FOSTERING 21ST CENTURY LEARNING SKILLS: TEACHER EDUCATORS' AND PRE-SERVICE SCIENCE TEACHERS' PERCEPTIONS

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Abstract:
In addition to customary academic skills, citizens need to possess other non-content knowledge skills and dispositions if they are to succeed in the 21st century society and workplaces. These skills by their nature cannot be taught as academic subjects but can be learned by participating in pedagogical activities. This study which adopted a descriptive survey design sought to find out the extent to which classroom activities in teacher education incorporate pedagogical practices which foster the development of 21st century learning skills. A total of 108 respondents made up of 64 pre-service science teachers and 34 science teacher educators drawn from a population of two hundred and thirty-six 400Level pre-service science teachers and seventy-seven teacher educators in the departments of science education in two federal government-owned universities offering teacher education programmes in South-East, Nigeria. A 42-item 4-point rating scale titled "Pre-service science teachers' learning skills survey" which had a Cronbach's Alpha reliability coefficient of 0.81 was used for data collection. Three research questions that guided the study were answered using mean and standard deviation while the hypothesis was tested using Pearson's Correlation. Results showed that teacher educators and pre-service science teachers perceive that some classroom practices which foster the development of 21st century learning skills were implemented in pre-service teacher preparation in federal government-owned universities offering science teacher education in South-east Nigeria. Results also indicated that teacher educators report that classroom practices fostering critical thinking as well as creativity and innovation skills were not well implemented in teacher education. The study recommended that teacher educators and teacher education programmes should willfully endeavor to incorporate pedagogical practices that foster the development of 21st century skills in pre-service science teachers.

Introduction

Rapid improvements in scientific and technological innovations, driven by globalization and economic competitiveness, have led to the redefining of

skills, capacities and dispositions required of individuals if they are to succeed in the rapidly changing society and workplaces (Stewart, 2010; Wilmart, 2010). These skills which are generally referred to as 21st Century Skills are broadly grouped into three main categories: learning and innovation skills, career and life skills and digital literacy skills.

Learning and innovation skills (also known as the 4C's) comprise critical thinking and problem solving, creativity and innovation, communication, and collaboration. These skills emphasize ability to find solutions to problems; work with others and effectively convey ideas to others. Digital literacy skills which include information, media and technology literacy, highlight ability to understand facts, figures and fiction, as well as the methods, channels and machines for publishing information. Career and life skills pertain to the individual's personal life that has influence on his/her long-term success. It incorporates flexibility and adaptability, leadership, initiative and self-direction, productivity and accountability, social and cross-cultural interaction (Trilling and Fadel, 2009; Saavedra and Opfer, 2012; Applied educational system, 2019).

Although these skills differ from traditional academic skills because they are not basically content-knowledge based (Cuban, 2015; Schleicher, 2015), mastering them will enable people to be successful in different roles and career-fields (Trilling and Fadel, 2009). Critical thinking, creativity and innovation, communication, and collaboration, have been identified as "the most prominent 21st century competencies found in international frameworks that have been shown to offer measurable benefits in multiple areas of life" (Ontario Ministry of Education, 2016, p.11).

Critical thinking connotes the ability to reason logically, classify, compare, sequence, critique, hypothesize, analyze and compare complex systems, and to understand how their interconnected parts support each other and the system. It involves patterning, deductive and inductive reasoning. To communicate effectively entails being able to express thoughts clearly, share information efficiently and effectively, articulate opinions, give coherent and unambiguous instructions, motivate and persuade others. It requires being able to listen effectively in order to decipher meaning, attitudes, knowledge and intentions; as well as being able to use digital media in communication to support personal and group learning. Collaboration requires working with diverse teams and valuing the contributions made by each team member. It also connotes being able to make compromises so as to ensure the achievement of common goals. Being creative and innovative implies being responsive to new and diverse perspectives and being able to produce new, diverse and unique ideas and to solve problems; without being restricted by

rules, customs or norms (Trilling and Fadel, 2009; Bellevue College, 2016; Ontario Ministry of Education, 2016; Applied educational systems, 2019).

These skills are considered by many to be the basic capabilities required by individuals if they are to acquire 21st century skills, as well as succeed in school, work and life (Applied educational system, 2019; Ross, 2017). Acquiring these skills is believed to be extremely important for learners to become good citizens that can be civically engaged, digitally literate, globally aware, critical thinkers and good communicators (P21, 2011; Ross, 2017). Unfortunately, these skills are not yet assessed in high-stake state and national examinations (Kivunja, 2014; Sinay, Nahornick and Graikinis, 2017), as these examinations predominantly measure content knowledge. However, Levy and Murname (2012) and Temmerman (2018), in emphasizing the need for students to have 21st century skills, stated that employers value employees with analytical thinking, digital and sophisticated communication skills, who demonstrate much more than just content knowledge.

Saavedra and Opfer (2012), suggest that pedagogy can help students learn not only the knowledge of the disciplines but also the skills associated with knowledge production within the discipline. Several research reports advocate for the use of technology-based, student-centered instructional approaches anchored on the social constructivist perspective; such as inquiry-based learning, problem-based learning, project-based learning, collaborative teaching and collaborative learning among others; to facilitate students' development of 21st century learning skills. These approaches are characterized by group activities, social interactions, critical thinking, generation of answerable questions, problem solving, scaffolding, knowledge building, critical thinking, direct instruction by teachers, intra-personal communication, leveraging on technology and presentation of findings, answers or solutions in a variety of formats (Care, Kim & Vista 2017; Mill & Kim, 2017; Chu, Reynolds, Notari, Taveres& Lee, 2017; Sinay, Nahornick and Graikinis, 2017).

For the Nigerian nation to successfully meet the challenges of preparing her citizens for life in the rapidly changing world, its schools must teach a fusion of academic knowledge and 21st century skills. The Nigerian national policy on education (NPE) acknowledges the pivotal role of quality teachers in providing quality education at all levels of the education system. Thus, it pledges that teacher education shall take cognizance of changes in methodology, regularly expose teachers to professional innovations, as well as incorporate information technology (IT) in all teacher-training programmes (Federal Republic of Nigeria -FRN 2013). This stand is strengthened by the National Teacher Education Policy, whose vision of Teacher Education in

Nigeria is "a national school system staffed by quality, highly skilled, motivated, devoted, knowledgeable and creative teachers (capable of raising a generation of Nigerian learners who can compete globally) based on explicit performance standards through world standard pre-service and in-service programmes" (FRN, 2014, pp. 6).

However, research reports suggest that science teaching in Nigeria has remained highly expository and teacher-centered (Kalu-Uche, Alamina and Adolphus, 2009; Owolabi, 2012; Kalu-Uche, Alamina and Ovute, 2015). Teacher-centered pedagogies give students opportunities to learn information and factual knowledge, but do not allow them to practice applying the knowledge gained in new contexts, solve problems, communicate in complex ways or develop creativity (Center for global education, 2018; Saavedra and Opfer, 2012). The emphasis on teacher-centered pedagogy is directly traceable to teachers' predominant use of the lecture method so as to "complete the West Africa Examinations Council (WAEC) syllabus within the regulated time" (Adegoke, 2017). This observation may give credence to the often quoted maxim that "teachers teach the way they are taught". On the other hand, if conscious efforts are made to inculcate 21st century learning skills in science teacher education practices, then science teachers will "teach the way they are taught".

To ensure that Nigerian students develop 21st century learning skills, needed to compete globally, instructional approaches that use technology, enable students to think critically, plan, and work in groups on authentic problems which require them to communicate respectfully, consider other people's points of view, and present their reports in diverse formats should be taught to and utilized by all teachers. Against the backdrop of Nigeria's desire to prepare her citizens to be relevant in the rapidly changing society, it is pertinent to investigate the extent to which teacher educators' pedagogical practices align with globally acclaimed approaches that support the acquisition of 21st century learning skills, and to determine the extent to which teacher educators' and pre-service science teachers' perceptions of teacher education practices supporting the acquisition of 21st century learning skills agree.

The following three research questions and one hypothesis guided the study:

- Which pedagogical practices do science teacher educators and pre-service science teachers perceive as important for fostering the acquisition of 21st century learning skills in pre-service science teachers?

- To what extent do science teacher educators' reports of their pedagogical practices align with their perception of classroom practices that support the acquisition of 21st century learning skills?
- To what extent do science teacher educators' and pre-service science teachers' reports of teacher education classroom practices that foster the acquisition of 21st century learning skills agree?
- There is no significant correlation between teacher educators' and pre-service science teachers report of teacher education classroom practices in federal universities in South-east Nigeria.

Method

The study adopted a descriptive survey design to investigate the extent to which teacher education practices that foster the development of 21st century learning skills are implemented in pre-service science teacher education in federal government owned universities in south-east Nigeria. Using the balloting method, two out of the three federal government-owned universities offering science education at the 400 level as at 2018/2019 session in South-east Nigeria were selected for the study. The sample for the study consisted of seventy-four 400 level pre-service science teachers offering Biology, Chemistry, Integrated Science, Mathematics and Physics Education and thirty-four science teacher educators. The sample was randomly drawn from a population of two hundred and thirty-six 400 level (2018/2019 session) pre-service science teachers and seventy-seven teacher educators in the departments of science education, University of Nigeria, Nsukka (UNN) and Michael Okpara University of Agriculture, Umudike (MOUAU). The instrument for data collection was a researcher-developed 42-item 4-point rating scale titled "Pre-service science teachers' learning skills survey". The instrument had two sections. The items in each section were arranged in four clusters. The instrument had two versions – one for science teacher educators and the other for pre-service science teachers. To establish the reliability of the instrument, it was administered to ten science education lecturers in Enugu State University of Technology. The instrument had a Cronbach's Alpha reliability coefficient of 0.81. Three research assistants were used to administer and retrieve the questionnaires. Data collected were analyzed using mean and standard deviation. The hypothesis was analyzed using Pearson's correlation coefficient.

Results

Table 1: Teacher Educators' and Pre-service Science Teachers' Perception of pedagogical practices that foster pre-service science teachers' acquisition of 21st century learning skills

	Pedagogical Practices	Educators		Students	
		Mean	**SD**	**Mean**	**SD**
A	**Creativity and Innovation**				
i	Allowing students to work on problems for which they can present their solutions in various formats	3.03	5.32	3.40	15.22
ii	Allowing students to decide on their own procedure or method for solving a problem/ performing a task	2.65	3.91	3.00	11.36
iii	Providing opportunities for students to do hands-on/ laboratory activities often	3.09	5.22	3.44	16.03
iv	Allowing students to make products that can be used by someone else	3.21	5.59	3.18	13.21
v	allowing students to work on tasks that can take a week or more to complete	2.56	4.03	3.18	16.26
	Pooled Mean	**2.91**		3.24	
B	**Communication**				
i	Allowing student to write essays to explain their thoughts at length	2.79	5.02	3.40	16.08
ii	Allowing students to give written or oral summary of a complicated content or subject in a concise way	2.85	4.72	3.14	14.25
iii	Allowing students to explain or justify their reasoning concerning specific topics or ideas when participating in classroom activities	3.24	5.72	3.29	14.44
iv	Allowing students to explain their reasoning to each other or to represent the same idea or relationship in more than one way	3.18	6.02	3.28	15.26
v	Allowing students to ask clarifying questions to fully understand teachers' intended message	3.24	6.34	3.43	15.41

vi	Allowing students to make presentations in diverse formats media	3.06	6.42	3.18	11.51
vii	Allowing students to demonstrate their work or make oral presentations to an audience that include people other than teacher, students and their family	3.03	6.58	3.31	13.87
	Pooled Mean	**3.05**		3.29	
C	**Critical Thinking and problem solving**				
i	Asking students questions to elicit their ideas and opinions, as well as to justify and explain their reasoning	3.18	6.84	3.32	16.81
ii	Allowing students to decide on their own procedures for solving a complex problem and then discussing the results	3.06	5.02	3.13	12.79
iii	Allowing students to work on challenging tasks for which there are no obvious methods of solution	2.74	4.03	2.78	15.65
iv	Allowing students to present their solutions to problems using multimedia and ICT formats.	3.03	7.70	3.21	15.64
v	Giving students tasks for which they source for information, make value judgements, write reports, and justify the steps they took to reach their conclusions	3.50	7.83	3.39	14.82
	Pooled Mean	**3.10**		3.16	
D	**Collaboration**				
i	Allowing students to work in small groups to come up with a joint solution to a problem or task	3.44	7.23	3.38	14.23
ii	Allowing student to have group discussions to deliberate on units/topics introduced in class	3.24	6.98	3.36	15.70
iii	Allowing students to work together in small groups/ teams to complete assignments that may take a week or more	3.35	6.80	3.13	11.02
iv	Allowing students to suggest or help in planning classroom activities	3.26	6.80	3.14	15.51
	Pooled Mean	**3.32**		3.25	

Data in Table 1 shows that all the items had mean scores above 2.50, with standard deviations ranging from 3.91 to 7.83 for Teacher Educators. The standard deviations indicate that the Teacher Educators' responses varied slightly from the mean. However, the standard deviations for pre-service science teachers ranged from 11.02 to 16.81. This indicates that the pre-service science teachers' responses varied widely from the mean. This result shows that in the opinion of the Teacher educators and Pre-service science teachers, the identified pedagogical activities will foster pre-service science teachers' development of 21st century skills.

Table 2: comparing science teacher educators' reports of their pedagogical practices with their perception of classroom practices that support the acquisition of 21st century learning skills

	Pedagogical Practices	**Perception**		**Practice**		**Remarks**
A	Creativity and Innovation	Mean	SD	Mean	SD	
i	Allowing students to work on problems for which they can present their solutions in various formats	3.03	5.32	2.68	3.35	Aligned
ii	Allowing students to decide on their own procedure or method for solving a problem/ performing a task	2.65	3.91	2.47	8.53	Differed
iii	Providing opportunities for students to do hands-on/ laboratory activities often	3.09	5.22	2.59	7.02	Aligned
iv	Allowing students to make products that can be used by someone else	3.21	5.59	2.47	4.56	Differed
v	allowing students to work on tasks that can take a week or more to complete	2.56	4.03	2.26	2.69	Differed
	Pooled Mean	2.91		2.49		Differed
B	Communication					
i	Allowing student to write essays to explain their thoughts at length	2.79	5.02	2.44	3.64	Differed
ii	Allowing students to give written or oral summary of a	2.85	4.72	2.18	6.06	Differed

	complicated content or subject in a concise way					
iii	Allowing students to explain or justify their reasoning concerning specific topics or ideas when participating in classroom activities	3.24	5.72	3.15	6.26	Aligned
iv	Allowing students to explain their reasoning to each other or to represent the same idea or relationship in more than one way	3.18	6.02	3.18	6.73	Aligned
v	Allowing students to ask clarifying questions to fully understand teachers' intended message	3.24	6.34	3.44	7.37	Aligned
vi	Allowing students to make presentations in diverse formats	3.06	6.42	2.68	6.34	Aligned
vii	Allowing students to demonstrate their work or make oral presentations to an audience that include people other than teacher, students and their family	3.03	6.58	2.47	3.04	Differed
	Pooled Mean	3.05		2.79		Aligned
C	Critical Thinking and problem solving					
i	Asking students questions to elicit their ideas and opinions, as well as to justify and explain their reasoning	3.18	6.84	2.56	4.03	Aligned
ii	Allowing students to decide on their own procedures for solving a complex problem and then discussing the results	3.06	5.02	2.44	4.61	Differed
iii	Allowing students to work on challenging tasks for which there are no obvious methods of solution	2.74	4.03	2.24	5.22	Differed

iv	Allowing students to present their solutions to problems using multimedia and ICT formats.	3.03	7.70	2.74	3.20	Aligned
v	Giving students tasks for which they source for information, make value judgements, write reports, and justify the steps they took to reach their conclusions	3.50	7.83	2.91	6.10	Aligned
	Pooled Mean	3.10		2.49		Differed
D	Collaboration					
i	Allowing students to work in small groups to come up with a joint solution to a problem or task	3.44	7.23	2.97	7.70	Aligned
ii	Allowing student to have group discussions to deliberate on units/topics introduced in class	3.24	6.98	2.91	5.50	Aligned
iii	Allowing students to work together in small groups/ teams to complete assignments that may take a week or more	3.35	6.80	2.15	2.69	Differed
iv	Allowing students to suggest or help in planning classroom activities	3.26	6.80	2.24	6.34	Differed
	Pooled Mean	3.32		2.57		Aligned

Table 2 shows that considering teacher educators' report of classroom practices in teacher education, ten items had mean scores below 2.50 while eleven of the items had mean scores that were above 2.50. The items had standard deviations ranging from 2.69 to 8.53. This result indicated that the science teachers' educators agreed to large degrees that some of the identified pedagogical practices fostering acquisition of 21st century skills were implemented in federal universities offering teacher education programmes in South-east Nigeria.

Table 3: teacher educators' and pre-service science teachers' reports of teacher education classroom practices that foster the acquisition of 21st century learning skills

	Pedagogical Practices	Pre-Service Science Teachers' Report		Teacher Educators' Report		Remarks
A	**Creativity and Innovation**	**Mean**	**SD**	**Mean**	**SD**	
i	Students are made to work on problems for which they can present their solutions in various formats	2.69	4.36	2.68	3.35	**Agree**
ii	Students decide on their own procedure for solving a problem	2.89	8.77	2.47	8.53	**Disagree**
iii	Students have sufficient opportunities for hands-on/ laboratory activities often	2.42	12.45	2.59	7.02	**Disagree**
iv	Students make products that can be used by other people	2.94	10.05	2.47	4.56	**Disagree**
v	Students work on tasks that can be completed within a week or more	2.92	18.03	2.26	2.69	**Disagree**
	Pooled Mean	**2.77**		**2.49**		**Disagree**
B	**Communication**					
i	Students are allowed to express their points of view about unresolved issues by writing reflective essays	2.78	10.44	2.44	3.64	**Disagree**
ii	Students are allowed to give a concise summary of a complicated content	2.83	8.31	2.18	6.06	**Disagree**
iii	Students are allowed to justify their reasoning concerning specific topics when participating in classroom activities	3.32	14.30	3.15	6.26	**Agree**
iv	Students are allowed to explain their ideas to each other or to represent the same idea or relationship in more than one way in class	3.36	14.65	3.18	6.73	**Agree**
v	Students often ask clarifying questions to fully understand the information the wants to pass across	3.31	15.07	3.44	7.37	**Agree**
vi	Students lead class discussions and make presentations in diverse formats	3.03	11.70	2.68	6.34	**Agree**
vi i	Students demonstrate their work or make oral presentations to an audience that include people other than their teachers, and other students	2.46	7.71	2.47	3.04	**Agree**
	Pooled Mean	**3.11**		**2.79**		**Agree**

	Critical Thinking and problem					
C	**solving**					
i	Students are asked questions to elicit their ideas and opinions	3.38	10.51	2.56	4.03	**Agree**
ii	Students decide on their own procedures for solving a complex problem and then discuss the results with the entire class	2.44	10.84	2.44	4.61	**Agree**
iii	Students work on challenging tasks for which there are no prescribed methods of solution	2.36	4.58	2.24	5.22	Agree
iv	Students often present their solutions to problems using multimedia and ICT resources	2.97	8.19	2.74	3.20	Agree
v	Students are given tasks for which they source for materials, make value judgements, write reports, and justify the steps they took to reach their conclusions in class	3.14	10.03	2.91	6.10	Agree
	Pooled Mean	**2.86**		**2.49**		**Disagree**
	Collaboration					
a	Students are allowed to work in small groups to come up with a joint solution to a task	3.32	15.14	2.97	7.70	Agree
b	Student often have group discussions to deliberate on units/topics introduced in class	3.15	11.51	2.91	5.50	Agree
c	Students work together in small groups/ teams to complete assignments that may take a week or more	2.90	6.67	2.15	2.69	Disagree
d	Students participate in in planning classroom activities	2.92	9.95	2.24	6.34	Disagree
	Pooled Mean	**3.07**		**2.57**		**Agree**

Data in table 3 shows that teacher educators' and pre-service science teachers' perceptions of classroom practices in teacher education that foster the development of 21st century learning skills differed on seven items, while agreeing on fourteen items.

Table 4: Analysis of Pearson's Correlation coefficient between Teacher Educators' and Pre-service service science teachers' report of teacher education classroom practices in federal universities in South-east Nigeria

Variables	n	r-value	Z' value	Remarks
Teacher Educators Versus Pre-service Science teachers report	**108**	**0.64**	**0.76**	**Significant**

The Pearson's correlation coefficient of 0.64 and the transformed z' value of 0.78 indicates a linear positive correlation between teacher educators' and pre-service science teachers' report of teacher education pedagogical practices in federal universities offering pre-service science teacher education in South-east Nigeria. Thus, the null hypothesis that there is no significant correlation between teacher educators' and pre-service science teachers' report of classroom practice in teacher education is rejected and the alternative hypothesis that there is a correlation between teacher educators' and pre0service science teachers' report of teacher education classroom practices in federal universities in south-east Nigeria.

Discussion

Schools are saddled with the responsibility of assuring that all students, and by extension all citizens, develop 21stCentury learning skills although these skills are not taught as content knowledge in academic settings. Pedagogy is touted to be perhaps, the way to facilitate students' development of these basic capabilities and dispositions required of individuals if they are to succeed in the present day society. The Nigerian nation in recognition of the pivotal role of quality teachers at all levels of the education system, saddles teacher education institutions with the responsibility of guaranteeing that pre-service science teachers are equipped with all skills they require for the effective performance of their duties. Since 21st century skills are not taught as content knowledge, researchers advocate that they can be developed through participating in classroom practices that foster their development.

In science teacher educators' (2.91) and pre-service science teachers' (3.24) opinions, classroom activities can foster pre-service science teachers' attainment of creativity and innovation skills. For teacher educators, allowing students to make products that can be used by other people (3.21) is most important for developing creativity and innovation skills in pre-service teachers. However, in pre-service science teachers' view, providing opportunities for students to do hands-on and laboratory activities (3.44) was a

more important classroom activity to help them develop creativity and innovation skills.

Teacher educators (3.05) and pre-service science teachers (3.29) in federal universities in South-east Nigeria agree that effective communication can be learnt by participating in classroom activities. Allowing students to ask clarifying questions to fully understand teachers' intended message was perceived as most important for developing efficient communication skills by both teacher educators (3.24) and pre-service science teachers (3.43).

Teacher educators (3.50) and pre-service science teachers (3.39) agree that giving pre-service science teachers tasks for which they source for information, make value judgments, write reports and justify the steps they take to reach their conclusions was the most efficient pedagogical activity that will promote critical thinking and problem solving skills in pre-service science teachers. Teacher educators (3.24) and pre-service science teachers (3.38) also agree that allowing student to work in small groups to provide joint solution to tasks was an effectual classroom activity encouraging the acquisition of collaboration skills.

Although teacher educators agree that pedagogical practices can promote the acquisition of creativity and innovation skills (2.91), their report of actual classroom activities imply that such practices are not carried out satisfactorily in pre-service science teacher education in federal universities in South-east Nigeria (2.49). Their reports suggest that pre-service science teachers are rarely given opportunities to: make products that could be used by someone else (2.47); decide on their own procedure for performing tasks (2.47); or engage in tasks that could take a week or more to complete (2.26). This is at variance with Chu, Reynolds, Taveres and Lee's (2017) as well as Sinay, Nahornick & Graikinis' (2017) reports of teaching strategies and their attendant classroom practices that foster creativity and innovation.

Teacher educators report that pre-service science teachers are allowed to ask clarifying questions to fully understand teacher educators' intended meaning (3.44); explain their ideas in various ways (3.15); lead classroom discussions and to make presentations in diverse formats in class (2.64). Although teacher educators report that pre-service science teachers are not allowed to give concise written or oral summary of complicated content (2.18); make oral presentations to audiences that include other people; nor asked to write essays to explain their thoughts at length (2.44); pre-service science teachers' perceive that all these classroom activities will promote their development of effective communication skills (3.31). Classroom activities that encourage students to make oral presentations ensure their development of better communication and presentation skills (Girard and Trapp, 2011), which

are essential in order to function effectively in professional settings (Zivkovic and Stojkovic, 2011).

Technology presents unrestricted access to information, sometimes from sources that do not have reputable standards for truthfulness (Pew, 2012); this makes critical thinking and evidence-based inquiry a primary goal for educators (Kraus, Sears and Burke, 2013). Teacher educators and pre-service science teachers in federal government owned public universities agree that students are given tasks for which they source for information, make value judgments, write reports and justify the steps they took in reaching their conclusions. This classroom practice agrees with Kraus, Sears and Burke's (2013) report of classroom activities that encourage evidence-based critical thinking.

Collaboration in the classroom requires students working together as a team to achieve a specified goal. Teacher educators and pre-service science teachers report that students are allowed to have group discussions and to work in small groups to present joint solutions to tasks. However, the pre-service teachers report that they are not allowed to work in teams on tasks that take a week or more to complete (2.15) neither are they allowed to contribute in planning classroom activities (2.24). This report is at variance with teaching strategies such as problem-based learning and peer teaching strategies (Care, Kim & Vista 2017; Chu, Reynolds, Notari, Taveres & Lee, 2017) which have been reported to be effective in promoting collaboration which 21st century learners require to excel.

There was a positive linear relationship between teacher educators' and pre-service science teachers' report of the extent of usage of pedagogical practices that enhance the development of 21st century learning skills in pre-service science teacher education in the federal universities in south east, Nigeria.

Conclusion

From the analysis of data, it is pertinent to conclude that teacher educators and pre-service science teachers perceive that some classroom practices which foster the development of 21st century learning skills are adopted in pre-service teacher preparation in federal government owned universities offering science teacher education in South-east Nigeria, such as creativity and innovation, communication, critical thinking and problem solving as well as collaboration. Although teacher educators' and pre-service science teachers' report of the extent of utilization of some pedagogical practices in teacher education did not agree, there was a linear correlation between their reports of classroom practices in teacher education.

Recommendations

To ensure that pre-service science teachers are well-equipped to succeed in the 21st century workplace, society and future roles as science teachers, teacher educators and teacher education programmes should consciously strive to incorporate pedagogical practices that foster the development of 21st century skills in pre-service science teachers.

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