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Pre-Service Teachers' Awareness and Attitude Toward STEM Education as a Panacea for National Development

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Abstract
The attitude and behaviour of individuals toward national development today would determine how prepared we are for the future and how the environment will respond to us in the future. Hence this study sought to examine pre-service science education teachers' awareness of STEM education and attitude towards it. The research adopted the descriptive survey of the correlation type, and 400 pre-service teachers were randomly selected for the study. The questionnaire was distributed to 400 pre-service teachers in three colleges of education in Oyo State, Nigeria with 310 duly filled and returned. Mean, Multiple Regression and t-tests were used for data analysis. Findings revealed that pre-service teachers in the colleges of education have a high level of awareness level of STEM education, they also found that the pre-service teachers had favourable attitudes toward STEM education for national development. The study, therefore, recommended among others that the schools where teachers are trained for the future should restructure their curriculum to incorporate STEM education that informs the trainee teachers of the significant roles, they can play in achieving national development through STEM and most importantly promote its knowledge in their classroom.
Keywords: Pre-service Science Teachers, STEM Education, Attitude, National Developments
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1. Introduction

Today, the economy of the world increasingly takes a structure based on knowledge, and countries continue to renew and increase their capacity to create innovation and technology to survive and obtain advantages in the global economy. STEM is an integrated approach to teaching science, technology, engineering, and mathematics that promotes the learning of 21st-century skills and provides developing countries with the tools they need to improve people's lives (Ramanathan and Tulivuori, 2022). The importance of Science, Technology, Engineering, and Mathematics (STEM) in any society that would remain within the center of the fourth industrial revolution cannot be over-emphasized. Africa stands at the margin of the global digital technology revolution also referred to as the fourth industrial revolution due to many factors, some of which have been identified as STEM skills shortage among professionals as well as low student attainment in STEM subjects, (African Union, 2014; Tikly *et al.*, 2018). STEM education provides the platform to introduce learners and students directly to the need for technological skills acquisition as well as numeracy and literacy skills. Thus, for STEM to be an effective tool in any society, its functionality must be recognized by education stakeholders, policymakers, industry players, parents, teachers, and students who all form the circle for STEM knowledge and skills acquisition. STEM also aims to provide students with a learning environment to apply the knowledge and skills required by the 21st century (Bybee, 2013; Dugger, 2010; Sanders, 2009). From preschool to higher education, STEM education provides life-related interdisciplinary knowledge and skills and prepares students for knowledge-based economics (National Research Council-NRC, 2011). This shows how important STEM education is for any meaningful development of a nation. For a nation to reap the bounty of STEM education, students must be aware of its importance and develop a positive attitude to its teaching and learning.

2. Literature Review

STEM is a teaching approach that integrates the areas of science, technology engineering, and mathematics together as a whole. Its teaching and learning help students develop skills needed in solving day-to-day problems. It is a hands-on approach to teaching that allows students to develop creative and innovative skills. The STEM acronym was introduced in 2001 by scientific administrators in the United States of America. National Science Foundation (NSF). The organization previously used the acronym SMET when referring to the career fields in those disciplines or a curriculum that integrated knowledge and skills from those fields (Judith Hailinen, 2023). In 2001, however, American biologist Judith Ramaley, then assistant director of education and human resources at NSF, rearranged the words to form the STEM acronym. Since then, STEM-focused curriculum has been extended to many countries beyond the United States, with programs developed in places such as Australia, China, France, South Korea, Taiwan, and the United Kingdom. STEM Education, being a key driver of economic and technological development globally, Nigerians cannot afford to lag behind in STEM education.

This accounted for different reforms in its education sector right from pre-primary to tertiary level. STEM as an integrated approach to teaching science, technology, engineering, and mathematics promotes the learning of 21st-century skills and provides developing countries with the tools they need to improve people's lives and bring unity into society (Agoro, 22). The problem of how best to teach STEM subjects and how to arouse and sustain student interest in STEM subjects still remains an issue of concern to Science educators in Nigeria. STEM tends to achieve the provision of trained manpower in the applied sciences, technology, and business and give training and impart the necessary skills to individuals for economic self-reliance (Agoro, 2022).

The 21st-century skills are sets of traits and attributes needed to be successful in today's world. It includes knowledge, habits, character, skills, and traits that individuals should possess to be employable and contribute their quota to the development of a nation. In the 21st century, students should be able to produce new knowledge and apply it to new situations and problems rather than to take existing knowledge readily (Wagner, 2008). There are many classifications related to 21st-century skills (OECD, 2005; MoNE, 2011; World Economic Forum, 2015). However, in this study, the classification referred to as P21 was explained due to its widespread use. The general framework of the P21 is:

(i) learning and innovation skills;
(ii) knowledge, media, and technology skills; and
(iii) life and career skills

Partnership for 21st Century Learning (2015) also classified 21st-century learning skills as follows:

- Learning and innovation skills
- Creativity and innovation
- Critical thinking and problem-solving
- Communication and collaboration Information, media, and technology skills
- Information literacy
- Media literacy
- Information, Communications, and Technology (ICT) literacy Life and career skills
- Flexibility and adaptability,
- Inıtıatıve and self-directıon
- Social and cross-cultural interaction,
- Productivity and accountability,
- Leadership and responsibility skills.

In order to have these skills for individuals, existing education systems should be reviewed and renewed according to these skill areas. STEM education facilitates the acquisition of these skills (Yıldırım, 2018). STEM education is more progressive, student-centered, and experimental than traditional teacher-centered education.

Margot and Kettler (2019) used thematic analysis to discover that teachers value STEM education, but barriers such as pedagogical challenges, curriculum challenges, structural challenges, concerns about students, concerns about assessments, and lack of teacher support were reported. Teachers felt the support that would improve their effort to implement STEM education included collaboration with peers, quality curriculum, district support, prior experiences, and effective professional development

Pagar (2018) observed that STEM education is geared toward creating critical thinkers, problem-solvers, and next-generation innovators. He averred that STEM education contributes to assisting students to engage in a transformation from being users of technology to being innovators. Pagar's focus was the Indian environment where 'STEM jobs are growing at a fast pace and currently outstripping the number of STEM graduates.' Pagar observed that while the transition from being users to innovators is slow, the Indian government, STEM companies, and schools are coming together to ensure a smooth and fast transition. For example, STEM centers are being set up by STEM-related companies in schools while the government upgrades library infrastructures and updates curriculum to make STEM teaching and learning have a connection to the learners' environment.

Wijaya *et al., (2022) in their* work to determine the factors influencing preservice teachers' intentions, as well as the effects of gender and age on the implementation of STEM education predicted the relationship between knowledge, social influence, attitude, perceived usefulness, control, and behavioral intention (BI) of using STEM education among preservice secondary school teachers using Theory of Planned Behavior (TPB). The results showed that perceived usefulness had a positive significance and a relationship with the attitudes of preservice teachers toward STEM education. Habit had a positive significance in influencing teachers' behavioral intentions and implementation. Subjective norms did not have a significant correlation with BI and implementation. In another research study, Erdogan and Ciftci (2017) showed that pre-service science teachers demonstrated positive opinions on the basic rationale, benefits, and limitations of STEM education, and proposals were made for the development and dissemination of STEM education. It was also established that Pre-service science teachers learned about STEM education and how to implement it, with the help of STEM education practices that were conducted within the scope of the research.

Students' attitude towards STEM plays a critical role in the effective teaching and learning of STEM subject. Attitude implies the ability and tendency to respond in a certain way to certain issues. It ranges from being positive to negative or from a good attitude to a bad attitude. Attitudes in learning refer to feelings, reactions, and beliefs toward the subject which are not innate characteristics of a student (Olufemi, 2012). Attitudes are considered to explain regularities and behavioral responses since it is considered to vary among individual learners (Adewuyi, 2006). Attitudes are the best predictor to estimate students' success and achievement (Dagnew,2007). According to Sahim, 2009, attitudes have been shown to affect how students learn and what they want to learn; thus, helping students attain favorable attitudes, which can foster their understanding of a subject (Sahin, 2009) Science education curriculum development and teacher education are needed to develop general and domain-specific awareness and attitudes toward STEM that enable learners in the future to assess and make decisions about national development (Burmeister et al., 2012). This implies that all students who pass through school STEM education should acquire skills that will enable them to make sound decisions in the wider society and in the field of science and technology in particular that will promote national development irrespective of whether they later will embark on a career in science and technology or not because all of them will be asked to act as responsible citizens in the future and to contribute to societal decision making.

2.1 Purpose of the Study

The study investigated pre-service science education teachers' awareness, attitude towards, and actual usage of STEM education towards national development. Specifically, the study examined:

1. The pre-service science teachers' awareness of STEM education.
2. The pre-service science teachers' attitude towards STEM education.
3. The pre-service science teachers' actual behaviour towards STEM education for national development.
4. The joint and relative contributions of awareness of STEM education and attitude to the prediction of pre-service Science teachers' actual usage towards national development.

2.2 Research Questions

The following research questions were posed for this study

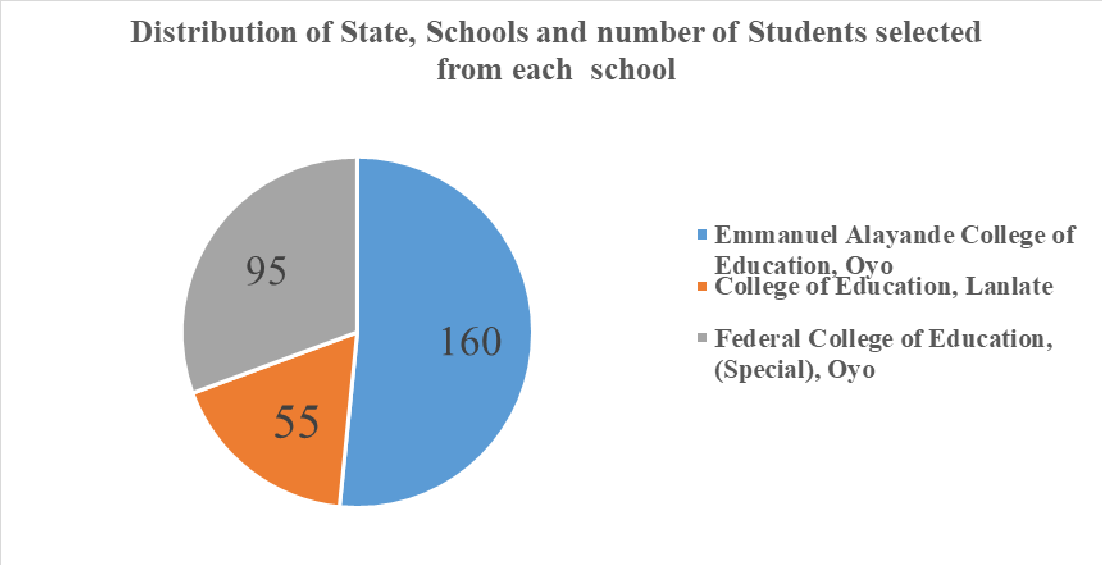
1. Are pre-service science teachers aware of STEM education?
2. What are pre-service science teachers' attitudes toward STEM education?
3. What is the pre-service science teachers' actual behaviour towards STEM education for national development?
4. Are the joint and relative contributions of awareness of and attitude to STEM education a prediction of pre-service Science teachers' actual behaviour towards national development?

3. Methodology

The design of the study was a descriptive survey of the correlational type. The design also shows whether an increase or decrease in the independent variables (awareness and attitude towards STEM education) affects the dependent variable (actual usage of STEM education) towards national development. The population for this study consisted of all the Pre-service science teachers in the three Government-owned colleges of education in Oyo State, Nigeria. The sample size was 310 pre-service science teachers in the departments of chemistry, biology, physics, mathematics, and integrated science from the School of Secondary Education (Science Programmes). The purposive sampling technique was used to select the colleges of education because they are government-owned institutions (Federal and State), students from the school of science and in years II. A random sampling technique was used to select students from the year II students. Finally, the instrument was administered to students in the departments considered for the study. The table below reveals the schools and the number of students selected. (Note 1)

Table 1: *Distribution of State, Schools, and number of Students selected from each school*

SCHOOLS	NUMBERS OF STUDENTS
Emmanuel Alayande College of Education, Oyo	160
College of Education, Lanlate	055
Federal College of Education, (Special), Oyo	095



The research instrument used to gather data for the study was a questionnaire adapted from Moju 2021. The instrument consisted of two sections; A and B. Section A dealt with the demographic variables of respondents such as gender and school. Section B had sub-sections on awareness, attitude towards, and actual behaviour. The response categories of the items in Section B were based on a four-point rating scale ranging (SA) strongly agree, (A) Agree, (D) Disagree, and (SD) strongly disagree for attitude towards and actual usage sub-sections while the response type for the awareness sub-section was based on aware and not aware. The response categories were assigned numerical values of 4, 3, 2, and 1. The internal consistency of the instrument was determined using Cronbach Alpha. The reliability coefficients established for the different sections of the questionnaire are presented in Table 2 (Note 2)

Table 2: Cronbach Alpha Result of the Different Dimensions of the Questionnaire

Dimensions	**Number of items**	**Cronbach's Alpha**
Attitude towards	05	0.72
Actual Behaviour	05	0.81

The instrument was administered to the respondents through personal contact by the researchers and other research assistants from each of the selected schools. Out of 400 questionnaires administered, 310 were duly filled and returned. These represented a 77.5% rate of return. Mean and multiple regression analyses were used to answer the research question.

4. Results

4.1 Respondents' Demographic Information

Table 3: ***Respondents based on Gender***

Gender	**N**	**%**
Male	148	47.74
Female	162	52.26
Total	**310**	**100.00**

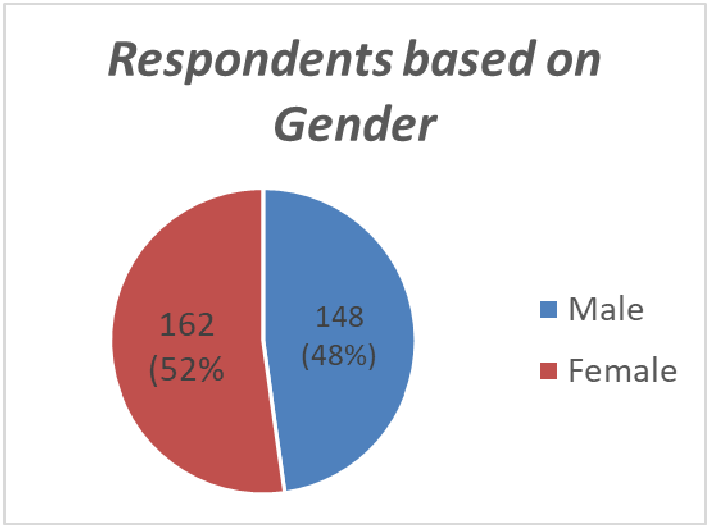


Table 3 (Note 3) shows that 148 (47.74%) of the respondents were male, while 162 (52.26%) of the respondents were female. This implies that female pre-service science teachers participated most in this study.

Research Question 1**:** Are pre-service science teachers aware of STEM education?

Table 4: Pre-service science teachers' awareness of STEM Education

Awareness	**Frequency**	**Percentage**
Aware	282	90.97
Not Aware	28	9.03

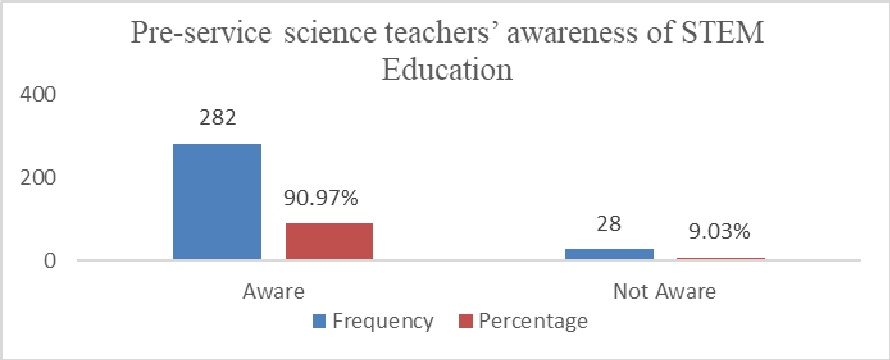


Table 4 shows the pre-service Science teachers in the College of Education's awareness of STEM education in their Schools. 282(90.97%) of the students are aware while 28(9.03%) are not aware.

Research Question 2**:** What are pre-service science teachers' attitudes toward STEM education?

Table 5: Pre-service science teachers' attitude towards STEM education

	ATTITUDE		
ATT1	STEM education makes me feel easy to science learning students.	3.13	Disagreed
ATT2	STEM education is somewhat not intimidating to me	2.58	Disagreed
ATT3	STEM education helps my thinking that which aids me to perform well	3.03	Disagreed
ATT4	I have a lot of confidence when it comes to STEM education.	3.24	Agreed
ATT5	I like to experiment STEM education for my development	3.31	Agreed
	Overall Mean Rating	3.06	Agreed

Table 5 shows the pre-service science education teachers' attitudes toward STEM education. The table revealed that STEM education makes me feel easy to science learning ($\bar{x}$ = 3.13), STEM education is somewhat not intimidating to me ($\bar{x}$ = 2.58), STEM education helps my thinking that which aids me to performing well ($\bar{x}$ = 3.03), I have a lot of confidence when it comes to STEM education ($\bar{x}$ = 3.24). Furthermore, I like to experiment in STEM education classes for my development ($\bar{x}$ = 3.31). An average mean of 3.06 revealed that pre-service science education teachers are having a positive attitude toward STEM education.

Research Question 3: The pre-service science teachers' actual behaviour toward STEM education for national development?

Table 6: Pre-service science teachers' actual behaviour towards STEM education

	Behavioural Intention		
AB1	STEM education increases the development of individuals.	2.71	Agreed
AB2	STEM education is taken through theoretical courses.	2.51	Agreed
AB3	STEM education to improve students' self-assessment	2.61	Agreed
AB4	STEM education adds value to the methods I use for self-attainment and achievements	3.01	Disagreed
AB5	STEM education is used for various aspects of national development in courses I take in school	3.12	Agreed
	Average Mean	**2.79**	

Table 6: Pre-service science teachers' actual behaviour towards STEM education (Note 6)

Table 6 presents the mean ratings on pre-service science education teachers' actual behaviour towards STEM education. STEM education increases the development of individuals ($\bar{X}$=2.71), and STEM education is taken through theoretical courses ($\bar{X}$=2.51). STEM education is used for various aspects of national development in courses I take in school ($\bar{X}$=3.12) However, the overall mean rating of ($\bar{X}$=2.79) reveals that pre-service science teachers 'actual behaviour towards STEM education for national development is adequate.

Research Question 4**:** The joint and relative contributions of awareness of STEM education and attitude to the prediction of pre-service teachers' actual behaviour towards national development?

Table 7: *Multiple Regression Analysis Results of* Joint and relative contributions of Awareness of STEM Education and Attitude to the Prediction of pre-service science teachers' actual behaviour towards national development (Note 7)

Model summary
R= .223
R^2=.112
R^2 (Adjusted) = .417
Standard Error of Estimate
=1.66512
F=17.12, *P* <0.05

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	T	p.
1	(Constant)	12.122	.522		12.935	.000
	Aw	.181	.032	.035	1.322	.000
	A	.213	.041	.022	1.412	.001

a. Predictors: (Constant), Aw (Awareness), A (Attitude)
b. Dependent Variable: Actual Behaviour

Table 7 revealed that awareness and attitude had positive multiple correlations with actual behaviour toward STEM education for national development (R=.223). The Adjusted R Square value of .417 indicated that awareness and attitude jointly contributed 41.7% to the variability of Pre-service Science teachers' actual behaviour towards STEM education for national development. This implies that the remaining 58.3% is due to other variables not included in this study. Analysis of Variance (ANOVA) of multiple regression data showed that the Adjusted R square value was significant (F=17.12, p<0.05).

The result of relative contributions of the independent variables to the prediction of pre-service Science teachers' actual behaviour towards STEM education for national development revealed that awareness and attitude contributed differently to the prediction of the actual behaviour of pre-service Science teachers towards STEM education for national development as indicated, awareness (ß=.181; t=1.322; p<0.05) and attitude (ß=.213; t=1.412; p<0.05) significantly contribute to the prediction of Pre-service Science teachers' actual behaviour towards STEM education for national development. This implies that awareness of STEM education and a positive attitude towards it for national development are very important factors responsible for pre-service science teachers' actual behaviour towards national development.

4.2 Discussions of Findings

The finding from the study is in accordance with findings by Margot and Kettler, 2019, Wijaya *et al.,* 2022 which revealed that pre-service science teachers are aware of STEM education and value STEM education, they

have a positive attitude towards it, and their actual behaviour is adequate. This can be shown through the concept of national development that occurs based on the type of education given to the learners. UNESCO (2000) emphasized that education should include critical analysis of the adequate information and contemporary factors of an economic and political nature underlying the contradictions and tensions between countries and ways of overcoming these contradictions which can be done through STEM education. This primarily sets out to promote values that engender development in society, thus STEM education cannot be compartmentalized as separate from or independent of the overall national development.

The awareness and attitude of individuals are pivotal to creating a cohesive development for any nation. Akpokiniovo (2018) observed that for STEM education to bring about national development in Nigeria, there must be a synergy between schools and education stakeholders in the pursuit of practical-oriented and hands-on activities in STEM subjects. STEM education emphasizes a value-based learner-centered system which oftentimes is contextualized to suit learners' environment. One goal of education in Nigeria is to maintain the peace and stability of the country for national development. Society provides the context for STEM awareness. Ezeife (2003) argued that STEM subjects are taught without acknowledging the debts of the indigenous communities as he averred that examples must not be drawn from Western societies/environments in the teaching of STEM. Briggs (2015) in his discourse on the importance of Science and Technology in evolving a sense of national development averred that good governance which prioritises developmental policies which take into cognizance the inevitable place of science, technology, engineering, and mathematics would create an environment for national unity.

4.3 Conclusion

STEM education plays a crucial role in achieving Sustainable Development Goals, improving the lives of people around the world, and ensuring inclusive and equitable education for all. It should be enhanced and developed wherever possible. Awareness and attitude have been established as a key factor that determines pre-service Science teachers' actual behaviors towards STEM education for national development. Based on the findings from this study, it is concluded that pre-service science teachers have great intentions to behave in a good way towards STEM education for national development. Pre-service Science teachers also owned a positive attitude towards participating in STEM education for national development due to their level of awareness which is tremendously high.

4.4 Recommendation

Based on the findings of the study and as reported in findings from surveys in developing countries STEM education needs improvement in different areas, hence it was recommended to the following stakeholders in education:

The Teachers:

1. Direct expression of STEM learning outcomes for each topic in a subject can better ensure the breadth and depth to which a topic is taught and assessed. There is also a need to establish that assessment should go beyond recalling facts. Test questions need to be hurled at a number of levels so that students' learning can be assessed more rigorously.
2. Using demonstrations with commonly available materials to showcase scientific concepts in a topic, formation of science clubs in schools (or raising activity levels of existing clubs), project work, and training teachers on how to inspire students in science and mathematics to make STEM teaching and learning more interesting.
3. Trainee teachers at the pre-service level in colleges of education should be encouraged to improve their skills to enhance the application of STEM education for national development.
4. Teachers should improve achievement by undergoing professional development programs that can improve their skills and competencies to keep them abreast of the latest developments in the world and help them nurture communication skills, promote students' critical thinking and collaboration to enhance national development by inculcating STEM in their learners.

The Policy Maker:

Science centers should be established to improve the literacy level of students, to encourage them to learn science so as to promote the actualization of STEM projects to contribute to the socioeconomic growth of a country.

1. Overhauling the school curriculum to accommodate the need for students and teachers to be exposed to less expensive initiatives that can promote integrated STEM education.
2. Private companies especially STEM-related ones should partner with the federal government to set up STEM centers in our public primary and secondary schools
3. Internet bandwidth for fast internet connectivity for teachers and pre-service teachers to ensure access

to internet resources for teaching and learning support.

4. There should be a reorganization of the teacher education program at all tertiary institutions (public and private).

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