



Managing Students Learning Challenges Through Integration of STEM Education for Developing 21ST Century Skills in Changing Global Workforce

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Abstract

This study investigates managing students learning challenges through integration of STEM (Science, Technology, and Mathematics) education for developing twenty-first-century skills in changing global workforce. The study employed a survey research design. Two research questions were raised. Data were obtained using a structured questionnaire. The respondents for the study comprised 232 respondents, made up of 186 STEM teachers and 46 principals. The reliability coefficient of instrument yields $\alpha = .87$, Using Cronbach Alpha. Mean and standard deviation were used to answer the research questions. The findings revealed skills needed in the 21st century include: capacity for innovation and creativity skills; business intelligence and analytical skills; problem solving and critical thinking skills and entrepreneurial skills. Challenges found out from the study includes: poor preparation of teachers; lack of connection with individual learners in a wide variety of ways; lack of research collaboration across STEM fields. Recommendations made amongst others that government should consider a comprehensive integration of STEM curriculum towards preparing students for STEM careers by prioritizing teaching and critical thinking, problem-solving, and teamwork across subject areas.

Keywords: Integration, Learning Challenges, STEM, Twenty-First Century Skills, Workforce.

Introduction

STEM education refers to the teaching and learning of science, technology, engineering and mathematics in education industry throughout the established levels of the sector (Usman, Muhammed & Ginger, 2013). They further stated that the broad area of study includes basic science and technology (at the Primary school level, Basic science at the junior secondary school (JSS), Mathematics, Biology, Chemistry, Physics, Woodwork, Electronics, Agricultural science, Physical and Health, Home Economics etc). The broad area of study is an interdisciplinary approach to learning that has been integrated into one entry-science education. STEM education according to Brown, Brown, Reardon, & Merrill (2011), has been defined as a standards-based, meta-discipline residing at the school level where all teachers, especially Science, Technology, Engineering, and Mathematics teachers, teach an integrated approach to teaching and learning, where discipline-specific content is not divided, but addressed and treated as one lively, fluid study. STEM-based learning is one of the appropriate models that can be applied in teaching and learning activities as an effort to develop work skills in learners (Kurnia, Setiawan, & Dittrich, 2014). Thus, in the face of increasingly complex global challenges, some countries have tried to integrate STEM in learning and have achieved great results in improving the work skills. STEM learning is capable to develop the latest science and technology invention with the

problem-based learning process Kurnia et al (2014) added. In addition, STEM disciplines helps learners in preparing for their career because STEM-based, learning improves a varieties of literacy skills. According to Adedayo (2011), there is inadequacy to meet up with the stated goals and objectives of science education in Nigeria. The researcher further stated for STEM education to foster national development, the focus must be on the goals which help to develop programmes and activities directed towards improving knowledge and practical skills, inculcating values, ethic and habits for useful work life.

According to Singh and Chan (2014), successful integration of communication technology in teaching and learning depends on the preparation of teachers. According to the researcher, lack of confidence leads to reluctance to use computer as a result of lack of confidence has been a challenge facing the educational system. This has led to a clarion call on science teachers to change their methods of teaching by adopting what can transform their teachings from teacher-centered to learner-centered activities (Tedla, 2012).

The integrated STEM education approach aims to remove the dividing wall between each STEM field on the separate approach and embedded approach and to teach students as one of the subjects. Interdisciplinary integration allows students to gain the mastery of the competencies required to complete



the task. Student trained with this means is considered more beneficial because it is a multidisciplinary system that relies heavily on the concept of STEM, where students solve real-world problems. Furthermore, implementing instruction through interdisciplinary integration will result in increased expectations of interest in the field of STEM content, especially if it begins at early stage. Integrated STEM education programs apply equal attention to the objectives of the STEM fields. Mustafa, Ismail, Tasir and Said, (2016) emphasized that the integrated STEM learning has the potential to prepare competitive future workforce with the 21st-century skills and positive impacts towards students' interest and achievement and that STEM educations develop problem-solving skills, promote student-centered learning, and cultivate higher-order thinking skills. This can be complemented by usual teaching and learning approaches such as project-based, problem-based, inquiry-based and theme-based learning. Schools should therefore encourage students to acquire more skills that give an advantage, promote their life value, and increase achievement (Sdoh, 2013)

Preparing students for future careers in STEM as well as for a workplace that emphasizes independence and flexibility is the major task ahead of everyone interested in education, facing the changing future of work and preparing students for STEM careers means embracing new pedagogical approaches and developing curriculums that go beyond the basics of what is currently available (Raupp, 2019) by the time student is ready to enter the workforce, they must have enough knowledge to make invaluable contributions to our nation's STEM industries. Also, it is important that schools have an ample number of teachers who are experts in STEM, it should focus on hands-on building and problem-solving rather than memorizing textbook material in order to engage students. The skills needed to be relevant in 21st Century are curiosity, creativity, taking initiative, multi-disciplinary thinking and empathy. Interestingly, these are skills specific to human beings that machines or robots cannot do, and people are taught to strengthen these skills through education. Meanwhile, employers are looking for a motivated and agile workforce with a mindset of lifelong learning and future-proof skills to take advantage of new opportunities through continuous retraining, and up skilling.

Challenges in this context mean something new and are not easy to do, difficulties that one face during the course of achieving certain task and requires great effort and determination. Challenges

faced towards preparing STEM graduates for workforce tests strength, skill, or ability, especially in a way that is interesting. Preparing students to succeed in a completely different job market is a responsibility that cannot be ignored, even though it may seem impossible to keep up with such rapid change. Meanwhile, what makes this task particularly challenging is that today's youth will likely face challenges that the adults around them can barely imagine, it is therefore, critical to prepare our students to navigate a world that is volatile, uncertain, complex and ambiguous. Therefore, the study seeks to investigate on managing students learning challenges through integration stem (Science, Technology, Engineering, and Mathematics) education for developing twenty-first-century skills in changing global workforce.

There is an understanding that STEM education should develop a set of personal attributes that are variously known in the education sector as twenty-first-century skills, soft skills or general capabilities, and include competencies such as problem-solving, collaboration, creativity, and innovation. This is often associated with an inquiry-based pedagogy. STEM is necessary to solve real-world challenges, and we need individuals with strong STEM literacy in order to address the complex problems facing the world. However, previous study revealed that STEM teaching did not stimulate curiosity, problem-solving, depth of understanding and continued interest in learning among students, or to thus encourage them to undertake advanced study in science and mathematics at school and beyond this was blamed on insufficient numbers of highly trained teachers in science, technology and mathematics and lack of teachers with subject specializations leads to teachers teaching outside their specialization. Challenges in preparing students for the future workforce cannot be avoided but can only be managed and improved for effective functioning of STEM that will be qualified workers for industries. Specifically, this study sought to investigate managing students learning challenges through integration stem (science, technology, engineering, and mathematics) education for developing twenty-first-century skills in changing global workforce.

The purpose of this study is managing students learning challenges through integration of STEM (Science, Technology, Engineering, and Mathematics) education for developing twenty-first-century skills in changing the global workforce. Specifically, it sought

1. to determine the most important twenty-first-century skills needed by STEM graduates to succeed in the workforce of the future;



- challenges that STEM education is facing in preparing graduates for developing work skills for changing global workforce.

Research Questions

Two (2) research questions guided this research.

- What are the most important twenty-first-century skills needed by STEM graduates to succeed in the workforce of the future?
- What are the challenges that STEM education is facing in preparing graduates for developing work skills for changing the global workforce?

Method

The study employed survey research design using a questionnaire. The population of the study was 312 comprised of secondary school science, technology and mathematics teachers and principals in Lagos state. To ensure that a representative sample was selected from the population, the researchers defined specific selection criteria used in selecting participants for the study. STEM teachers with a minimum of ten years teaching with NCE experience were considered the base selection criteria for participants for the study. The sample for the study comprised of 186 STEM teachers and 46 principals to make a total of 264. Participants were purposefully selected to ensure that only those with adequate knowledge related issues were chosen, and also to ensure that quality data was generated. The instrument for data collection was a structured questionnaire. The instrument had three sections A to C. Section A sought information on personal data of the respondents such as status, gender, and name of school. Section B sought information on important twenty-first-century skills needed by STEM graduates to succeed in the workforce of the future. Section C sought information on challenges that STEM education is facing in preparing graduates for developing work skills for changing the global workforce. The questionnaire used was closed-ended, validated by three STEM teachers from Department of Science and Technology Education to ensure that instruments measure what it tends to measure. The internal consistency of the instruments was determined using Cronbach Alpha, with an alpha value of $\alpha = .87$. The instrument was administered to the respondents through research assistants and personal contact. Out of 264 questionnaires administered, 232 were duly filled and returned. These represented 94% rate of return. Data generated from the return questionnaire were analyzed using mean, and Standard Deviation and the benchmark mean is 3.50.

Results

Table 1: Mean and Standard Deviation of the responses of Science, Technology and Mathematics teachers and principal on important twenty-first-century skills needed by STEM graduates to succeed in future workforce N=232

S/ N	Important Twenty-First Century Skills Needed by STEM Graduates to Succeed in the Workforce	\bar{X}	SD
1	The workforce needs the skill to communicate effectively and build strong relationships in order to create powerful team dynamics.	4.53	.61
2	An employee needs emotional intelligence workers that see the attributes in coworkers that are crucial for mental health, personal success, and success for greater company.	3.81	.48
3	Time management skills and ability to prioritize are essential for workers	3.78	.88
4	Willingness to be flexible, agile and adaptable to change	3.69	.46
5	Technical core capabilities for STEM	3.80	.61
6	Capacity for innovation and creativity	3.84	.85
7	A worker needs the ability to be able to adapt to the changing environment.	3.79	.40
8	Fundamental core capabilities around reading, writing, and arithmetic	3.91	.45
9	Basic computer and software/application skills to enhance versatility	3.95	.46
10	Industry- or occupation-specific skills	3.77	.40
11	Capacity for innovation and creativity skills are needed by the workforce	3.88	.67
12	Analytics skills and business intelligence	3.69	.46
13	Problem solver and critical thinker – design thinking	3.79	.40
14	Entrepreneurial spirit	3.69	.46
15	abilities to be able to coach and empower others, and to motivate those around you do their best work	4.06	.51

Benchmark mean=3.50

Table 1 present the mean responses of respondents regarding important twenty-first-century skills needed by STEM graduates to succeed in the future workforce. The mean scores of each item on important twenty-first-century skills needed by STEM graduates to succeed in future workforce identified from the study ranging from 3.50 to 4.00 suggesting that those skills listed were important to succeed in future workforce some of which include that: workforce needs skill to communicate effectively and build strong relationships in order to create powerful team dynamics; employee needs emotional intelligence o see the attributes in



coworkers that are crucial for mental health, personal success, and success for greater company; time management skills and ability to prioritize are essential for workers; a worker needs ability to be able to adapt to the changing environment; capacity for innovation and creativity skills are needed by workforce; analytics skills and business intelligence; problem solver and critical thinker – design thinking; entrepreneurial spirit, and abilities to be able to coach and empower others, and to motivate those around you do their best work. skills t

Table 2: Mean and Standard Deviation of the responses of science, technology, and mathematics teachers and principal on challenges STEM education faced in preparing graduates in developing work skills for changing global workforce N=232

S/N	Challenges stem education faced in preparing graduates in developing work skills for changing global workforce	\bar{X}	SD
1	Poor preparation and shortage in supply of qualified STEM teachers	3.71	.51
2	The non-existence of access to quality learning environments	3.67	.40
3	Lack of investment in teachers' professional development	3.88	.50
4	Poor preparation and inspiration of students	3.70	.49
5	Lack of connection with individual learners in a wide variety of ways	3.89	.51
6	Lack of support from the school system	3.58	.48
7	Lack of research collaboration across STEM fields	3.93	.50
8	Poor Content preparation	3.69	.50
9	Poor Content delivery and method of assessment	3.50	.56
10	Poor Condition of laboratory facilities and instructional media	3.82	.56
11	Lack of hands-on training for students	3.69	.47
12	Most of the STEM teachers did not major in the subject they taught	3.59	.40
13	Most stem teachers are without much experience of workplace outside educational facilities	4.53	.50
14	there was uncertainty among STEM teachers about how best to teach science,	3.69	.48
15	STEM teachers' relatively low levels of interest and academic attainment in science and mathematics	3.58	.50

Benchmark mean=3.50

Table 2 shows the mean responses of respondents regarding their opinion on challenges STEM education faced in preparing graduates in developing work skills for changing the global workforce. The challenges that STEM education faced in preparing graduates in developing work skills identified through the study among others include: poor preparation and shortage in supply of qualified STEM teachers; non-existence of access to quality learning environments; lack of investment in teachers' professional development; poor preparation and inspiration of students; lack of connection with individual learners in a wide variety of ways; lack of support from the school system; lack of research collaboration across STEM fields; poor Content delivery and method of assessment; poor condition of laboratory facilities and instructional media; most of the STEM teachers did not major in the subject they taught; there was uncertainty among STEM teachers about how best to teach science, and STEM teachers' relatively low levels of interest and academic attainment in science and mathematics. With means values ranging from 3.57 above the cut-off point of 3.50, it was evident that the respondents considered the challenges that STEM education faced in preparing graduates identified as hedge to developing work skills for changing global workforce.

Discussion

The findings from the study revealed the following among the most important skills required to include: workforce needs skill to communicate effectively and build strong relationships in order to create powerful team dynamics; employee needs emotional intelligence skills to see the attributes in coworkers that are crucial for mental health, personal success, and success for greater company; time management skills and ability to prioritize are essential for workers; a worker needs ability to be able to adapt to the changing environment; capacity for innovation and creativity skills are needed by workforce; analytics skills and business intelligence; problem solver and critical thinker – design thinking; entrepreneurial spirit, and abilities to be able to coach and empower others, and to motivate those around you do their best work.

These findings are supported by previous studies Mustafa, et al, (2016) who emphasized that the integrated STEM learning has the potential to prepare competitive future workforce with the 21st-century skills and positive impacts towards students' interest and achievement and that STEM educations develop problem-solving skills, promote student-centered learning, and cultivate higher-order thinking



skills. Regarding the findings on the challenges STEM education faced in preparing graduates for developing work skills for changing global workforce. The finding is in line with perception of Singh and Chan (2014) that lack of confidence leads to reluctance to use computer as a result of lack of confidence has been a challenge facing the educational system. Mathipa and Mukhari (2014) asserted that teachers are afraid of 21st century communication technology because they do not know how to use the gadgets.

Conclusion

Given the diverse views expressed by science, technology and mathematics teachers regarding managing students learning challenges: through integration of STEM (Science, Technology, Engineering, and Mathematics) education for developing twenty-first-century skills in changing global workforce. The findings revealed that the importance of skills needed in the 21st century includes: capacity for innovation and creativity skills; business intelligence and analytical skills; problem solving and critical thinking skills and entrepreneurial skills. In addition, the challenges found out from the study includes: poor preparation of teachers; lack of connection with individual learners in a wide variety of ways; lack of research collaboration across STEM fields; poor condition of laboratory facilities and instructional media. It is worthwhile for government, educators, policymakers and industry leaders to ensure that twenty-first-century workforce skills are integrated into the curriculum of Science, Technology and Mathematics program in our secondary schools to develop skill for global worlds also, it is important that those challenges confronting STEM education be addressed in order to prepare qualified STEM workers by ensuring that every student has the opportunity to master basic STEM concepts, including computational thinking, and to become digitally literate.

Recommendations

Based on the findings of the study, it was recommended that:

1. The government should consider a comprehensive integration of science, technology and mathematics curriculum towards preparing students for STEM careers by prioritizing teaching critical thinking, problem-solving, and teamwork across subject areas
2. STEM teachers should be encouraged to embrace new pedagogical approaches to teach curriculum that go beyond the basics of what is currently available

3. Government and STEM teachers should ensure that challenges confronting STEM education be addressed in order to prepare qualified STEM workers by ensuring that every student has the opportunity to master basic STEM concepts, including computational thinking, and to become digitally literate.

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