Chapter 10

Global Demands for the 21st Century Skills: Need for a Paradigm Shift in Instructional Approach

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Aim and Objectives

This chapter aims to highlight the Global Demands for the 21st Century Skills: Need for a Paradigm Shift in Instructional Approach to enhance students' acquisition of relevant skills. The specific learning objectives include:

- Explain the 21st-century skills
- Highlight the components of the 21st-century skills; core subject skills, learning and innovative skills, career and life skills, and digital skills
- Explain critical, creative communicative and collaborative skills
- Highlight what is learning paradigm
- Explain a constructivist learning environment
- Characteristics of a constructivist learning environment
- The role of the teacher in a constructivist learning environment

The Organisation of this Chapter

To meet the needs of a wide range of readers to adequately understand this chapter, the presentation of this chapter is sub-divided into introduction which deals with the collection of information from different sources to establish current observations, opinion, and views of researchers on the subject matter. This was followed by the explanation and components of 21st century skills. The 4Cs (critical thinking, creative, collaborative and communicative skills), learning paradigm, constructivist learning environment, the role of the teacher in a constructivist learning environment are discussed. Finally, there is the conclusion of the chapter.

Introduction

The global society has evolved in the last two decades from the industrial-based economy to the modern knowledge-based economy of the 21st century. Therefore, there are calls globally by the government, industry and academia on the need to prepare students with skills that are relevant to the 21st century (Lay & Osman, 2018b; Teo, 2019). Langdon, McKittrick, Beede, Khan, and Doms (2011) reported that the specific skills that can be required to build a vibrant economy in the twenty-first century are embodied in the integration of science, technology, engineering, and mathematics (STEM) education. These skills (21st century skills) are sought after skills by employers of labour to increase the productivity of their workforce (Delgado, Porter, & Stern, 2011). This is because STEM content knowledge and 21st Century skills will equip the students with the ability to identify and integrate knowledge from different sources to generate innovative solutions to complex problems (Chew, Idris, Leong, & Daud, 2013; Khalil & Osman, 2017). The education system is known as one of the most critical drivers of the economy and social change (World Economic Forum, 2016). Therefore, STEM education directly or indirectly is the building block for the economy of the twenty-first century, which is knowledge-based (Kertil & Gurel, 2016; Pickering, 2010).

Nevertheless, traditional instruction has continued to dominate the classrooms in many countries of the world which have resulted in unsatisfactory learning outcomes (Kivunja, 2015; Lay & Osman, 2018a; Saxton et al., 2014). In the present classroom situation, teachers, lay more emphasis on the coverage of course content and curricular as well as lower-order thinking skills to the detriment of 21st century skills (Saxton *et al.*, 2014). Given this, the research gap between the content knowledge of STEM education and relevant workplace skills have been identified by the employers of labour (Fullan & Langworthy, 2014). Educators have also reported the need to reform education to better prepare graduates for global competition (Kivunja, 2014; Lay & Osman, 2018b; Yaki, Saat, & Renuka, 2016).

Puffenberger (2010) warned in his study that lack of adequate 21st century STEM education reforms and implementation would have huge implications on the economic and political power of nations. This implies that if the developing countries especially Nigeria continue to play politics or lip service on educational reforms that are relevant to the age, there will be a devastating consequence on its struggling economy and technological advancement.

Consequently, the Organisation for Economic Co-operation and Development (OECD) observes that educational systems of countries (Nigeria inclusive) have an essential responsibility to support innovation by raising highly skilled labour force in all sectors of the economy through quality teaching and learning (OECD, 2011). Accordingly, if STEM classroom instruction at all levels of education is to prepare students for work and life in the 21st century, then educational stakeholders must have an understanding of the skills that are required now and, in the future, to adequately prepare students global competition. These skills are the 21st century skills and are in high demand by the 21st century labour market (Fullan & Langworthy, 2014).

Twenty-first Century Skills

Before the 21st century, the essential skills that were required to be an educated individual were literacy and numerical skills, otherwise referred to as reading, writing and arithmetic (3Rs) (Wagner, 2008). Globalisation, technological development, changing markets in the 21st century came with its attendant environmental impacts, unemployment, poverty and global competition. These make the teaching of literacy and numerical skills outdated, and a new set of skills called 21st-century skills were born. These are skills that are believed to be essentials for school success, work and life in the 21st century (Kivunja, 2015; Partnership for 21st Century Skills, 2009; Wagner, 2008). It is reported that although it is essential for an educated person to master the literacy and numeracy skills to live a meaningful life in the 21st century; individuals must acquire essential skills such as critical thinking skills, creative, innovative and problem-solving skills. Others are collaboration, communication, adaptability and digital literacy (Trilling & Fadel, 2009). Trilling and Fadel (2009) grouped 21st-century skills into four domains, as presented in Table 1.

Table 1: *Twenty-first Century Skills Domain*

Main Domain	Essential Skills
Core Subject Skills	Reading
	Writing
	Numeracy
Learning and Innovative Skills	Critical thinking
	Creative and innovative
	Problem-solving
	Communication
Career and Life Skills	Teamwork and collaboration
	Adaptability and flexibility
	Leadership and responsibility
	Self-direction and initiative
	Social interaction
	Productivity and accountability
	Self-reliance and career learning
Digital Skills	ICT literacy
	Computer literacy
	Information literacy
	Media literacy

Adopted from Trilling and Fadel (2009)

The partnership for the 21st century identified some of the 21st Century skills listed in Table 1 as super skills. These super skills include critical thinking, creative, collaborative and communicative skills (4Cs) (P21, 2015). Saxena (2015) concurs that 4Cs are super skills of the digital era. Kivunja (2015) opined that graduates are expected to graduate with these skills in addition to the 3Rs to compete favourably in the global market. Therefore, in this chapter, the 21st century skills will refer to the 4cs. These skills are discussed as follows:

Critical Thinking Skills

There is a consensus among educational stakeholders that critical thinking is an essential goal of education (Li & Payne, 2016; Mapeala & Siew, 2015; Tiruneh, De Cock, Weldeslassie, Elen, & Janssen, 2017). However, there is no consensus on the meaning of critical thinking skills. It is seen as thinking that involves higher-order thinking skills of analysing, evaluating and creating (Kivunja, 2015). It is considered as one of the super skills because an individual's

measure of success in education can be determined by the individual's ability to analyse, evaluate and synthesise available data to make an informed decision (Abrami *et al.*, 2015; Halpern, 2014).

Globally, humankind is continually challenged with unexpected problems that must be addressed, such as climate change, environmental degradation, poverty, resource utilisation, and control. On the other hand, companies, industries, and employees are constantly challenged by the demand for innovative products for their clients. To deal with these problems requires students and graduates with critical thinking skills. However, labour market employers observed that school graduates' level of critical thinking skill is unsatisfactory (Casner-Lotto & Barrington, 2006; Kivunja, 2015; Wagner, 2008). In particular, students in Nigeria at all levels of education demonstrate a low level of critical thinking skills (Salami, 2013). Therefore, there is a need for a paradigm shift in teaching and learning that will improve learners critical thinking skills.

Creative Skills

The economy of the 21st century is driven by innovation, which could be seen as the product of creative thinking. Thus, creativity is the ability to develop new ideas to solve problems or create products that will benefit society. Creativity spurs innovations that open up the opportunity for great jobs and solve complex challenges (Saavedra & Opfer, 2012). Example, the grab car employment market, can be seen as a product of creative thinking in the 21st century. According to Torrance (1966), creativity is the process of being sensitive to the existence of a problem, disharmonies, gaps in knowledge, and it involves searching for a solution, hypothesising, testing hypotheses and communicating findings.

Therefore, creativity is divergent thinking to produce new ideas. The dimensions of creativity include fluency (involves generating many ideas to select from), flexibility (ability to look at a problem or question from different viewpoints), and originality (ability to generate unexpected ideas) (Guilford, 1950; Kim, 2005; Shively, 2011). It is observed that instruction focusing on creativity has positive impacts on students' achievement and on individual's experience (Jeng, Hsu, Xie, Lin, & Huang, 2010). It was advocated that creative techniques should be infused into course content (Wu, Siswanto, Suyanto, Sampurno, & Tan, 2018). Literature has reported that students are deficient in creative thinking skills even though it is one of the super skills of the 21st century (Cheng, 2011). Furthermore, there is limited research on creative

thinking skills among students, especially in the developing countries (Dagher & BouJaoude, 2011); hence, the motivation of this chapter.

Communication

The advent of globalisation and digital technologies calls for the need for effective communication so that ideas and information could be understood across cultures. Effective communication has been reported to be a critical factor for success in the workplace, business and family life (Kivunja, 2015). Communication involves the sharing of ideas, questions, thoughts and findings effectively. The 21st century is regarded as the information and communication age, and literature has highlighted that effective communication is vital for students' success both in the classroom and real-world (Muijs & Reynolds, 2011; P21, 2014). Gerald (2015) opined that communication is one of the 4Cs. Therefore, graduates should be taught how to communicate correctly, concisely, clearly, friendly, and courteously. This can be achieved by integrating communication-oriented contents into each instructional unit to provide students with the opportunity to communicate their ideas and findings. This could be achieved through project presentation, group work and findings from students' research.

Collaboration

Collaboration involves teamwork, which could be through cooperation, group discussion, group projects and brainstorming. Kivunja (2015) reported that collaboration is critical when it involves teamwork and working cooperatively. The real-world problems are multidisciplinary and multifaceted and require the collaboration of experts from different disciplines to solve the problem. Literature is replete with the effects of collaboration on students learning outcomes (Abrami *et al.*, 2015; Gambari, James, & Olumorin, 2013; McCrae, 2011). Collaborative skills can be enhanced by integrating teamwork group interaction and cooperation into an instructional unit. This skill can be improved by providing students with opportunities to share and justify their ideas during classroom instruction.

Research has highlighted the need to assist students in developing 21st century skills: ability to think critically, creatively, collaboratively, communicative, ability to integrate knowledge, and deeper STEM content understanding as well as technology literacy (Fullan & Langworthy, 2014; Kivunja, 2015; Saputri, Sajidan, Rinanto, Afandi, & Prasetyanti, 2019). Given the preceding, however, Trilling and Fadel (2009) reported that students at all levels of education are

deficient in these skills, as highlighted in Table 1. This implies that the quality of STEM education graduates could be measured by their ability to demonstrate these skills and how well they can adapt to the dynamics of the twenty-first century.

To assist students in developing 21st Century skills, there must be a paradigm shift in instructional approach from the traditional learning environment to the new learning environment. In support of this, Bill Gates stated that "When I compare our high schools to what I see when I am travelling abroad, I am terrified for our workforce of tomorrow" (Mundy, 2005). He advocated for change in the learning environment and approach from traditional to 21st learning environment. Similarly, Kivunja (2014) advocated for a paradigm shift from the behaviourist to the constructivist approach.

Learning Paradigm

A paradigm of learning provides us with an understanding of what learning is and the processes of learning. This implies that it assists us in identifying how students learn and what is expected of the teacher to facilitate and create a learning environment that will enhance meaningful learning. Learning paradigms have evolved from the behaviourist to the cognitivist and to the constructivist to explain how learning takes place and how teachers can facilitate it. These paradigms are supported by the behavioural, cognitive and constructivist learning theories respectively.

Behaviourist Learning Paradigm

Learning occurs as a result of the interaction between stimulus and response. The behaviourist places emphasis on the role of the environment in learning. Forces in the environment influence learning, and it is reflected in terms of a stimulus (cause) and response (effect). The proponents of this theory include; Ivan Pavlov, B. F. Skinner, E. L. Thorndike, Hull, J.B. Watson, to mention a few. This theory encourages teacher-centred instruction, and the learning outcome focuses on facts and memorisation (Jonassen & Henning, 1999). Instructional practices based on this learning paradigm dominate the Nigerian classroom, especially at the university level. In support of this, the Academic Staff Union of Universities (ASUU) in Nigeria urged the Federal Government of Nigeria as a matter of utmost importance to reconceptualise the education system at all levels. To enable it to function adequately within the present realities within the context of the global market and the vibrant world (Okwoufu, 2014).

United Nations Educational, Scientific and Cultural Organisation (UNESCO) observed teaching without learning in Nigeria. They reported that Nigeria is one of the 37 countries in the world where meaningful learning has deserted the Nigerian educational system resulting in underachievement. This is attributed to the didactic method of teaching. Hence, there is a need for a paradigm shift from the behavioural approach to the constructivist approach. The learning theory and instructional environment that will promote the development of 21st-century skills such as adaptability, creativity, critical thinking, among others are germane for human resources development. The constructivist learning environment is seen as the most suitable learning paradigm for 21st-century learning and skills (Thomas & Anderson, 2014).

Cognitive Learning Paradigm

The proponents of this learning paradigm see learning as the result of the construction of meaning by the individual learner. This rooted in cognitive theory which focuses on mental processes such as habits of mind, memory, and problem-solving therefore learning is seen as a change in the learners' schemata; existing knowledge, experience and value a learner brings to the learning process, upon which new knowledge is built. Hence, instructional strategies and resources to be used must have the potential to stimulate cognitive processes of the learner. Thus, STEM education is a practical area that the application of cognitive theory is essential. Because STEM education is a concern with producing individuals with abilities and skills to solve a complex task. However, cognitivism does not emphasise learning in a social context where vital skills such as collaboration and communication could be acquired. In this learning paradigm, the teacher acts as a facilitator, and learning is student-centred and active participation of the learner is required for effective learning to take place.

Constructivist Learning Paradigm

Unlike the teacher-centred and textbook approach of the behavioural model of instruction which focuses on factual knowledge and fails to enhance 21st-century skills among learners, the constructivist is a paradigm that emerges from the cognitive theory. The strength of the constructivist model of instruction is that it emphasises on an individual construction of meaning and focuses on higher-order thinking skills. The constructivist learning environment is built based on the elements of the constructivist theory. It provides the students with the opportunity to explore, perform an experiment, think out of

the box to find meaning (Bullard, 2010; Teo, 2019). The significant elements of the constructivist learning environment include; firstly, student-centred learning. This implies that the students are at the centre of instructional planning, delivery and assessment. The learner takes responsibility for his learning while the teacher acts as a facilitator. Secondly, the learner should be actively engaged in the learning process, and this could be achieved through hands-on and minds-on activities. Thirdly, learning should take place in a social context, and this implies that students should be provided with the opportunity to interact with their peers to gain a shared understanding of the instructional content. These elements, student-centred learning, active engagement and social interaction have been reported to enhance students' motivation and cognitive learning outcomes (Kwan & Wong, 2015; Lay & Osman, 2018a; Teo, 2019).

Empirical Findings on the Constructivist Learning Environment

A glean at literature indicates that there are studies that focused on the effects of constructivist approach on various learning outcomes in several STEM disciplines in some parts of the world. The studies include Kwan and Wong (2015), which concluded that there is a positive relationship between constructivist instructional environment and students' ability to think critically when cognitive strategies and goal orientation serve as mediating variables. Ilyas, Wasim, and Rawat (2014) reported that students that learned using the constructivist instructional approach demonstrated significant and positive learning of fractions. Similarly, Oludipe and Oludipe (2010) investigated the effectiveness of the constructivist instructional approach on students' achievement in Integrated Science. They employed a Quasi-experimental research design. The constructivist group performed better than the traditional group. Findings also showed that constructivist environment enhanced students' attitudes and perception toward the nature of Science (Sridevi, 2013). It was also reported that integrated STEM instructional materials (iSTEMim) which were characterised by the constructivist instructional environment, active participation, learner-centred and group discussion deepen students' understanding. The iSTEMim group performed significantly better than the traditional group (Yaki, Saat, & Sathasivam, 2019). It is also reported to improve motivation to learn among university students (Nareli & Baser, 2010). Therefore, employing this approach to teaching and learning could be the right step in the right direction.

Designing Instruction

Teachers should design instruction based on the constructivist approach, which could enable students to be critical thinkers, problem solvers, collaborators and communicators. Saavedra and Opfer (2012) accentuated that educators need to make learning relevant to students through interdisciplinary and real-life applications. For instance; instead of teaching genetics to students, teachers could model Mendelian genetics and how it plays a significant role in modelling a pet rabbit. Therefore, the instructional environment that would enhance the development of these skills should be characterised as follows:

Integrate technology: This is the integration of technology to learn the instructional content of a subject matter. Literature is replete with the potential of technology to transform learning and assist learners in acquiring relevant skills (OECD, 2015; Topper & Lancaster, 2013). Technology could be integrated as an instructional resource; this can be achieved through the use of specific technological applications such as computer modelling, computer simulation, digital animation, multimedia productions, and virtual exploration (Crippen & Archambault, 2012; Kelley, 2010; Osman & Saat, 2014). Researchers are contending that technology has the potential to positively influence classroom instruction and relevant to today's learners because the present students are digital natives (Jacobs, 2010; OECD, 2015; Topper & Lancaster, 2013).

Real-world problem: Learning becomes relevant and motivating when it is situated in a real-world context using a real-world problem; an ill-defined problem that is relevant to the students' personal, social, community and global context (Bybee, 2010). The real-world problem offers a meaningful context that engages students' higher cognitive skills, which would enhance the development of 21st-century skills.

Collaboration: Instruction should be designed to provide the opportunities for students to walk in a group to define a problem, find a solution and communicate findings (National Research Council, 2012). There is a positive relationship between collaboration and critical thinking skills (Loes & Pascarella, 2017).

Learner-centred instructional strategies: These include strategies such as; project-based learning, integrated STEM-based inquiry, context-based, design-based, dialogic and task-based learning, among others. These instructional strategies should be characterised by hands-on, minds-on, activities, open-ended

problem, authentic task and assessment, questioning, group projects, and modelling (Fortus, Krajcik, Dershimer, Marx, & Mamlok-Naaman, 2005; Stohlmann, Moore, & Roehrig, 2012; Teo, 2019).

Evaluation: This employs formative portfolio and summative evaluation strategies. Emphasis should be placed on formative and portfolio evaluation which focus on the process of learning rather than the product of learning (National Research Council, 2012)

Instructional feedback: This is an essential component of instruction, students should be provided with feedback on their thinking processes and attitudes (National Research Council, 2012; Saavedra & Opfer, 2012)

Teacher as a facilitator while learning is student-centred: Teachers should employ constructivist learning approaches or instructional strategies that are supported by constructivist learning theory.

The Role of the Teacher in the Constructivist Learning Environment

In recognition of the critical role of the teacher in the instructional process, it was enshrined in the National policy of education that no education system can grow above the level of its teachers (FRN, 2004, P32). The teacher is an essential factor of the constructivist learning environment. In this environment, learning is student-centred. Therefore, the role of the teacher is to facilitate the learning process. This can be achieved by introducing the instructional unit such that it will activate the learners' prior knowledge and stimulate their curiosity. Example, presenting the instructional unit in the form of an open-ended problem that is relevant to the instructional content. This will engage the learners' thinking skills and influence them to think out of the box. Douglas, Koro-Ljungberg, McNeill, Malcolm, and Therriault (2012) observed that open-ended or ill-defined problem promotes critical thinking among learners.

The teacher could also facilitate the instruction by scaffolding the students' learning. This could be achieved by providing the students with question prompts, clues that direct the students towards achieving the goal and objectives of the instructional unit. Motivating context, conjectures, charts, pictures among others could also be used to scaffold students' learning. Students' interactions characterise the constructivist learning environment, as highlighted earlier. Therefore, teachers will guide classroom interaction to promote shared understanding through the promotion of constructive criticism and mutual respect. Thus, the entire learning process in the constructivist environment is

characterised by driving questions from the facilitator. These driving questions will serve as a compass for the students to navigate the learning landscape to achieve the objectives of the learning unit (Dass, 2015; National Research Council, 2012). The teacher's role has shifted from the one that transmits knowledge to the student who is a recipient to the one that assists the students to engage in meaningful learning through active engagement in the 21st-century classroom.

Conclusion

Twenty-first-century skills drive the economy of the 21st century. Consequently, the constructivist approaches or learning environment could nurture the development of these skills among learners. The paradigm shift from the traditional educational practices to the constructivist approach to instructions could assist the education system in surmounting the challenges of the traditional classroom practices. Thus, it is logical to conclude that the constructivist-based approaches to instruction could be a potent model that will enhance a more in-depth and meaningful understanding of STEM instructional content. It has the potential to assist learners in acquiring essential skills for academic success, work and life in the 21st century. Hence, it has an implication for teachers' classroom practices.

Self-Assessment Exercise

- Explain the components of the 21st-century skills
- Justify the importance of the four super skills (4cs) to the 21st-century labour market
- What is a learning paradigm? Discuss the constructivist learning environment
- Explain the role of the teacher in the 21st-century learning environment
- Explain the rationale for a paradigm shift from the behaviourist to the constructivist learning environment

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