century TVET practitioners, if we must continue to be competitive and relevant in our chosen career globally, we have to imbibe some of these changes and devise means of addressing the accompanying challenges. If education is the key to development, TVET is the master key to the solution of our problems. We must therefore strive to deliver TVET applying various methods such as the PBL, Constructivist, iSTEM and Greening TVET methodologies, and indeed other delivery approaches to transform the culture, mind-set and disposition of our societies, institutions and communities for the better via curriculum change, enlightenment campaigns, campus crusades, research activities etc. To achieve this, we have been charged to make concerted effort and create greening education programmes (GEP) in our educational institutions. Another key point is that Science, Technology, Engineering and Mathematics Education elements of which are being taught in our current TVET system, is deficient in preparing learners for problem-solving and developing creativity in them, in that, we treat each subject discipline as a 'silo' rather than in an integrated form. This has been criticized as being unproductive for this digital era in our contemporary world. Therefore, training our young ones (the 21st Century learners) with 16th or 19th Century methodologies and competencies will not give us the desired results. No problems will ever be solved by the products of our education if problem-solving techniques and skills are not taught to the students at all levels of education. Thus, all TVET stakeholders here are being called upon to put hands on deck in order to ensure transformed and viable educational programme for our dear country, Nigeria. The people, the economy or profit and the environment/planet are all very integral and essential, as such must be protected. As we conference, let us remember the theme, "Refocusing TVET Instructional Delivery in Nigerian Schools in the Digital era" and try to begin to change first our TVET system, and next our delivery of the system possibly by changing the way it is, its objectives, definition, structure, its delivery mode, assessment techniques, and above all our perceptions, culture, attitudes and practices. "Change begins with me" (Buhari, 2016). Thank you for your patience and for reading.

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