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TEACHERS' PERCEPTION OF SCIENCE, TECHNOLOGY, ENGINEERING, AND MATHEMATICS AND SCIENCE EDUCATION AS VERITABLE TOOLS FOR NATIONAL DEVELOPMENT

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Abstract

This study investigated teachers' perceptions of Science, Technology, Engineering, and Mathematics (STEM) and Science education as veritable tools for national development. The study was carried out in Delta north senatorial district of Delta state, Nigeria. The purpose of this study is to find out the perceptions of teachers on STEM and Science education by examining their knowledge and perceived competence; in Delta North Senatorial District of Delta State, Nigeria. Two research questions and one hypothesis guided the study. The study adopted a descriptive survey research design. The sample size of the study was 100 Science teachers. Data was collected using the research instrument titled Teachers' perception of STEM education questionnaire (TPSEQ), which was validated, and gave reliability co-efficient of 0.72 as a measure of internal consistency which was estimated using Cronbach Alpha. Results of the study revealed that science teachers have good perceptions regarding STEM education and are willing to integrate STEM education in their teaching. The findings also showed that Science teachers, have good content knowledge regarding STEM education and their perceived competence, is relatively high. It was concluded by reason of these findings that Science teachers have good perceptive knowledge and competence of STEM education. It was therefore recommended amongst others that curriculum planners and the government should encourage and motivate Science teachers' perceptions to keep aligning to STEM integrated approach to enable them continual development on their existing knowledge and competence of STEM Education.

Keywords: *Teachers' Perceptions, STEM, Science education, Veritable tool, National Development.*

Introduction

The purpose of education lies in its transforming ability to equip the recipient with positive changes, as transformation of the individual is a transformation of the society. Positive changes can only be accomplished through STEM education. STEM is an acronym which describes Science, Technology, Engineering, and Mathematics. STEM is an integrated approach to learning of the aforementioned disciplines into a single unified knowledge rather than in fragments (Ejiwale, 2013). STEM education was introduced to stimulate students' performance as well as influence their exploitation in careers related to science (Herman, 2013). Many nations of the world invest huge capital in designing its curriculum in adopting interdisciplinary approaches to the teaching of science with emphasis on teachers' perceptions in the delivery of the curriculum to produce men for the labor market in STEM careers (Zhang, Chia, & Chen, 2022).

Teachers' perceptions have to do with the teacher's content knowledge of STEM education, his perceived competence to apply STEM education in his teachings, and his ability to understand the importance of transferring critical thinking and problem-solving abilities to the learners to tackle real-life challenges (Herdem & Ünal, 2018). In agreement to this, Sujarwanto, Madlazim, and Ibrahim, (2019) viewed STEM education as the education that prepare students with the needed skills for problem solving as they face the development of science and technology, in the world of work. According to him, he viewed perception, competence, and application toward STEM as the teacher's level of inquisitiveness towards STEM education, the teachers understanding to apply the integration of STEM during learning, and what the teacher thinks about STEM education. The knowledge integration of STEM education serve as raw materials enriching learners in making the world a conducive place, rather than the didactic pedagogic approach that had been (Sari, Alici, & Sen, 2017).

Science is a systematic study of nature (Clement, Bello, & Sunusi, 2017). It is an ordered collection of facts, principles, techniques and methods. Scientists give sense to the world through the processes of science: which include observing, investigating, interpreting, evaluating, applying and inferring, while Technology is the rightful application of scientific knowledge using natural phenomenon (Nwigboji & Egbe (2017). Engineering is the branch of science and Technology concerned with the design, building and use of engines, machines, and structures by using methods engendered in science. Engineering is the assemblage and the utilization of the knowledge of science and mathematics in understanding and solving the challenges of man and his environment (Cooper & Heaverlo, 2013). Mathematics is the study of numbers, quantities, and patterns and the relationships that exist amongst them (Inweregbuh, 2015). The application of educational principles in understanding the inter-relationships that exist between Science and other disciplines is termed Science education.

Science is the driving force that propels STEM education in any nation. Education in STEM focuses on the acquisition of problem-solving skills (Care, Griffin, & Wilson, 2018). Having a sound pedagogy of STEM for national development therefore is a function of teachers' perceptions to interpret and apply STEM concepts since they are the main factors in the implementation thus, showing the important role that teachers play in the success of any STEM education. Hitherto, Science teaching in Nigeria has been didactic, non-creative, and certificate conscious, as the core sciences (Physics, Chemistry, Biology, and Mathematics) are taught as single entity rather than a unified whole in the secondary schools. The need for innovative pedagogy in incorporating integrated teaching approaches to implement STEM education becomes therefore necessary. In order to do away with instructional challenges teachers are faced with due to the interdisciplinary nature of the STEM curriculum and the present nature of school structure, McMullin and Reeve (2014) posited that teachers' perceptions are the propelling force for overcoming instructional challenges in STEM education. Kartimi, Ari, and Dindin (2021) conducted a research on assessing the elementary teachers' perception and readiness towards STEM-based contextual learning in 21st Century Era; the findings showed that elementary school teachers had good perceptions and were ready to implement STEM-based contextual learning. According to Kartimi, Ari, and Dindin (2021), the main problem faced by the teachers to implement STEM-Based contextual learning was the difficulty of integrating the subjects and providing contextual aspects related to students' real life.

In the areas of national development, education in STEM finds application and usefulness in innovative teachings, research (in the areas of scientific inventions, food production), problem-solving and prospects. The world is a global village. Therefore, STEM is needed to solve the emerging challenges and issues in todays' world such as out breaks of epidemics, famines, climatic changes, poverty alleviation etc to foster development (Wasagu, 2019). It is obvious that learning and acting in STEM enables the development of skills that equip students for the labor market where their capacities and success depend on what they can offer practically and not just on what they know from theoretical point of view. STEM education is relevant to the society in the areas of energy, healthcare, good governance, food, shelter, poverty alleviation; as a rejection of STEM amounts to a rejection in national development (Ugo & Akpoghol, 2016).

For an effective implementation of STEM education in secondary schools therefore, the perceptions of teachers in terms of their content knowledge, their pedagogical competency in delivering the curriculum becomes very important (Sujarwanto, Madlazim, & Ibrahim, 2019). Integrating STEM concepts across disciplines becomes challenging when teachers lack confidence, and have little or no understanding of the related ideas in each discipline, the researcher therefore seek to carry out an empirical study to investigate teachers' perceptions on STEM education in Delta north senatorial district of Delta State.

Statement of the Problem

Education in STEM seeks to build and provide innovative solutions to the challenges and issues of human existence especially those related to teacher pedagogies and their perceptions. The concept of STEM education as a single unified field of knowledge is relatively new in Delta north Senatorial district of Delta State, and there is prerequisite limit in terms of knowledge, skills, perceptions, and experiences in its applicability, as science teachers are therefore uncertain in the effective and successful implementation of STEM education. It then becomes necessary to investigate empirically, teachers' perceptions of STEM in the teaching and learning of Science in Delta north Senatorial district of Delta State.

Research Questions

1. What are the perceptions of science teachers to STEM education in Delta North Senatorial District of Delta State?
2. What is the extent of science teachers' perceived competence in the application of STEM education in Delta North Senatorial District of Delta State?

Hypothesis

There is no correlation between science teachers' perceptions and their perceived competence in the applying STEM education in Delta north Senatorial district of Delta State.

Methods

A descriptive survey design was adopted for the study. The survey carried out was done on science teachers' perceived knowledge and competence on STEM education. The study was carried out in Delta north senatorial district of Delta State. The target population was 720 Science teachers who teach courses related to science: Mathematics, Engineering-related courses, and Technology-related courses. A sample of 100 Science teachers was purposively selected to respond to the questions in the survey. The instrument used for the study was a questionnaire titled teachers' perceptions on STEM education Questionnaire (TPSEQ). The questionnaire was divided into sections A and B. Section A comprised of demographic variables while section B comprised of the questionnaire items. The instrument was taken to an expert for validation and was found valid and suitable for data retrieval. A pilot test was carried out using 20 science teachers in a secondary school outside the study area to establish the reliability of the research instrument. Using Cronbach Alpha, a reliability coefficient of 0.72 was obtained as a measure of internal consistency, which implies that the instrument was reliable for data collection. Data collected were analyzed, mean and standard deviation were used to answer the research questions. As a result, any response with a mean of 2.50 and above was accepted, while any response below 2.50 was rejected. Pearson Product Moment Correlation was used to test the hypothesis at 0.05 level of significance.

Presentation of Results

Research question 1

What are the perceptions of science teachers to STEM education in Delta North Senatorial District of Delta State?

Table 1

Mean rating of the perceptions of Science teachers to STEM education in Delta North Senatorial District of Delta State

S/N	Items	Mean(x)	SD	Decision
1.	Aside my area of specialization, I can teach any other science related subjects	2.88	.327	Accepted
2.	I can teach engineering concepts at secondary school level	2.46	.642	Rejected
3.	I can teach Technological concepts at secondary school level	3.12	3.056	Accepted
4.	Lack of Computer knowledge limits my understanding of STEM concepts connections	2.33	.697	Rejected
5.	I am willing to collaborate with other subject teachers	2.79	456	Accepted
6.	I am ready to attend STEM education workshops/courses	2.85	.411	Accepted
7.	I believe that STEM education can attract students	2.76	.534	Accepted
8.	The quality of education can be improved through STEM	2.81	.419	Accepted
9.	I am ready to use new teaching methods	2.85	.359	Accepted
10.	I set my targets in STEM education	2.61	.618	Accepted
Average mean2.746				

Table 1 showed that, the perceptions of science teachers to STEM education in Delta North

Senatorial District is relatively high as almost all the items were accepted except two that were rejected. This is seen in the perception level of 2.746 which is higher than the benchmark mean of 2.50. The table clearly showed that majority of the science teachers can conveniently teach Technological concepts at the secondary school level as this has the highest mean score of 3.12 and a standard deviation of 3.056. Also, a great number of the teachers can teach science related subjects aside their areas of specialization as this has the second highest mean of 2.88 and a standard deviation of .327.

Research question 2

What is the extent of science teachers' perceived competence in the application of STEM education in Delta North Senatorial District of Delta State?

Table 2

Mean rating of science teachers' perceived competence in the applying STEM education in Delta North Senatorial District

S/N	Items	Mean(x)	SD	Decision
1.	When I teach Mathematics and its applications, it can help solve daily life problems	2.90	.333	Accepted
2.	I do incorporate engineering concepts with other science Subjects in my teachings	2.53	.594	Accepted
3.	I do design lesson/modules that can help solve real life problems through integrated STEM concepts	2.72	.604	Accepted
4.	I do select related supplementary resources for teaching Integrated STEM concepts	2.53	.563	Accepted
5.	I link with ease all the STEM concepts in solving real life Problems in the classroom setting	2.57	.644	Accepted
6.	I can apply different teaching methods in teaching integrated STEM concepts	2.80	.449	Accepted
7.	I enjoy teaching STEM education at the secondary school level	2.67	.604	Accepted
8.	The implementation of STEM education is not difficult for me	2.50	.644	Accepted
9.	I strategize my teaching methods on the bases of students' need	2.77	.468	Accepted
10.	I try my best to positively integrate STEM education	2.74	.525	Accepted
	Average mean 2.673			

Table 2 showed that, all the items were accepted which implies that science teachers have a relatively, high perceived competence in applying STEM education in the Senatorial District. This is shown in the average mean of 2.673 which is greater than the benchmark mean of 2.50. Again, the table showed that majority of the science teachers teach and apply Mathematics to solve daily live problems as this has the highest mean of 2.90, and a standard deviation of .333. In the same manner, most of the science teachers applied different teaching methods in teaching integrated STEM concepts as this has the second highest mean of 2.80 and a standard deviation of .449.

Hypothesis

There is no correlation between science teachers' perceptions and their perceived competence in the applying STEM education in Delta north Senatorial district of Delta State.

Table 3

Pearson Product Moment Correlation of the relationship between science teachers' perceptions and their perceived competence in the applying STEM education in Delta north Senatorial district of Delta State

Variables	N	Pearson (r)	Sig (p value)	- Decision
Teachers Perceptions	100	.492	.000	Ho_1 is Rejected
Teachers Competence	100			

$\alpha = .05$

Table 3 showed Pearson Product Moment Correlation between teachers' perceptions and their perceived competence in applying STEM. It showed a correlation value (r) = .492 and a p-value of .000. Testing at an alpha level of .05, the p-value is less than the alpha level. Therefore, the null hypothesis is rejected. This implies that there is a correlation between science teachers' perceptions and their perceived competence in the applying STEM education in Delta north Senatorial district of Delta State.

Discussion of Results

The findings in research question one revealed that aside their area of specialization, the teachers can teach any other science related subjects, cannot teach engineering concepts but can teach technological concepts. It also revealed that lack of computer knowledge limits their understanding of STEM concepts connections, and that they are willing to collaborate with other subject teachers, they are ready to attend STEM education workshops/courses, they believe that STEM education can attract students, the quality of education can be improved through STEM, they are ready to use new teaching methods and they set their targets in STEM education.

The result from the findings of this table is in agreement with Kartimi, Ari, and Dindin (2021) who conducted research on assessing the elementary teachers' perceptions and readiness towards STEM-based contextual learning in 21st Century Era; the findings showed that elementary school teachers had good perceptions and were ready to implement STEM-based contextual learning. Thus, the result showed that Science teachers in Delta north have good perceptions of STEM education.

The findings in research question two revealed that teachers who teach Mathematics and its applications can help solve daily life problems, they incorporate engineering concepts with other science subjects in their teachings, they design lesson/modules that can help solve real life problems through integrated STEM concepts, they select related supplementary resources for teaching integrated STEM concepts, they link with ease all the STEM concepts in solving real life problems in the classroom setting, they can apply different teaching methods in teaching integrated STEM concepts, they enjoy teaching STEM education at the secondary school level, the implementation of STEM education is not difficult for them, they strategize their teaching methods on the bases of students' need and they try their best to positively integrate STEM education. However, hypothesis one tested revealed that there is a correlation between science teachers' perceptions and their perceived competence in applying STEM education in Delta north Senatorial district of Delta State. This implies that science teachers' perceptions and their perceived competence in applying STEM education are positively related. The findings are in agreement with Sujarwanto et al (2019) who opined that Science teachers are in strong agreement to apply STEM education in teaching and learning and are sure that students would get added value when applying STEM education, as he viewed perception, competence, and application toward STEM as the teacher's level of inquisitiveness towards STEM education, the teachers understanding to apply the integration of STEM during learning, and what the teacher thinks about STEM education. Thus, supporting the result of the finding that Science teachers in Delta north Senatorial district have high relative application to STEM education.

Conclusion

The findings of this study showed that science teachers have relatively high perceptions of STEM and that there is a correlation between their perceptions and perceived competence in applying STEM in the teaching and learning of Science, and that collaborating and integrating different pedagogy in Science-

related subjects help equip students in solving daily, real-life challenges that fosters national development.

Recommendations

It was therefore recommended amongst others that:

1. The curriculum planners and the government should encourage and motivate Science teachers the more in the knowledge of STEM education.
2. Science teachers should keep aligning to STEM integrated approach to enable them continual development on the already existing knowledge and competence of STEM Education

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