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Original Article

DETERMINANTS OF UNIVERSITY STUDENTS' INTEREST IN SCIENCE, TECHNOLOGY, ENGINEERING AND MATHEMATICS EDUCATION IN NIGERIA: A CASE OF A STRUCTURAL EQUATION MODELING

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ABSTRACT

The role of Science, Technology, Engineering, and Mathematics Education (STEME) in National development cannot be overemphasized. However, the enrollment of students in the STEME courses at the university level seems not to be encouraging. Moreover, literature is scarce on the major determinants of students' interest in STEME courses. Thus, this study explored the possible determinants of university students' interest in STEME courses using a structural equation modeling approach. The study adopted a correctional research design using a sample of 255 undergraduate Science Education students in Universities in Enugu State Nigeria. STEME students' interest determinants questionnaire and STEME Interest scale were used for data collection. The two instruments were properly face validated by test development experts. The internal consistency reliability indices for the two instruments were 0.85 and 0.79 respectively. A structural equation modeling statistical approach was used to analyze the data. The model fit of the data was tested using the Root Mean Square Error of Approximation (RMSEA) and Confirmatory Factor Index (CFI). The result showed that there was a significant model fit for the data, RMSEA = 0.45, CFI = 0.965. The results further revealed that motivation, self-efficacy, self-esteem, and task persistence are significant (p<.05) determinants of students' interest in STEME courses. This result implies that students have high motivation, self-efficacy, self-esteem, and task persistence are bound to do well in any of the STEME courses at the University level. Therefore, it was recommended among others that students should be adequately supported by their parents for the sake of their academic excellence in University.

KEYWORDS: Determinants, Science Technology And Mathematics Education, University Students' Interest, Nigeria

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INTRODUCTION

There has a been prioritization in almost all countries' policies due to the low number of students enrolling for science technology, engineering and mathematics subjects and workforce(Bahar & Adiguzel, 2016).Vedder-Weiss and Fortus (2012) reported a decline in interest, motivation, and engagement in science learning by students. There is clear evidence that far too few students choose teaching as a career not to talk of choosing their area of specialty as mathematics teaching (Preez, 2018). Thus, Preez (2018) noted that there is a worldwide shortage of STEM teachers. Previous studies have shown that the development of students' motivation to learn science is a function of school among other factors (Bottia et al., 2018; Sha et al., 2016). There is a problem of the decline in STEM occupational outcomes among students when policymakers and researchers are interested in the quality of the

STEM workforce (Han, 2017).In the USA, According to the National Science Board, as cited in Jeffries et al. (2020), enrolments in science and engineering degrees in the USA were found to be low.

Similarly, the Royal Academy of Engineering as cited Jeffries et al. (2020)predicted a shortfall of 10,000 STEM graduates in the UK yearly. There is a need for the development of STEM-related capabilities among the populace at-large in Australia(Jeffries et al., 2020). In the African context, Fomunyam (2019) found that STEM education is lagging. Buttressing this, a report by African American institute as cited in Fomunyam (2019) showed that in 2012, only 6% of the total secondary school enrolment was in technical vocational education and training (TVET) and trends in international mathematics and science (TIMS). Besides, Hooker (2017) noted that the performance of African students in mathematics and sciences has always been on a low compared to international standards according to the UNESCO global monitoring reports revealed that the. As a result of the observed gap in STEM expectations from the students, researchers and policy-makers have explored the factors that are responsible for such abysmal outcomes(Sahin et al., 2017).

A lot of studies have been carried out to unravel the factors that determine students' interest in science, technology, engineering and mathematics education (STEME). According to Sahin et al. (2017), students' interest in STEM is dependent on parental expectations and students' motivational beliefs. Sahin et al. (2017) found that higher mathematics efficacy and higher science efficacy predicted positively students' interest in STEM. Social and ability belonging and self-efficacy of high school students predicted positively their interest in pursuing STEM (Ito & McPherson, 2018). Jeffries et al. (2020) found that students' interest in STEM depends on their regards to science, enjoyment of science, self-concept in mathematics and science. Han (2017) found that students' interest in STEM courses is dependent on their attitudes toward science and technology. Bahar and Adiguzel (2016) found that self-motivation is a significant predictor of American students' interest in STEM.

Caspi et al. (2019) revealed that students' positive attitudes towards science and their ability in science significantly determine their interest in STEM courses. Family support, child interest, and self-efficacy for learning are significant determinants of their interest in science learning (Sha et al., 2016). Bottia et al. (2018) indicated that students' STEM-related outcomes in North Carolina are dependent on their attendance to a high school with a STEM program. Otoo et al. (2018) found that students' confidence and motivation significantly determine their interest in the learning of mathematics. Students' interest in STEM courses can be improved by making science lessons interesting or making the social significance of science, technology, engineering, and mathematics (STEM) known to them(Badri et al., 2016). Sellami et al. (2017) found that perceptions of homework assignments, self-confidence, and intention to pursue further study had a significant influence on students' interest in STEM. Emotional intelligence, self-esteem, and self-efficacy are significant predictors of students' achievement in mathematics (Ugwuanyi et al., 2020).Female active participation in science and technology in Nigeria can be determined by important factors like home, school, and society (Ndirika & Agommuoh, 2017).Gana et al. (2019) found that students' achievement in STEM subjects like physics is dependent on motivation, self-efficacy, and locus of control.

Based on the foregoing, it can be found that researchers have made efforts in determining the factors that influence students' interest in STEME globally. In the Nigerian context, a lot seems not to have been done concerning the potential determinants of University students' interest in STEME. Thus, this creates a serious gap in the literature which necessitated the conduct of this present study. Therefore, the major purpose of this study was to develop a causal model for the explanation of university students' interest in STEME based on parental support, motivation, self-esteem, self-efficacy,

and task persistence. The researchers hypothesized that there would be a significant causal model for the explanation of university students' interest in STEME based on parental support, motivation, self-esteem, self-efficacy, and task persistence.

METHODS

Research Design

This study adopted a correctional survey researcher design. This kind of design enables researchers to establish the nature of associations between the independent variable(s) and dependent variable(s). In this study, the independent variables are parental support, motivation, self-esteem, self-efficacy, and task persistence while the dependent variable is the interest in STEME. This design had been used by Ezema et al. (2019), Okenyi et al. (2019), Achagh et al. (2020), Ugwuanyi et al (2020) in similar studies.

Participants

The participants for this study comprised 255 undergraduate science education students in all the universities in Enugu state Nigeria. The science education students were drawn from their universities using simple random sampling by balloting. This technique was used to ensure that every student had an equal opportunity of being included in the study without any form of discrimination.

Measures

STEME students' interest determinants questionnaire and STEME Interest scale were used as tools for data collection. The two sets of instruments were developed by the researchers through available literature on the subject matter. STEME students' interest determinants questionnaire had 50 items in five clusters with each cluster addressing one of the five independent variables for the study (parental support, motivation, self-esteem, self-efficacy, and task persistence). STEME Interest scale had 20 items relating to the nature of students' interest in STEME. The two instruments were properly face validated by test development experts. The internal consistency reliability indices for the two instruments were 0.85 and 0.79 respectively.

Procedure

The researchers sought permission from the office of the Heads of Departments of the Science Education in all the universities used for the study. Haven granted permission to carry out the research, the researcher went ahead to first administer informed consent forms to all the participants. That was done to ensure that all the participants consented to participate in the research. Thereafter, the copies of the instruments were administered to the participants in their various universities with the help of Postgraduate students in those schools who served as research assistants. The copies of the filled instruments were retrieved at the end of the administration exercise and arranged for data analysis.

Ethical Consideration

Ethical clearance letter was obtained for the conduct of the study through the University of Nigeria Committee on research ethics. During the study, the following were, therefore, observed: gaining entry or permission, participants' rights, informed consent, confidentiality, protection from harm, achieving anonymity, and maintaining professionalism.

DATA ANALYSIS

The data generated were analyzed using a structural equation modeling approach. The SEM approach was done using analysis of moment structures (AMOS) version 16.0. Structural equation modeling was used to develop a causal model for the data set. Confirmatory factor index (CFI), and root mean square error of approximation (RMSEA) were used to test the model fit for the data.

RESULTS

The causal model for the explanation of the prediction of students' interest in STEME based on parental support, motivation, self-esteem, self-efficacy, and task persistence are shown in Figures 1 and 2. Figure 1 shows the causal model based on the unstandardized estimates of the predictor variables while Figure 2 shows the causal model based on the standardized estimates of the predictors.

Table 1: Model Fit Indices for the Data

Model	RMSEA	CFI	$\chi 2$	p
Default Model	.045	.965	210.415	.000
Independence Model	.050	.928	198.931	.000

RMSEA = Root Mean Square Error of Approximation, CFI= Confirmatory Factor Index, $\chi 2$ = Chi-Square, p = Probability value

Table 1 reveals that the default $\chi 2$ = 210.415; *df*= 254; p <.050; *RMSEA* = .045; *CFI* = .965. The goodness-of-fit indices for this model supported an adequate model fit in that the CFI value was higher than .90 and the RMSEA value was less than .05. In order words, the observed causal model fitted the theoretical model for the data set.

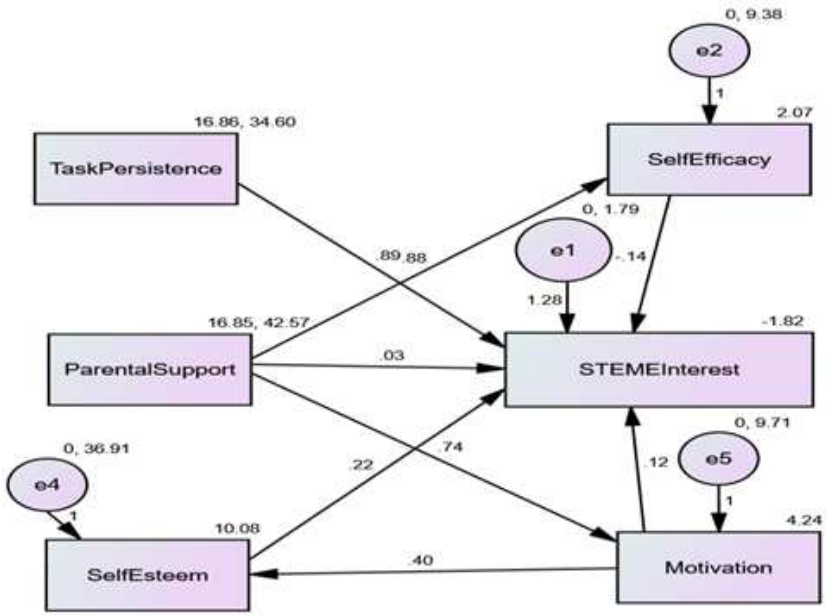

Figure 1: Causal Model for the Explanation of Students' Interest in STEME based on the Unstandardized Estimates.

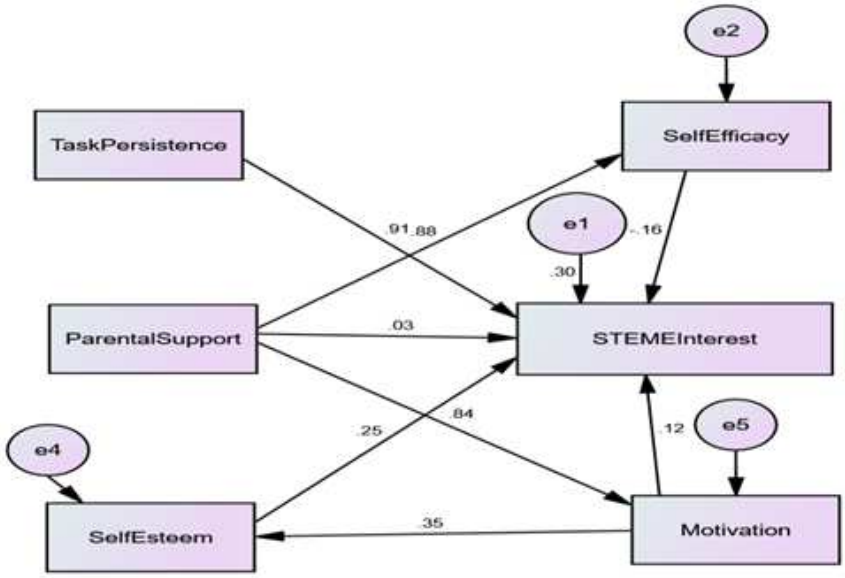

Figure 2: Causal Model for the Explanation of Students' Interest in STEME based on the Standardized Estimates.

Table 2: Regression Weights of the Predictors Variables on Criterion Variables

Determinants of			Estimate	S.E.	C.R.	p
Motivation	<---	ParentalSupport	.745	.030	24.868	***
Self-Esteem	<---	Motivation	.396	.066	5.996	***
Self-Efficacy	<---	ParentalSupport	.883	.029	29.994	***
STEMEInterest	<---	TaskPersistence	.892	.018	48.978	***
STEMEInterest	<---	Self-Esteem	.221	.018	12.552	***
STEMEInterest	<---	ParentalSupport	.027	.043	.630	.529
STEMEInterest	<---	Motivation	.118	.035	3.359	***
STEMEInterest	<---	Self-Efficacy	-.139	.035	-3.975	***

Table 2 shows that task persistence had a significant path coefficient with students' interest in STEME, $\beta = .892$, $p < .05$; self-esteem had a significant path coefficient with students' interest in STEME, $\beta = .221$, $p < .05$; motivation had a significant path coefficient with students' interest in STEME, $\beta = .118$, $p < .05$; and self-efficacy had a significant path coefficient with students' interest in STEME, $\beta = -.139$, $p < .05$. However, parental support does not have a significant path coefficient with students' interest in STEME, $\beta = .027$, $p > .05$. This implies that the causal model for the explanation of the prediction of students' interest in STEME does not include parental support but the motivation, self-esteem, self-efficacy, and task persistence.

On the other hand, Table 2 shows that parental support had a significant path coefficient with students' motivation, $\beta = .745$, $p < .05$; motivation had a significant path coefficient with students' self-esteem, $\beta = .396$, $p < .05$ and parental support had a significant path coefficient with students' self-efficacy, $\beta = .745$, $p < .05$.

Table 3: Correlation Matrix for the Predictor Variables

		Parental Support	Motivation	Self-Efficacy	Self-Esteem	Task-Persistence
Correlation	Parental Support	1.000				
	Motivation	.160	1.000			
	Self-Efficacy	.469	.251	1.000		
	Self-Esteem	.315	.131	.822	1.000	
	TaskPersistence	.311	.132	.787	.831	1.000

Table 3 shows that there are positive correlations among the predictors variables. For instance, Parental support had positive correlation with motivation, $r = .160$, $p < .05$; Parental support had positive correlation with self-efficacy, $r = .469$, $p < .05$; Parental support had positive correlation with self-esteem, $r = .315$, $p < .05$; Parental support had positive correlation with task persistence, $r = .311$, $p < .05$. Also, motivation had positive correlation with self-efficacy, $r = .251$; motivation had positive correlation with self-esteem, $r = .131$, $p < .05$; motivation had positive correlation with task persistence, $r = .132$, $p < .05$. Self-efficacy had positive correlation with self-esteem, $r = .822$, $p < .05$; self-efficacy had positive correlation with task persistence, $r = .787$, $p < .05$; while self-esteem had positive correlation with task persistence, $r = .831$, $p < .05$.

DISCUSSIONS

This study sought to determine the causal model for the explanation of students' interest in STEME based on parental support, motivation, self-esteem, self-efficacy, and task persistence. It was revealed that motivation, self-esteem, self-efficacy, and task persistence are significant predictors or determinants of University students' interest in STEME. This is an indication that the above psychological factors play significant roles in determining students' choices on STEME courses at the university level. In other words, for students to do well in any of the STEME courses, there is a need for high motivation, self-esteem, self-efficacy, and task persistence. This finding conforms with the findings of current studies in the area of STEM.

Sahin et al. (2017) found that students' interest in STEM is dependent on parental expectations and students' motivational beliefs. Sahin et al. (2017) found that higher mathematics efficacy and higher science efficacy predicted positively students' interest in STEM. Social and ability belonging and self-efficacy of high school students predicted positively their interest in pursuing STEM (Ito & McPherson, 2018). Jeffries et al. (2020) found that students' interest in STEM depends on theirregards to science, enjoyment of science, self-concept in mathematics and science. Han (2017) found that students' interest in STEM courses is dependent on their attitudes toward science and technology. Bahar and Adiguzel (2016) found that self-motivation is a significant predictor of American students' interest in STEM.

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significant predictors of students' achievement in mathematics (Ugwuanyi et al., 2020).Female active participation in science and technology in Nigeria can be determined by important factors like home, school, and society (Ndirika & Agommuoh, 2017).Gana et al. (2019) found that students' achievement in STEM subjects like physicsis dependent on motivation, self-efficacy, and locus of control.

CONCLUSION AND RECOMMENDATIONS

The researchers based on the findings of the study concluded that motivation, self-esteem, self-efficacy, and task persistence are significant determinants of University students' interest in STEME. Thus, students' choices of STEME courses are dependent on the above psychological factors. Therefore, the researchers recommended that for quality STEME products, the students should be properly guided in making the choices of STEME courses based on their levels of motivation, self-esteem, self-efficacy, and task persistence. Also, the students should be adequately supported by their parents for the sake of their academic excellence in University.

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