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RE-ENGINEERING SCIENCE, TECHNOLOGY, ENGINEERING AND MATHEMATICS (STEM) EDUCATION IN NIGERIAN TERTIARY INSTITUTION BEYOND CERTIFICATION: THE ROLE OF EMPLOYABILITY SKILLS

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Abstract

Most industries or workplaces in the 21st century require STEM Education graduates equipped with employability skills and attributes aside from the right academic qualifications. These skills are required for getting a job, keeping the job and being effective and successful in the job. Unfortunately, STEME graduates have been reported as unemployable, half-baked, excessively theoretical, overloaded with irrelevancies, obsolete and disconnected from the labour market. On this note, this paper therefore x-rays employability skills and ways of promoting the acquisition of these skills among tertiary institution STEME students. It is concluded that, the re-engineering of STEME programs to embed employability skills will lead to the production of high-quality graduates who meet the needs of the current global labour market. The study recommended among others that ministry of education (federal and state) through national universities commission, national commission for colleges of education and national board for technical education should renewed career counselling centres, build tertiary education-industry/ workplace collaboration, renewed pedagogical strategies, re-engineering STEME curriculum, re-engineering mode of assessment and strengthening quality assurance systems to enhance STEME students' knowledge and employability skills for job creation.

Keywords: STEM Education, Employability skills, Workplace collaboration, Carrier counselling centre, Quality assurance.

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Introduction

Education in Science, Technology, Engineering and Mathematics (STEME) explains events in nature, helps people to think and reason in a logical manner, solves problems encountered on a day to day basis, develops social skills through proper handling of objects and equipment, develops social skills by establishing friendship while working cooperatively in groups and helps satisfy curiosity through opportunities in carrying out investigations (TESSA, 2011). The objectives of STEM education are not only to equips students with knowledge of science, technology, engineering and mathematic, but also to develops the competence to apply knowledge to solve real-life problems, thereby increasing learning motivation, researching passion within students and connecting the school with society and community (Blotnicky *et al*.,2018). STEM education and practice are drivers of economic performance, and this is essential for helping growing economies to compete in the global market, create jobs and improve wealth, which leads to the development of peaceful and resilient communities (Rosca *et al*., 2020). The important contribution of STEME as an enabler for sustainable national economic growth was affirmed at the World Summit on Sustainable Development (WSSD) in 2002. According to Olorundare (2010), the inclusion of engineering into STEME can be justified by the mere fact that young children tend to be engineers first; building, making and doing projects long before they can explore scientific principles that allow their buildings to stand or "canals" between puddles to carry water. In the framework of the New Partnership for Africa's Development (NEPAD), African leaders recognized that STEME will play a major role in the economic transformation and sustainable development of any nation (David *et al*., 2018).

In the same vein, the study of Ideozu (2018) has shown that many national leaders have equally acknowledged the significance of STEME. For instance, former president of the United States of America, George Bush hurled the American Competitiveness Initiative, whose aim was to improve STEME and in turn grew the number of working scientists. Izeodu further advanced economics need a continuous training of scientists and engineers who are critical in driving the innovations. The innovations, in turn have a crucial role in the growth of the Gross Domestic product (GDP) of countries. Similarly, former president Barrack Obama also frequently acknowledged the significance of STEME and initiated the "Educate to Innovate" campaign in support of the STEME. It has been the critical instruments used to uplift not only the standard of living but the economy of any nation. The basic reason for the integration of STEME at the level of discipline in high school is the response to the acute demand in the labour market, the professional aspirations of modern youth, the situation in the labour market and economic requirements (Aydin & Zhu, 2017).

Nigeria education, according to FGN (2009), is subdivided into three areas which include primary, secondary and tertiary education. The essence of primary education is to build a foundation or preparatory ground for the learner with manipulative capabilities in order

to be morally sound and contribute meaningfully to the betterment of the country. Also, secondary education prepares learners with certain job-specific skills (e.g., entrepreneurial, vocational and technical education skills) for their independence. At tertiary education in Nigeria, Okute and Olom (2012) stated that STEME is aimed at preparing the individual for the acquisition of appropriate knowledge, skills, competencies and attitudes that equip the individual for self-employment or paid employment in any chosen career in a public or private sector of the economy. This level of education has the mandate to train learners for the work force and self-reliance need. Given its primary role as knowledge provider, tertiary education serve as a powerful means to help create a more sustainable future (Abanyam & Agbo, 2019). STEME programs at this level of education have the fundamental role of preparing the next generation of scientists, technology experts, engineers, and mathematicians to meet 21st century real-world demands in a global economy. STEME graduates this level of education are the guarantors of a country's economic success and social welfare (Knight& Bennett, 2019).

In the bid to ensure quality in tertiary education, Ene (2016) submits that the Nigerian government established commission like the National Universities Commission (NUC), National Commission for Colleges of Education, (NCCE), and National Board for Technical Education (NABTE), as parastatals of the Federal Ministry of Education. These commissions and the Board are mandated to ensure quality tertiary education (Ogunode & Abubakar, 2020). Today, the number of universities, polytechnics and colleges of education (both public and private) keep on increasing. In support of this, Egwunyenga (2018) quoting Yusuf and Afolabi (2014) asserted, that tertiary education in Nigeria since inception in 1932, with the establishment of Yaba higher college and later Yaba college of technology in 1947, tertiary education institutions have grown rapidly from 02 to 481, comprising over 170 universities, 159 polytechnics and 152 colleges of education. Preparing students especially STEME education for employment post-graduation has been a key driver for tertiary education institutions for many years (Succi & Canovi, 2020). Article 81(d) - (e) of the revised NPE, according to NERDC (2013), equally stipulates that tertiary education shall (d) reduce skill shortages through the production of skilled manpower relevant to the needs of the labour market. Hence, it is imperative that these tertiary institutions ensure that their STEME graduates are "employable" and make them productive contributors to the labour market (Olayemi & Oluwatoyin, 2018). The duty of every tertiary education is to provide high-quality student-centered learning with comparative study programs and processes to meet the different needs of the labour market economy in a global economic perspective (Eneji *et al*., 2022).

Unfortunately, in recent times, doubt has been expressed about the relationship between tertiary institutions and job creation in Nigeria (Hack-Polay *et al*., 2019). This is evident by the quality of graduates produced by these tertiary institutions. Bayyat *et al*. (2016) submit that, most Nigerian STEM education graduates lack the skills required to

work in industries: even with their fantastic certificates because they lacked the creative abilities. Labour employers do not rely on the certificate alone in the 21st century for job placement (Audu *et al*., 2013). This perspective is consistent with the findings of Okolie *et al*. (2019b) who found that an overdependence on certificates in Nigeria has promoted poor-quality learning. Okolie *et a*l. further explain that students who are desperate to gain more certificates, given the importance attached to their acquisition, indulge in various forms of malpractice to achieve that end. It is not uncommon for a graduate with a first- or second-class upper division to be employed in an office and even having obtained a high graduation result to not be able to defend the quality of the results they graduated with (Eneji *et al*., 2022).

On a sad note, STEME graduates have been reported by Umar (2019) as unemployable, half-baked, full of theory but lacking in practical content, of dubious quality, deficient in skills and attitude. To worsen the situation, Sodipo (2014) reported that employers of labour do not readily fill the few existing vacancies that occasionally crop up because these graduates are said to be unemployable. In corroboration, Pitan (2016a) reported a high extent of skill mismatch between the 'received' and the 'needed' – life skills for the navigation of the waters of life which has rendered many STEME graduates unemployable. Okolie *et al*. (2019a) affirms that, the majority of Nigerian STEME graduates lack entrepreneurial skills and knowledge that could lead to job creation. Every year, tertiary institutions which are comprised of universities, polytechnics and colleges of education (Harry *et al*., 2018) have been turning out graduates that have persistently congested the labour-market along with the unemployed youths in the nation. Nigeria's labour market is seemingly saturated with job applicants. This among other factors may have led to the present level of massive unemployment in Nigeria.

The rising rate of unemployment in Nigeria has become a nagging concern. National Bureau of Statistics (2020) recorded an increase in the national unemployment rate from 23.1% in 2018 to 33.3% 2020. The multinational consulting firm in a newly released report tagged 'KPMG Global Economy Outlook report HI 2023' projected that this unemployment rate in Nigeria has increased to 37.7% and will rise further to 40.6% in 2023 (Punch, 11th April, 2023). This situation has not only posed a great challenge to the economy but also retarded the socioeconomic growth and security of the country (Surajo & Karim, 2016). Instell (2015) observes the insecurity of the country to be in this order; insurgency in the north, ritual killings in the west, kidnappings in the east, militancy in the south-south and political and non-political assassinations all over the country. Among the factors escalating the insecurities is the rate of unemployment in Nigeria and a continuous increase in the unemployment year in and year out may be associated with lack of employability skills needed by the employers. Therefore, re-engineering STEM education beyond certification to meet present day challenges "employability skills" become a matter of necessity.

Employability Skills

STEM education, by its' nature is a practical oriented, providing lots of opportunities for the development of skills. These skills can be achieved, through the provision of experiences and resources that may help develop analytical thinking, problem solving, scientific, technical skills and many more, through examining and interpreting experimental results and making evaluations which have been reported as employability skills (Okonkwo & Samuel, 2020). Most industries or workplaces in the 21st century require STEM education graduates equipped with specific skills and attributes aside from the right academic qualifications (Suarta *et al*., 2017). These skills are known as employability. The skills required for getting a job, keeping the job and being effective and successful in the job (Muo, 2016) refer to as employability skills. There have been a multitude of definitions of employability (Bennett, 2016). According to Small *et al.* (2018) define employability as the capacity to be self-reliant in navigating the labour market, utilising knowledge, individual skills and attributes, and adapting them to the employment context, showcasing them to employers while taking into account external and other constraints. Wilson *et al*. (2017) see employability skills as critical thinking, complex problem-solving, emotional intelligence, creativity, judgment, decision-making, cognitive flexibility, people management, service orientation, and coordinating with others and negotiation. Employability as the ability of graduates to possess and exhibit the knowledge, skills, attributes and attitudes needed to get and maintain jobs in which they can be successful and fulfilled (Pitan, 2016a). The following are ways of developing employability skills in STEME students

Re-engineering STEME Curriculum

One of the reasons why graduates find it difficult to secure jobs after graduation may be traced to inadequate curriculum adopted by their institutions (Sara & Mburza, 2011). This is because curriculum seems to reflect what teachers regard as relevant rather than the skills employers require (Jang, 2015). To meet this challenge, the Federal Government set up the National Directorate of Employment in 1987, which was charged with responsibility to reduce unemployment amongst youths by creating jobs and fostering entrepreneurship (Wombat *et al*., 2018). The major aim was to educate individuals in tertiary institutions on entrepreneurship, thereby building intention and impacting skills, attitudes, and competencies that would ensure effectiveness in the workforce after graduation (Olorundare & Kayode, 2014). Based this, STEME programs must develop professional competencies today for the future (Sanchez- Carracedo *et al*., 2018), and tertiary institutions must recognize the value of providing employability skills in the curriculum. Skills development can be embedded in a curriculum with training sessions targeting specific skills (Galloway, 2017). This is in accordance with Oghiagbephan's (2015) assertion that quality STEM education through a re-engineering STEM curriculum is the

key to increasing human capital and economic growth. Okolie *et al*. (2019a) see the curriculum as the main focal point in developing entrepreneurial and job creation skills.

Along with addressing the question of relevance through curriculum reviews, tertiary institutions today should include entrepreneurship in their curricula to foster the employability of their graduates (Clarke, 2018). Entrepreneurship could therefore be seen as the act of identifying, initiating, organizing, and bringing an idea or vision to life, be it a new product, service, process, strategy, or market (Mbanefo & Eboka, 2017). Entrepreneurship education should be embedded as part of the STEME core curriculum and students should be trained to possess innovative, creative and entrepreneurship skills in order to develop employability skills and be able self-employed. Entrepreneurship education is a programme that prepares individuals to undertake the formation of acquisition of small business (Nwanshak & Ochigbo, 2021). Entrepreneurship education has been revealed as an effective tool in building up entrepreneurship intention and innovation, thereby increasing the number of entrepreneurs an (reducing the rate of unemployment. "Entrepreneurship education consists of three ingredients: creativity—creating all kinds of ideas; innovation—find value in selected ideas; and entrepreneurship—develop a business from the innovative idea" (Nwekeaku, 2013). Alharbi *et al*. (2018) reveal that entrepreneurship education can be taught to any student irrespective of the course of study and these programmes can build not just knowledge but also the intention which informs the action to be an entrepreneur – start a business enterprise.

It is also conceived that the full knowledge of entrepreneurial skills and competencies is derived from entrepreneurship education and this knowledge drives an intention to be relevant in the workforce and make change in the environment (Onuma, 2016). Ndubuisi-Okolo and Amekwe (2018) rightly stated that promotion of creativity and entrepreneurship can help generate job creation. They further agreed to the findings of this study that creativity is capable of stimulating youth empowerment, entrepreneurship development and self reliance to attain sustainable development. Creativity has been described as the generation of ideas and appropriate solutions to open-ended problems in any domain of human activity (Sogol & Dana, 2018). Lemchi *et al*. (2016) remarked that creativity is vital to sustainable development adding that it involves developing problem solving skills, evolving new technologies and new ways of solving problems. Usman (2016) equally observed that creativity seems to be the fundamental premise and the genesis of entrepreneurial activity. Hernandez and Gonzalez-Roma (2016), views innovations as new ideas, new methods or interventions aimed at improvement of a programme or venture. Based on this, STEME teachers need to teach STEME students in such a way that they will promote some essential innovative, creative and entrepreneurial skills in the students (Agommuoh *et al*., 2020).

Re-engineering Mode of Assessment

A central goal of STEM education is to help students improve higher-order thinking skills (HOTS) to help them face the challenges in their daily lives by improving cognitive skills

such as critical thinking, reasoning, reflective thinking and science process skills (Zachariades *et al*., 2013). In STEM education classroom, skills that include the use of HOTS are complex thinking that goes beyond basic recall of facts, such as evaluation and invention, enabling students to retain information and to apply problem solving solutions to real world problems (Ramos *et al*., 2013). According to Nguyen (2018), HOTS includes the ability to think critically, reflective, meta-cognitive, creative thinking. Rosli and Maarof (2017) see HOTS as the ability to apply knowledge, skills and values to make reasoning and reflection to solve problems, make decisions, innovate and strive to create new things. Despite varied viewpoints, there is general consensus that HOTS can be associated with skills that include critical, logical, reflective, metacognitive and creative domains (Azian *et al.*, 2017). The revised Bloom's taxonomy has six levels: remembering, understating, applying, analyzing, evaluating and creating. Bloom's taxonomy is an instructional framework that is often used to determine the outcomes of teaching and learning (Bergmann & Sams, 2014b). To Bloom Taxonomy, questions asking for analysis, evaluation, and creation are classified as higher order thinking questions (Bowker & Fazioli, 2016) and are valued in preparing students for their future careers and advanced academic work (Ramos *et al*., 2013).

In order to realize this need, it becomes a must to familiarize students to develop HOTS that can be seen from several aspects such as critical thinking, creative, problem solving, and high level decision making that can be developed in the learning process (Pramesti *et al*., 2019), both in the classroom and in the laboratory (Yonata & Nasrudin, 2018), and in assessment activities (Razmawaty & Othman, 2017). The effectiveness of HOTS as an important predictor of success for the future is evident in research studies. HOTS believed able to develop students' academic performance and prepared the future generations in the elements of lifelong learning, problem-solving and critical and analytical thinking (Zainudin *et al.*, 2018). Lee and Choi (2017) argue that the HOTS issue has an important role in the education success, in academics and also in the workplace. The use of HOTS questions in exams can spur on students to think deeply how to answer the questions in learning and help increase students learning motivation, because HOTS questions bring stimulus that come from surrounding environment (Ghani *et al*. 2017). In addition, HOTS questions can also improve the achievement of student learning outcomes so that they can be competitive both nationally and internationally (Fanani, 2018). Moreover, HOTS plays a role in the training of logical and critical thinking, as well as reasoning skills, that are fundamental to everyday life. These skills set are also parts of academic achievement called employability skills (Marshall & Horton, 2011).

Re-engineering Pedagogical Strategies

Employability is "predominantly conceptualized as the skills and personal attributes considered important by industry and needed by graduates in order to secure employment" (Rowe & Zegwaard, 2017). The acquisition of a life-long employability skills

calls for effective and efficient teaching strategies and the utilization of improved and standard instructional facilities, to ensure the production of desired quality of graduates with enterprising skills (Okeke-ezeayanwu, 2021). Nwazor and Onokpaunu (2016) disclose that strategies are laid down framework of plans and actions of an organization geared towards achieving its set objectives in the short and long run. Developing employability skills requires STEME teachers moving away from ineffective teaching and learning strategies to student centred learning strategies. Bennett *et al*. (2020) disclose that effective learning of employability skills requires that the STEM education curriculum use teaching and learning strategies that are constructivist, inquiry-based, reflective, collaborative, and integrative.

Several researchers have emphasized some strategies for developing employability skills in STEM programs. Sogol and Dana (2018) specifically mentioned guided discovery, peer tutoring and programmed instruction teaching strategies as effective in stimulate students' independence and critical thinking ability. They opined further that these student centred strategies are capable of enhancing creativity skills in students. In the same vain, Ekwue *et al*. (2019) revealed nine key strategies for which there is evidence of successful outcomes in improving students' employability skills acquisition. If new teaching strategies such as problem-based learning, flipped teaching, industrial attachment, teaching practice, career seminars enquiry-based learning, work-based learning, practice-based learning, self-directed learning, cooperative learning and collaborative learning are adopted, students will develop core entrepreneurial knowledge and skills (Okolie *et al.,* 2021). More so, Robson *et al.* (2015) equally mention that game-based educational activities are seen as novel strategies to increase student engagement and encourage more active learning. There are few explorations of game-playing or gamification for work-integrated learning (Barr, 2019) but the research has suggested that game-based elements help to develop work competencies and to address psychological needs for competence, autonomy, and relatedness and thereby increase learners' motivation in working or learning contexts. Fional and Bhavik (2021) opine that this activity provided a creative platform for students to showcase a range of employability skills, which they reflected upon immediately afterward and a year after graduating. These strategies promote the use of higher order thinking skills as well as employability skills.

Re-engineering Career Counselling Centres

Skill acquisition service and counselling are vital for the tertiary education organization (Sujadi *et al*., 2020). Although several tertiary education institutions already exist, not all of them have established standard career counselling centres. As a result, students in higher education who have difficulties are unsure how to seek professional assistance; thus, some of them are determined to communicate their concerns with their friends and even on social networking websites (Azeem *et al*., 2021). Hayati and Sujadi (2018) opined

that, counselling services in tertiary institutions are necessary. A tertiary institution is the point where a student as a mature person comes to finalize their plans about careers and require counselling assistance for dealing with learning challenges for effective learning outcomes. On this premise, re-engineering career development centres in tertiary institutions become a necessity. Career counselling is the process that assists a person in obtaining suitable placements/jobs, resolving disputes with their employers, or locating other valuable services (Savickas, 2019). Different studies have clarified that facing troubles in career decision making have often been used as a benchmark to measure career services' effectiveness (Spurk *et al*., 2015). Jacquin and Juhel (2017) explained effectiveness of career services by concentrating on its results and followed procedures that enabled graduates get prepared and employed in no time. Career counsellors' main focus is to help clients know their interests, abilities, values and strengths, encourage them to explore options, set career goals and take actions (Jordon & Marinaccio, 2017). In the career counselling procedure, career counsellors can assist people in getting a better awareness of what is important to them, how to plan their careers independently, and how to make difficult decisions and get through times of crisis using their counselling and teaching skills (Savickas, 2019). The benefits of carrier counselling had been stressed by many researchers in the literature review. Sujadi (2018) observe that students strongly support career counselling at the tertiary institution level, suggesting that career counselling should be provided at the time of admission and the end of the degree and also during the education; in this situation, university-level students who are having difficulties find it challenging to acquire professional assistance; thus some of them decide to communicate their concerns with their friends and even on social networking sites. Dey and Cruzvergara (2014) explain that tertiary institutions' career counselling centres play active roles in the employment and success of their students even after they finish their programs.

Building Tertiary Education-Industry/ Workplace Collaboration

It has been observed by Bunshaft *et al*. (2015) that, there is a gap between the content that is delivered in academic STEME programs and what is valued in education versus the current requirements in the industries/workplaces. For example, academia ensures that students are familiar with curricula (theoretical knowledge and content-specific tasks) and have the ability to learn. At the same time, employers believe that graduates need stronger technical (i.e., practical skills) and interpersonal skills (Jackson *et al*., 2016). Owens and Tibby (2014) suggest that employers value innovative, adaptable, resilient graduates with flexible enterprise skills, an enterprising mindset and business awareness, which are mainly the outcome of enterprise learning. But today's education is more about doing than knowing (Bunshaft *et al*., 2015). This is the reason why STEM educators need to focus more on work-integrated learning or industry-based learning than traditional discipline specific knowledge (Rayner & Papakonstantinou, 2015) and emulate a

collaborative approach to their students (Bunshaft *et al*., 2015). To achieve this mission, tertiary institutions must formulate a sustainable collaboration with industry/ workplace, government and community. Inevitably, if tertiary institutions design educational programs without engaging employers, such programs may fall short of societal needs and cause graduates to suffer unemployment (Mgaiwa, 2021). Mbah (2014) view that, the lack of collaborations may result in the absence of programs, courses, and subjects relevant to potential employment.

Therefore, tertiary institutions and employers must collaborate to reflect current and future priorities of the workplace to enhance graduates' work readiness (Rayner & Papakonstantinou, 2015). In addition, scholars have provided some exemplary case studies, such as China, the Netherlands, and Singapore that address the mismatch between tertiary education and skills supply and ways of making tertiary education more relevant to the labour market, by increasing collaborations with employers and industries (Wang & Liu, 2011). Rowe and Zegwaard (2017) disclose that, tertiary institution- industry collaboration practices share a common aim of connecting theory to practice, and they come in many forms such as work placements, internships, conducting real life projects (for students), curriculum development, research and development (for academics), guest speakers, recruitment drives or practical projects of various types. Arguably, the competencies and knowledge acquired through internships can enhance students' employability in the global knowledge economy (Tran Thi Tuyet, 2017). In addition, Tetrevova and Vlckova (2018) contended that the main contribution of tertiary education–industry collaborations lies in creating competitiveness through knowledge transfer and the production of high-quality graduates who meet the needs of the current global labour market.

Strengthening Quality Assurance Systems

All institutions are expected to have quality assurance mechanisms in place as a way of assuring stakeholders about the high standards of their programmes and their achievement through outcomes (Olayemi & Oluwatoyin, 2018). In relation to educational institutions, quality refers to a measure of how good or bad the products of tertiary institutions in Nigeria are in terms of academic performance and meeting globally established standards. That is the ability of tertiary institutions to conform to established standards and appropriateness, and the availability of imputes to meet the needs of the society for which it was established (Alaka & Obadara, 2013). This sets the background for meaning of quality assurance. Oladosu cited Okoro & Aguguam (2017) stated quality assurance as the process of monitoring quality and ensuring that standards are not only continuously sustained but also improved upon. According to him, it entails continuous assessment, evaluation, maintenance and improvement of quality by an institution or a programme. Kpolovie (2013) describes quality assurance as "a process centred approach for certifying that an organization is providing the best possible products or services; it

focuses on enhancing and maintaining the processes that are used to create the end result, rather than focusing on the result itself". Alaka and Obadara (2013) opined that quality assurance in the tertiary system implies the ability of the institution to meet the expectations of the users of manpower in relation to the quality of skills acquired by their outputs.

For quality tertiary education to be successful in any nation, all the key players of learning which include the teacher, learners, instructional materials and environment must be arranged in a co-operative way. Generally, quality assurance systems ensure that tertiary institutions are not reduced into degree mills. It is noteworthy that quality assurance principles regulate both the external and internal activities of an educational institution. The activities of internal quality assurance involve stages that are meant to appraise the system and likewise its processes to determine the weaknesses and possible remedial measures for possible solutions. External quality assurance refers to the monitoring and evaluation for agreement with stipulated rules and standards carried out by statutory agencies from outside the tertiary institutions (Okoro & Aguguam, 2017). The non-existence of internal and external quality assurance measures will lead to the disappearance of the aims of producing experienced, skilled and proficient manpower that will be in the governance of the country. To Okoro and Aguguam (2017), quality assurance upholding the reliability of programmes and the worthiness of the certificates issued by tertiary institutions of learning; providing confidence to teachers themselves; makes tertiary institutions to be competitive both nationally and internationally. Quality assurance should be in the lime-light of every educational policy and beyond if the objectives of tertiary institutions are to be achieved.

Conclusion

STEM education graduates have continuously been found incapable of meeting up with the employment requirements of the industry/workforce and have thus been unsuccessful in either securing or keeping a job. This, in turn, makes Nigeria's labour market seemingly saturated with job applicants and led to the present level of massive unemployment in Nigeria. Nigeria's unemployment level has increased with lots of consequences on socioeconomics and security. Clearly, it is therefore concluded that re-engineering of STEM education is the key to develop employability skills in STEM education students that match the demands required by industry/workplace and reduce unemployment and insecurity. With the re-engineering of STEM education directed to solve deep-rooted foils, Nigeria would not only boast of quality graduates to run governance efficiently but also record a considerable reduction in unemployment and insecurity.

Recommendations

Arising from the foregoing, the following recommendations have been made:

(i) There should be an urgent tertiary institutions STEME curriculum overhauling in such a way it will promote essential innovative, creative and entrepreneurial skills in the STEME students. This will foster the employability of their graduates and reduce unemployment and insecurity.

(ii) Government should as a matter of urgent public interest improve the funding of education and improve their lukewarm attitude towards funding tertiary institutions in Nigeria.

(iii) The Nigerian Government and tertiary institutions management should upholding the reliability of programmes and the worthiness of the certificates issued by tertiary institutions of learning; providing confidence to teachers themselves; makes tertiary institutions to be competitive both nationally and internationally through internal and external quality assurance systems.

(iv) Ministry of education (federal and state) through National Universities Commission, National Commission for Colleges of Education and National Board for Technical Education should collaborate with industry/workplace in creating competitive programs through knowledge transfer and the production of high-quality graduates who meet the needs of the current global labour market.

(v) Students should do their Students Industrial Work – Experience Scheme (SIWES) in places relevant to their discipline so as to have hands-on experience and be familiar with the latest and modern equipment before they get employed. Also, students should be encouraged to have a paradigm shift in their orientation of searching for jobs that are just not available, but aspire to be employers of labour themselves.

(vi) The board of regulatory bodies such as the National Universities Commission (NUC), National Board for Technical Education (NBTE), and National Council of Colleges of Education (NCCE) should be restructured in a manner that their membership would accommodate representatives of the private sector to ensure and monitor that the curricular used in these institutions are in line with their recommendations i.e. the curricular reflecting what the private sector wants.

(vii) Ministry of education (federal and state) through National Universities Commission, National Commission for Colleges of Education and National Board for Technical Education should establish or revitalize standard career counselling centre to guide the students in their choices of career, how to cope with the challenges they may face in the work place and how to transit into working class situation. This centre may engage in tracking the employability performance of their graduates.

(viii) Since HOTS plays a role in the training of logical and critical thinking, as well as reasoning skills, that are fundamental to everyday life, tertiary institutions should organize seminars or workshops for their lecturers/teachers on use of HOTS questions. This will improve the achievement of STEME student learning outcomes so that they can be competitive both nationally and internationally.

(ix) Nigerian Tertiary institution lecturers/teachers should be encouraged and trained to engage STEME students with new pedagogical strategies such as laboratory strategy, activity oriented, metacognitive, problem-based learning, flipped

teaching, work-based learning, practice-based learning, self-directed learning, cooperative learning, collaborative learning and so on. This will help students to develop core entrepreneurial knowledge and employability skills.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

Abanyam, N.L. & Agbo, M.O. (2019). Examination malpractice as a challenge to national development in Nigeria. *Benue Journal of Sociology*, 7 (1), 283 – 295.

Alharbi, J., Almahdi, H.& Mosbah, A. (2018). The impact of entrepreneurship education programs (EEPs) on the entrepreneurial attitudes among higher education students. *International Journal of Management, Economics and Social Sciences*, 7(3), 245 –271.

Agommuoh, P. Chinyere, T.& Ndirika, M. (2020). Promoting innovation, creativity and entrepreneurship skills in science education Students: A Panacea for Employability. *Journal of Education and Practice*,4(Issue 3), 44 – 55.

Aina, J.K. & Ogundele, A.G.(2014). Overcoming tertiary institutions' challenges through science and technical education. *International Journal of Research in Humanities and Social Studies*, 1(Issue 1), 1-6.

Audu, R., Kamin Y. B. & Saud, M. S. B. (2013). Acquisition of employability skills in technical vocational education: Necessity for the 21st -century workforce. *Australian Journal of Basic and Applied Sciences,* 7(6), 9-14.

Azeem, A., Faiz, Z., Siddique, M., Ali, M. S., & Warraich, W. Y. (2021). School psychologists' perspectives about effectiveness of behaviour therapy for children with attention deficit hyperactivity disorder in Pakistan. *Humanities & Social Sciences Reviews,* 9(3), 1142-1155.

Aydin, A. & Zhu, C.(2017). Investigating variables predicting Turkish pre-service teachers' integration of ICT into teaching practices. *British Journal of Educational Technology*, 48 (Issue 2), 552-570.

Azian. A. A., Fauziah, I., Noor, M. I, Norhanim, A. S. (2017). Investigating the implementation of higher order thinking skills in Malaysian classroom: Insights from L2 teaching practices. *Sains Humanika*, 9. 4-2, 65–73.

Barr, M. (2019).Graduate skills and game-based learning: Using video games for employability in higher education; Springer.

Bayyat, M., Orabi, S. M. & Altaieb, M. H. A. (2016). Life skills acquired in relation to teaching methods used through swimming context. *Asian Social Science,* 12(6), 223-231.

Bennett, D. (2016). Developing employability in higher education music. *Arts and Humanities in Higher Education*, 15(3–4), 386–395.

Bennett, D., Knight, E., & Rowley, J. (2020). The role of hybrid learning spaces in enhancing higher education students' employability. *British Journal of Educational Technology*, 51,1188–1202.

Bergmann, J. & Sams, A. (2014b). *Flipped Learning: Gateway to Student Engagement.* Washington DC: International Society for Technology in Education.

Blotnicky, K. A., Franz-Odendaal, T., French, F. & Joy, P. (2018). A study of the correlation between STEM career knowledge, mathematics self-efficacy, career interests, and career activities on the likelihood of pursuing a STEM career among middle school students. *International Journal of STEM Education,* 5, 22.

Bowker, M. H. & Fazioli, K. P. (2016). Rethinking critical thinking: A relational and contextual approach. *Pedagogy and the Human Sciences*, 6(1), 1-26.

Bunshaft, A., Curtis-Fink, J., Gerstein, A., Boyington, D., Edwards, T. & Jacobson, C.(2015), "Focus on employability skills for STEM workers: Points to experiential learning". *STEM connector's STEM Innovation Task Force*, 7, 856-76.

Clarke, M. (2018). Rethinking graduate employability: The role of capital, individual attributes and context. Studies in Higher Education, 43(11), 1923-1937.

David, E., Dallatu, Y.R. & Yusuf, A. (2018). Science, technology, engineering and mathematics (stem) education for sustainable national economic growth. *59th Annual Conference Proceedings, STAN*, 33-40.

Dey, F. Y.& Cruzvergara, C. Y. (2014). Evolution of Career Services in Higher Education. *New Directions for Student Services*, 43-56.

Egwunyenga, E. J. (2018). "Tending the Ivory Tower Swimming against the tide" 63rd in the series of Inaugural lecturers of the Delta State University, Abraka, Nigeria, 71-83.

EDITOR-IN-CHIEF
Prof. A.I. Mteiye [MALAWI]

Ekwue, K. C., Udemba, N. F.& Ojuro, C. I. (2019). Strategies for improving employability skills acquisition of business education students. *Nigerian Journal of Business Education,* 6(1), 94-106.

Ene, I. E. (2016). Quality assurance in Nigerian tertiary institutions: a significant factor for sustainable democracy. *International Journal of Education and Research,* 4(7), 98-116.

Eneji,C.O.,Petters,J.S.,Esuabana,S.B.Onnoghen,N.U.,Udumo,B.O.,Ambe,B.A.,Essien,E.E., Unimna,F.A., Alawa, D.A.& Ikutal, A.(2022). University academic dishonesty and graduate quality for national development and global competitiveness: Nigerian Universities in Perspective. *International Journal of Learning, Teaching and Educational Research,* 21(5), 401-427.

Fanani, M. Z. (2018). Strategi pengembangan soal HOTS dalam kurikulum 2013. *Edudeena*: *Journal of Islamic Religious Education,* 2(1), 57–76.

Federal Government of Nigeria. (2009). *National policy on education. Lagos*: NERDC.

Federal Republic of Nigeria (2013). *National Policy on Education*. 5th ed, NERDC Press.

Federal Republic of Nigeria (2014). *National Policy on Education*. Abuja: NERDC.

Fiona, P.& Bhavik, A.P. (2021). Work-Integrated Learning: A game-based learning activity that enhances student employability. *Journal of Chemical Education*, 98, 888–895.

Galloway, K. W. (2017). Undergraduate perceptions of value: degree skills and career skills. *Chemistry Educational Research Practice*, 18 (3), 435–440.

Ghani, I. B. A., Ibrahim, N. H., Yahaya, N. A., & Surif, J. (2017). Enhancing students' HOTS in laboratory educational activity by using concept map as an alternative assessment tool. *Chemistry Education Research and Practice*, 18(4), 849–874.

Hack-Polay, D., Igwe, P.A. & Okolie, U.C. (2019) Room for improvement: a study of overconfidence in numerical skills among British graduates. *Industry & Higher Education*, 2(5), 34-46.

Harry, T., Chinyamurindi, W. T. & Mjoli, T. (2018). Perceptions of factors that affect employability amongst a sample of final-year students at a rural South African university. *South African Journal of Industrial Psychology*, *44*(1), 1-10.

Hayati, I. R. & Sujadi, E. J. T. J. I. P. (2018). Perbedaan keterampilan belajar antara siswa IPA dan IPS. 14(1),1-10.

Hernandez, A., & Gonzalez-Roma, V. (2016). Uncovering the dark side of innovation: The influence of the number of innovations on work teams" satisfaction and performancethrough negative team mood. *European Journal of Work and Organizational Psychology*,25, 570–582.

Ideozu, S. (2018). STEM and economic growth: implications for research, curriculum and teaching. 59th *Annual Conference proceedings, STAN*, 61-66.

Instell, F. (2015). *The cost and effect of insecurity in Nigeria*, Retrieved October 16th 2015 from http://www.myfinancialintelligence.com/proffessional-services/cost,andeffectinsecurity-nigeria.

Jackson, K., Lower, C. L. & Rudman, W., J. (2016), "The crossroads between workforce and education", *Perspectives in Health Information Management*, 13, 45-64.

Jacquin, P. & Juhel, J. (2017). An individual mixed-evaluation method for career intervention. *The Career Development Quarterly*, 65(1), 16-28.

Jang, H. (2015). "Identifying the 21st century STEM competencies using workplace data", *Journal of Science Education and Technology*, 2, 1-33.

Jordon, A. L. & Marinaccio, J. N. (2017). Chapter 3. In Facilitating career development: An instructional program for career services providers and other career development providers. *National Career Development Association*, 45-53.

Knight, E., and Bennett, D. (2019), "Employability thinking and the future of STEM", *Developing Employability,* 5, 1-8.

Kpolovie, P. J. (2013). Quality assurance in the Nigerian educational system: matters arising. maiden education summit organized by the Nigerian Army Education Corps(NAEC), 4th–8th November at Uyo, Akwa Ibom state.

Lee, J. & Choi, H. (2017). What affects learner's higher-order thinking in technology-enhanced learning environments? The effects of learner factors. *Computers and Education*, 115(January), 143–152.

Lemchi, I., Ezema, N. P. & Iloeje, C. (2016). Promoting self reliance through the enhancement of creativity in Home Economics students for sustainable development. *Researchgate Journal*, 1(2), 275-287.

Marshall, J. C. & Horton, R. M. (2011). The relationship of teacher-facilitated, inquiry-based instruction to student higher-order thinking. *School Science and Mathematics,* 111(3), 93-101.

Mbah, M. F. (2014). The dilemma of graduate unemployment within a context of poverty, scarcity and fragile economy: Are there lessons for the university? *International Journal of Economics and Finance*, 6(12), 27–36.

EDITOR-IN-CHIEF
Prof. A.I. Mteiye [MALAWI]

Mbanefo, M. C. &Eboka, O. C. (2017). Acquisition of innovative and entrepreneur skills in basic science education for job creation in Nigeria. *Journal of International Council of Association for Science Education*, 207- 213.

Mgaiwa,S.J.(2021). Fostering graduate employability: rethinking Tanzania's university practices. *SAGE Open*, 1–14.

Muo, I.K. (2016). Skill mismatch and employability in Nigeria; A Review of Literature. *Journal of Advances in Humanities*, 4(5), 575-579.

Ndubuisi-Okolo, P. U. & Anekwe, R. I. (2018). Strategies for achieving sustainable development in Nigeria: The nexus. *International journal of academic research in business and social sciences,* 8(6), 168-180.

Nigerian Educational Research and Development Council (2013). *Federal Republic of Nigeria National Policy on Education (6th Ed.)*. Abuja, Nigeria: Author.

Nwanshak, M.B.& Ochigbo, S.E.(2021). Innovation and creativity in tertiary institutions in Nigeria: the role of entrepreneurship education. *The Intuition, 9*(1),1-13.

Nwazor, J. C., & Onokpanu, M. O. (2016). Strategies considered effective for transforming business education programmes to the needs of 21st century workplace in Delta State, Nigeria. *African Journal of Education and Practice,* 1(2:5), 74-82.

Nwekeaku, C. (2013). Entrepreneurship education and challenges to Nigerian universities.*Journal of Education and Practice*, 4 (3), 51-56.

Obadara, O.E. & Alaka AA.(2013). Accreditation and quality assurance in Nigerian Universities. *Journal of Education and Practice*, 4,13-41.

Oghiagbephan, A.D. (2015). Restructuring educational goals for national and economic development in Nigeria. *IOSR Journal of Research & Method in Education*, 5(4), 08–14.

Ogunode, N.J.& Abubakar, M.(2020). Higher education in Nigeria: Challenges and the ways forward. *Electronic Research Journal of Behavioural Sciences*, 3, 84-98.

Okeke-ezeanyanwu, J.(2021). Strategies for improving employability skill acquisition of business education students in the e-world in tertiary institutions in Anambra state. *Multidisciplinary Journal of Vocational Education& Research,* 14 (1), April *174 – 18.*

Okolie, U.C., Igwe, P.A. & Elom, E.N. (2019a). Improving graduate outcomes for technical colleges in Nigeria. *Australian Journal of Career Development* 28(1): 21–30.

Okolie, U.C., Nwajiuba, C.A., Eneje, B., Binuomote, M.O., Ehiobuche, C. & Hack-Polay, D., (2021). A critical perspective on industry involvement in higher education learning: Enhancing graduates' knowledge and skills for job creation in Nigeria.98-105.

Okolie, U.C., Nwosu, H.E., Eneje, B.N., et al. (2019b). Reclaiming education: Rising above examination malpractices and its contextual factors on study progress in Nigeria. *International Journal of Educational Development,* 65, 44–56.

Okonkwo, I.G.A. & Samuel N. N.C.(2020). Chemistry education and acquisition of employability and production skills: A case study. *Unizik Journal of Educational Research and Policy Studies,*11 (1), 116-128.

Okoro, C. O.& Aguguam, .C. N.(2017). Strategies for transformation of higher education towards enhanced productivity in Nigeria - The role of quality assurance. *European Scientific Journal*, 13(10), 137-148.

Okute, A. L. & Olom, P. A. (2012). Entrepreneurship education as a tool for sustainable national economy: Entrepreneurs' perception. *Nigeria Vocational Association Journal*, 17(1), 1-10.

Olayemi, A.O. & Oluwatoyin F. O.(2018). Quality of university education and employability of universities' graduates in Nigeria. *Journal of Education Review*,10(1), 63-70.

Olorundare, A. S. & Kayode, D. J. (2014). Entrepreneurship education in Nigerian universities: A tool for national transformation. *Asia Pacific Journal of Educators and Education*, 29, 155-175.

Olorundare, A.S. (2010). *Where Is The STEM? Missing Context In Science, Technology, Engineering And Mathematics Instructions.* A Paper Presented At The 15th Kwara State Conference Of The Science Teachers Association Of Nigeria, Ilorin.

Onuma, N. (2016). Entrepreneurship Education in Nigerian Tertiary Institutions: A Remedy to Graduates Unemployment. *British Journal of Education*, 4(5), 16-28.

Owens, J. & Tibby, M. (2014). *Enhancing employability through enterprise education: Examples of good practice in higher education*. UK: The Higher Education Academy.

Pitan, O.S. (2016a). Towards enhancing university graduates employability in Nigeria. *Journal Sociology Soc. Anth*, 7(1), 1-11

Pramesti, B. N., Sajidan, S., Dwiastuti, S. & Setyaningsih, E. (2019). The feasibility of biology module based on Stim-HOTS models. *JPBI (Jurnal Pendidikan Biologi Indonesia) J*, 5(1), 101–108.

EDITOR-IN-CHIEF
Prof. A.I. Mteiye [MALAWI]

Ramos, J. L. S., Dolipas, B. B., & Villamor, B. B. (2013). Higher order thinking skills and academic performance in physics of college students: A regression analysis. *International Journal of Innovative Interdisciplinary Research,* 1(4), 48-60.

Rayner, G. M. & Papakonstantinou, T. (2015), "Employer perspective of the current and future value of STEM graduate skills and attributes: An Australian study", *Journal of Teaching and Learning for Graduate Employability,* 6(1), 100-115.

Razmawaty, M. & Othman, L. (2017). Authentic assessment in assessing higher order thinking skills. *International Journal of Academic Research in Business and Social Sciences*, 7(2), 466–476.

Robson, K., Plangger, K., Kietzmann, J. H., McCarthy, I.& Pitt, L.(2015). Is it all a game? Understanding the principles of gamification. *Business Horizons,* 58 (4), 411–420.

Rosca, E., Nivedita, A & Alexander, B. (2020). Women entrepreneurs as agents of change: a comparative analysis of social entrepreneurship processes in emerging markets. *Technological Forecasting and Social Change*, 157, 120067 (May).

Rosli, M. F. M. & Maarof, N. (2017). The effects of higher order thinking skills questions in improving ESL pupils` writing performance. *The 5th Global Summit on Education*, 70-80.

Rowe, A. D., & Zegwaard, K. E. (2017). Developing graduate employability skills and attributes: Curriculum enhancement through work-integrated learning. *Asia-Pacific Journal of Cooperative Education, Special Issue, 18*(2), 87-99.

Sanchez Carracedo, F., Soler, A., Martin, C., Lopez, D., Ageno, A., Cabre, J. &Gibert, K. (2018), "Competency maps: An effective model to integrate professional competencies across STEM curriculum", *Journal of Science Education and Technology,* 27, 448-468.

Sara, S. S. & Mburza, A. (2011). Determinants of self-employment among unemployed graduates in Jigawa State. Implications for career development. *Conference proceeding of National Conference of the Counselling Association of Nigeria (CASSON)*, Pp 11 – 20.

Savickas, M. (2019). *Career counseling*. American Psychological Association Washington, DC.

Small, L., Shacklock, K.& Marchant, T.(2018). "Employability: A contemporary review for higher education stakeholders." *Journal of Vocational Education & Training,* 70 (1), 148–166.

Sodipo O.O. (2014). Employability of Tertiary Education Graduates in Nigeria: Closing the Skill Gap. *Global Journal of Human Resource Management*..2(3), 28-36.

Sogol, H. & Dana, H. (2018). Creativity in business education: A review of creative self-belief theories and arts-based methods. *Journal of open innovation: Technology, market and complexity*, 4, 45-55.

Spurk, D., Kauffeld, S., Barthauer, L. & Heinemann, N. S. (2015). Fostering networking behaviour, career planning and optimism, and subjective career success: An intervention study. *Journal of Vocational Behaviour*, 87, 134-144.

Suarta, M., Suwintana, K., Sudhana, G. P. F. P., & Hariyanti, N. K. D. (2017). Employability skills required by the 21st-century workplace: A literature review of labour market demand. *Advances in Social Science, Education and Humanities Research*, 102, 337–342.

Succi, C. & Canovi, M. (2020). Soft skills to enhance graduate employability: Comparing students and employers' perceptions. *Studies in Higher Education*, 45(9), 1834–1847.

Sujadi, E. J. T. J. I. P. (2018). Kode etik profesi konseling serta permasalahan dalam penerapannya. 14(2), 69-77.

Sujadi, E., Meditamar, M. O., & Wahab, M. (2020). Islamic Counseling Program to Resolve Personal, Social, Career and Academic Problems of Students. *Tarbawi: Jurnal Ilmu Pendidikan,* 16(1), 59-70.

Surajo, A. Z. & Karim, A. H. M. Z. (2016). Youth unemployment and poverty in Nigeria: a threat to sustainable growth and development. *International Journal of Scientific Research and Management (IJSRM),* 4(11), 4919-4928.

TESSA (2011). *Manual for The Re – Training of Teachers: Basic science and Technology*, Abuja. Universal Basic Education Commission.

Tetrevova, L. & Vlckova, V. (2018). Benefits, limitations and measures concerning the development of cooperation between higher education institutions and external entities. *Tertiary Education and Management*, 24(4), 377–394.

Tran, Thi Tuyet (2017). Enhancing graduate employability and the need for university-enterprise collaboration. *Journal of Teaching and Learning for Graduate Employability,* 7 (1), 58-71.

Umar,Y.(2019). STEM Education as a catalyst for national development: problems and prospects. *Journal of Learning Science and Mathematics,* 14, 48-59.

Usman, T. I. (2016). Teaching methods students' academic performance in kinemedical motion. *American Journal of Social Sciences and Humanities,* 3(1), 69-87.

Wang, X. & Liu, J. (2011). China's higher education expansion and the task of economic revitalization. *Higher Education*, 62(2), 213–229.

Wilson, C., Lennox, P.P., Hughes, G. & Brown, M. (2017). How to develop creative capacity for the fourth industrial revolution: creativity and employability in higher education. In F. Reisman (Ed.), *Creativity, Innovation and Wellbeing,* 241-274. Philadelphia, USA: KIE Conference Publications.

Yonata, B. & Nasrudin, H. (2018). Laboratory activity worksheet to train high order thinking skill of student on surface chemistry lecture. In *Journal of Physics: Conference Series,* 947, 1–7.

Zachariades, T., Christou, C. & Pitta-Pantazi, D. (2013). Reflective, systemic and analytic thinking in real numbers. *Educational Studies in Mathematics,* 82(1), 5-22.

Zainudin, H., Jayalatchmee, M., Lokman, T., Rohaya, T., Sanitah, M.Y. & Noor, A.A. (2018). The 21st century learning in Malaysian primary school: Exploring teachers' understanding and implementation of HOTS. *Advances in Social Science, Education and Humanities Research,* 27, 326-336.

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Prof. A.I. Mteiye [MALAWI]