

Entrepreneurship and STEM Competencies Education Among Female Estate Management Students of Polytechnics

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Abstract: Entrepreneurship is a catalyst for the economic prosperity of countries through wealth creation and employment generation. The high unemployment rate in Nigeria is more pronounced among female graduates. As a result, numerous research and government interventions to address this scenario were initiated, but female graduate unemployment still rises at alarming rate. This has been attributed to the lack of intention of female students toward entrepreneurial activities. Thus, this study investigated entrepreneurship education and STEM and entrepreneurial competencies of female students. Three hypotheses were used. The study utilised the quantitative method and survey design based on a cross-sectional time horizon. The collected data from a sample size of 37 female students of estate management in Plateau State Polytechnic. The study also utilised the systematic review and conceptual secondary evidence, by reviewing and analysing 30 recent articles and using SPSS to generate simple percentages, descriptive statistics and simple linear regression model. Results revealed a positive and significant relationship between entrepreneurship education and entrepreneurial intention majorly among social science students. On this premise, a conceptual framework was developed with STEM competencies as moderator to fill the knowledge gap. The conceptual framework reiterates the need to assess moderating effects of STEM competencies based on socio-emotional skills, multi-literacy skills, and knowledge-thinking skills among female estate management students of Plateau State Polytechnic and this showed a moderate positive and significant relationship. Based on the findings, the institutions of higher learning should improve the quality of entrepreneurship education by leveraging on course content enrichment, pedagogical flexibility, and extracurricular activities to strengthen TVET EI of female students.

Key Words: Entrepreneurship, STEM, TVET, Gender

I. Introduction

Entrepreneurship is a catalyst for the economic prosperity of countries through wealth creation and employment generation. Entrepreneurship is usually measured by the entrepreneurial activities executed by individuals who exploit opportunities for business development. Comparing the statistics of entrepreneurial activities of some countries around the world, the U.S.A. is 42.88, Germany, 41.05, UK 35.8, and Israel 34.25; while Ghana is 13.35, Nigeria 14.11, Rwanda 14.96, and South Africa 15.12 (CEOWORLD Magazine, 2021). Equally, the General Entrepreneurship Monitor report of 2022 disclosed that a country may have high entrepreneurial activities but without a commensurate impact on economic realities like unemployment (GEM, 2022). On account of these, the unemployment rates of these countries are 3.3%-Israel, 3.5%- U.S.A., 3.5%-UK, and 5.4%-Germany; and 4.7%-Ghana, 16.5%-Rwanda, 32.9%-South Africa, and 33.3%-Nigeria (OECD, 2023). Considering these statistics indicate that the unemployment rate in Nigeria is very high. This is more pronounced among female graduates as NBS' (2021) statistics showed a rising trend from 31.6% in the 2nd quarter to 35.2% in 4th quarter of 2020. Scholars blamed the unemployment situation on the inability of female students to develop their entrepreneurial intentions (Aga, 2023; Iyortsuun et al., 2020), alongside lack of Technical and Vocational Education and Training (TVET) background to fit current employability trend.

Entrepreneurial intention is viewed as the significant factor in determining whether an individual would start any business activity (Yang & Niyomsilp, 2022). Furthermore, Sim et al., (2023) asserted that all entrepreneurial activities begin with entrepreneurial intention without which no entrepreneurship will exist. This implies that stimulating the TVET-based entrepreneurial intention of a teeming student population heralds great entrepreneurship milestone through flexible business models. In other words, without TVET-based EI, graduates would end up becoming ardent job-seekers (Yonla et al., 2020) and unemployable rather than job-makers.

Entrepreneurship education is regarded as formal lectures and programmes meant to create entrepreneurship awareness and skills in students. Entrepreneurship education is described in terms of pedagogy, course content, and extracurricular activity (Adisel et al., 2022; Dakung et al., 2022). These dimensions enable the use of several approaches to make entrepreneurship teaching and learning attractive and meaningful. In addition, UNESCO-UNEVOC observed that teaching of entrepreneurship offers a realistic and effective means to develop the transferable skills needed to match the changing world of work (UNESCO, 2018). Further,

studies like Astiana et al., (2022); Faloye & Olatunji (2018); Soomro & Shah, (2020); Walidayni et al., (2023); Wu et al., (2022); revealed that entrepreneurship education has a positive and significant influence on fresh graduates' business start-up intention. Though, Dabbous (2023) did not find a link between EE and EI, Tu & Akhter (2023) discovered that entrepreneurship education based on teachers' creativity promote competencies in entrepreneurship. This means that EE can be organised to predict STEM competencies.

In this study, STEM competencies are viewed as multi-disciplinary capabilities that can accelerate workforce readiness for industrial revolution. In view of this, STEM competencies are seen as socio-emotional intelligence, multi-literacies, thinking skills, and knowledge dimensions (ILO, 2020). These dimensions (regarded as STEM in TVET) have been packaged to provide knowledge and skills related to occupations in various segments of economic and social life through formal, non-formal and informal learning methods to drive youth employment and entrepreneurship (UNESCO, 2018). In achieving this, STEM competencies can be used to foster TVET learning and mastery of specialised techniques as well as general knowledge, skills and values (Moses, 2023). Where learners are able to articulate these techniques and scientific principles into lifelong career skills, will result in strengthening entrepreneurial competencies. Thus, entrepreneurial competencies enable students to cope with all manners of situations in driving innovative breakthroughs (Mulder, 2017). More so, Joensuu-Salo et al., (2022); Iddris et al., 2022; Iwu et al., (2021) established a positive and significant link between entrepreneurial competencies and entrepreneurial intentions.

The study sought to fill the knowledge gap in moderating role of STEM competencies in the relationship between entrepreneurship education and TVET entrepreneurial intentions. Also, this was carried out among female Estate students of polytechnics where entrepreneurship research is considered limited.

Objectives

The main objective of this study was to identify possible means of developing entrepreneurial intentions within TVET framework utilising entrepreneurship education and STEM competencies for female estate management students of polytechnics. Other specific objectives which hypotheses will be tested on include the following:

- i. To ascertain how entrepreneurship education affect socio-emotional skills of female estate students of polytechnics.
- ii. To identify the moderating role of entrepreneurship education on the multi-literacy skills of female estate students of polytechnics.
- iii. To find out the effect of entrepreneurship education on knowledge thinking skills of female estate students of polytechnics.

II. Review of Literatures

TVET Entrepreneurial Intentions

Based on the opinion of Krueger and Carsrud (1993), intention is a perfect predictor of subsequent behaviour. The stronger the intention to engage in entrepreneurial activities, the more likely to become an entrepreneur or behave entrepreneurially at last (Ajzen, 1991). Thompson (2009); Bird (1988) defined entrepreneurial intention as the awareness and conviction by an individual to set up a new business venture and plan to execute such in the future. Arising from these submissions, entrepreneurial intention implies the willingness or desired plan to carry out innovative business in the shortest possible time. Thus, forming entrepreneurial intention connects to advancing knowledge regarding entrepreneurship in an innovative manner (Lee et al., 2022). As a result, TVET entrepreneurial intention can tailor the mind-set of students to pursue goals through technical and vocational means to be able to cope with current technological changes around the world. Thus, a TVET entrepreneurial intention makes the development of entrepreneurship career all inclusive -both science and arts, or formal and informal, also across gender and age.

Entrepreneurship Education

Entrepreneurship education is defined as the provision of formal lectures, curricula and programmes that attempt to equip students with the necessary entrepreneurial competencies, knowledge and skills for the pursuit of an entrepreneurial career (Ekpoh & Edet, 2011). Furthermore, scholars have contended that the most effective education methods for entrepreneurial teaching and learning is the learner-centred, using active-application and active experimentation approaches instead of the frequent teacher-centred transmission of passive knowledge (Dakung et al., 2022). Developing entrepreneurial course content is aimed at stimulating entrepreneurship awareness among students to intensify their interest in entrepreneurship (Dakung et al., 2022). As such, entrepreneurial course content and the interaction with the educators are key factors in developing and fostering entrepreneurialism (Bell & Liu, 2019). In line with this, Lanero et al., (2011) identified some essential building blocks of a functional and effective entrepreneurship education such as case studies, business plans, projects, and financial management.

STEM Competencies

STEM competencies have been adopted in this paper as socio-emotional intelligence, multi-literacies, thinking skills, and knowledge dimensions. These help to build strong entrepreneurial capabilities necessary to withstand economic pressures (International Labour Organisation -ILO, 2020). Socio-emotional intelligence competencies denote "the ability to integrate feeling, intuition, and cognition to acknowledge, comprehend, manage, relate, and express an individual's sentiments. It also

helps the learner to conduct social interactions at the appropriate time, and purpose, in the right context, and with the right person or group” (Devis-Rozenthal, 2017). STEM thinking competencies include creative/inventive thinking, critical thinking, systems thinking, computational thinking, decision-making and ethical thinking. STEM knowledge competencies that are both disciplinary and trans-disciplinary and are important in TVET. Therefore, the idea of STEM competencies is to reinforce the concept of entrepreneurial competencies. This means that STEM competencies are crucial in the development of TVET entrepreneurial intentions to facilitate employability to secure job or become self-employed (ILO, 2020).

Entrepreneurship Education (EE) and TVET Entrepreneurial Intentions (EI)

Walidayni et al.,’ s (2023) conducted a study in vocational high school where students could be equipped with ready-to-use industrial skills upon graduation in West Java Province, Indonesia. The results indicated that students’ value co-creation in entrepreneurship education significantly affected their entrepreneurial intention. Similarly, Dabbous and Nada (2023) utilised SEM model to analyse responses of 223 business students in Lebanon. The result showed that entrepreneurship education has a positive effect on entrepreneurial intention but not significant. Wu et al., (2022) using Statistical Package for Social Science (SPSS) computed regression analysis on a random sample of 804 college students in Zhejiang Province, China. It was found that entrepreneurship education is significantly and positively related to entrepreneurial intention of students.

Astiana et al., (2022) examined the role of entrepreneurship education in increasing entrepreneurial intention among business students in Indonesia. The data showed that entrepreneurial intentions were positively and significantly influenced by perceived desirability, feasibility, propensity to act, and entrepreneurship education by 61.12%. Similar approach of study was employed by Astiana et al., (2022) by Soomro and Shah (2020) to investigate of entrepreneurship education, self-efficacy, need for achievement and entrepreneurial intention among 184 Pakistan’s commerce students whose findings replicated observation in Indonesian business students.

Arising from the foregoing, learning of entrepreneurial subjects and skills are essential in fostering their internal motivation which help to build confidence toward starting and owning business venture rather than hunting for jobs after graduation.

Entrepreneurship Education and STEM Competencies

The essence of reviewing this relationship is to ascertain how EE has influenced STEMC. Following this, Tu & Akhter (2023) explored the role of entrepreneurial education, technology and teachers’ creativity in excelling entrepreneurial competencies through vocational colleges. The application of PLS-SEM on the data of 357 of potential future entrepreneurs was used to establish a significant positive association between the said predictors and entrepreneurial competencies. Xiang et al., (2023) supported such finding having examined the pathways of entrepreneurship education, digital government building, and gender differences on entrepreneurial competencies of college social entrepreneurs.

Furthermore, Mets et al., (2022) used a self-assessment questionnaire based on the ‘generic’ entrepreneurship competence model, improved with the section on entrepreneurial process competence. The study revealed that college students develop entrepreneurial competencies by participating in entrepreneurship competitions (as mediator) unlike students who participate in regular entrepreneurship education. Adeyemo et al., (2021) made same findings after examining the extent to which entrepreneurship education influence entrepreneurial competencies and entrepreneurial intentions among the students of Osun State Polytechnic, Iree, Nigeria.

Wang et al., (2019) utilised the National Taiwan University to investigate differences in business school students’ entrepreneurial competencies and intention between those who took the Creativity and Entrepreneurship Programme and those who did not. They further explored the context limits on facilitations in the entrepreneurship education of college students in different academic disciplines of management school. Results showed that the EE course did have positive impacts on all entrepreneurial competencies and intention, that the effectiveness on the attitude domains was more evident than that on the knowledge or skills domains, and that academic disciplines did have a context effect on students’ entrepreneurial competencies and intention.

STEM Competencies and TVET EI

Joensuu-Salo et al., (2022) explored how sustainable entrepreneurship competence impacts entrepreneurial intentions in two educational contexts of higher and secondary education. The results revealed that sustainable entrepreneurship competence is a significant factor that can explain entrepreneurial intentions in both higher and secondary education contexts. Likewise, the research by Iddris et al., (2022) examined the effect of innovation education and competence on entrepreneurial intentions among postgraduate students and the role of innovation competence and gender in Ghana, results indicated that innovation competence has a significant positive influence on entrepreneurial intention.

In a similar way, Iwu et al., (2021) study in a South African university identified that a prerequisite to self-employment is entrepreneurial intention. The empirical results suggested that the perceived competency of the lecturing team demonstrates a moderate and positive correlation with student entrepreneurial intention. Equally, Botha et al., (2019) studied South African business students on entrepreneurship competencies. The findings revealed that entrepreneurial competencies have a positive relationship with recurring entrepreneurial action, recurring entrepreneurial intention behaviours and recurring entrepreneurial intention attitudes.

Theoretical Foundation

This paper incorporates the theories of planned behaviour, and social cognitive to provide a structure of support to the relationships of variables under investigation. The Theory of Planned Behaviour (TPB) is used as an underpinning theory since it is able to explain the link between attitudes toward learning from entrepreneurship education and intention, up to the point of entrepreneurial behaviour. TPB as proposed by Icek Ajzen in 1980 presented three types of beliefs - behavioural, normative, and control which translated into attitude toward behaviour, subjective norm and perceived behavioural control respectively (Ajzen, 1988). In this regard, when attitudes of students on EE are favourable, it leads to entrepreneurial intention. Nevertheless, the TPB is limited in this investigation as its only dwell on students' approaches to learning from EE, whereas the constituent of EE and the institutions have fundamental role to play in stimulating the competence desires of students. On this account, the need to integrate social cognitive theory to bridge the gap arises.

The Social Cognitive Theory (SCT) was proposed by Albert Bandura from the Social Learning Theory (Bandura, 1986). The SCT is used in this paper as a competing theory to explain how a student can acquire knowledge in a social context and maintain a particular behaviour. The theory assumes that past experiences can inspire reinforcements and expectations, necessary for one to engage in entrepreneurial behaviour. The SCT is anchored on the tenets of reciprocal determinism, behavioural capability, observational learning, reinforcements, expectations and self-efficacy (LaMorte, 2019; Bandura, 2008). On the assumption of 'reciprocal determinism', the students who undergo entrepreneurship education would develop experience from the course, compare with entrepreneurial activities obtainable around and decide to respond in the form of stimuli by changing behaviour (Cai & Shi, 2020). Also, 'behavioural capability' assumes that students would need actual ability, knowledge and skills to perform any entrepreneurial activity as inspired by the EE. Furthermore, 'observational learning' holds that students of entrepreneurship can equally witness and observe how entrepreneurial activities are conducted by others, and then replicate the actions commensurate with their intentions. These constitute the approaches for effective motivation to drive STEM competencies to reflect socio-emotional intelligence, multi-literacies, problem-solving and thinking skills.

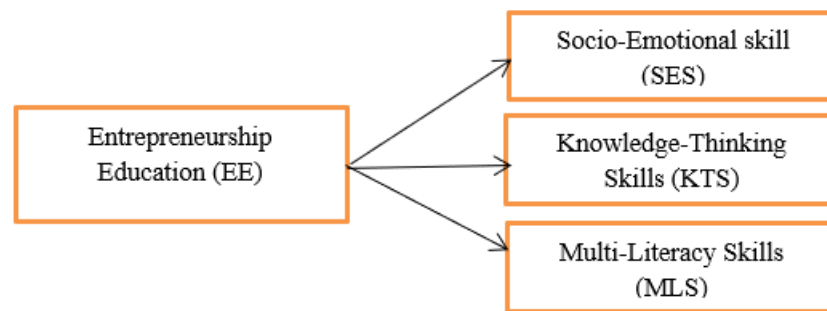


Figure 1: Conceptual Framework

III. Method and Procedures

The paper adopted the systematic review method, where 30 articles related to EE, STEM Competencies and TVET EI were gathered. The paper discusses the protocol, criteria for inclusion of review, search strategy, data extraction, and data synthesis/analysis (Ahn & Kang, 2018). Implementing these methodologies judiciously bring out the uniqueness of the systematic review to be different from the general literature review. Google scholar platform was used to purposively sample 30 articles on entrepreneurship education, STEM competencies and TVET entrepreneurial intentions from 2013, 2016 to 2023. The software preference for data analysis was quantitative tools such as PLS, AMOS, E-View, and SPSS. The paper further used a quantitative approach to carry out survey design of cross-sectional type to collect data from different students at a specific time (Thomas, 2020). The population of study comprises 37 female estate management students of National Diploma (ND) II surveyed from a class of 132 which was equally used as the sample size. In reaching out to the sample, the simple random technique was utilised to ensure everyone participate in the survey. A primary source of data collection was designed through questionnaire structured on five Likert scales of strongly disagree, disagree, neutral, agree and strongly agree. Additionally, entrepreneurship education was measured by adapting scale from Lanero et al., (2011), while STEM competencies variable was measured by modifying the scale from Armuña et al., (2020). The questionnaire was checked for Common Method Bias based on the suggestion of Taseen et al., (2017), as well as ensuring its validity and reliability.

IV. Results and Discussion

The research sets to investigate the entrepreneurship education, STEM and entrepreneurial competencies of female students. Thus, this section presents results in accordance with the three objectives of the study stated earlier. The results of this study include a response rate of 94.6% out of the 37 female estate management students. The most participated age bracket was 18-22 (68.6%) year's old students, while the marital statuses were mostly 91.4% singles. Furthermore, the assessment of prerequisite tests for the use of linear regression model was evaluated using SPSS version 27. Bases on these, missing values analysis,

outliers, data normality, multi-collinearity, correlation and model fit with data were assessed and they all met relevant thresholds. Results of the main analysis are presented in table 1.

Table 1: Regression Results for Test of Hypotheses

A

Coefficients ^a						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	3.419	1.546		2.212	.034
	EE	.230	.073	.479	3.134	.004
a. Dependent Variable: SES						

B

Coefficients ^a						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	4.127	1.872		2.204	.035
	EE	.182	.089	.336	2.050	.048
a. Dependent Variable: MLS						

C

Coefficients ^a						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	4.223	1.688		2.503	.017
	EE	.197	.080	.393	2.456	.019
a. Dependent Variable: KTS						

Table 1A reveals a moderate positive and significant ($\beta = .497$; $t = 3.134$; $sig = .004$) relationship between EE and SES. This implies that entrepreneurship education affects the socio-emotional skills of the female estate students of Plateau State Polytechnic. Also, the result of table 1B indicates that EE is positive and significant ($\beta = .336$; $t = 2.050$; $sig = .04$) predictor of MLS. The outcome suggests that entrepreneurship education affect the multi-literacy skills of the female estate students of Plateau State Polytechnic. Similarly, table 1C shows that EE has a positive and significant ($\beta = .393$; $t = 2.456$; $sig = .019$) moderate effect on KTS. The result implies that entrepreneurship education affects the knowledge-thinking skills of the female estate students of Plateau State Polytechnic.

Effect of EE on SES

The findings of how entrepreneurship education affects the socio-emotional competencies of female estate students of polytechnics have proven positive and significant. The means that as female estate students of polytechnics offer entrepreneurship courses the ability to integrate feelings in social interactions is developed in them. Socio-emotional competencies may become high in strengthening technical and vocational intentions. In other words, EE that could affect socio-emotional competencies positively can promote communication, partnership, support, compassion, lifelong wide learning, resilience, guidance, service coordination, project management and global mind set would probably result in TVET desires. This finding aligns with Tu & Akhter (2023) who found positive and significant link between EE and the construct of entrepreneurial competencies. The finding also corroborates some of the tenets of the theories adopted in this study. For TPB (Ajzen, 1991), where the attitudes of female estate students toward EE is controlled by socio-emotional competencies it would lead to technical and vocational feelings. Likewise, in SCT's behavioural capabilities and reinforcement, where female estate students utilise EE on the premise of socio-emotional competencies, they would have actual sensitivity competencies and inspiration (Bandura, 2008) to glamour for

technical and vocational education. Though, in this study the contribution of EE on SES is not large enough to sustain all of these benefits in the long run.

Consequences of EE on MLS

There is a positive and significant link between EE and multi-literacy competencies among female estate students of polytechnics. EE's pedagogies, course contents and extracurricular activities have positive consequences on the mathematical ability, digital mastery, cultural intellect, civic literacy, business health literacy, entrepreneurial mastery and organisational literacy (ILO, 2020), as a potent pathway to technical and vocation education. In consonance with the finding of Xiang et al., (2023) between EE and construct level of entrepreneurial competencies, the consequences of EE on MLS opens up diverse expert perspectives of entrepreneurship. More so, this finding conforms with tenet of reciprocal determinism and self-efficacy in SCT which suggest that as female Estate students offer entrepreneurship education they gain mastery experience and confidence of multiple literacies that lead to behavioural change desire (Cai & Shi, 2020; Kisubi, et al., 2021). Also, the female estate students can be motivated with the new intention from mastery innovative ideas and opportunities leading to "effective" competencies (Bacigalupo et al., 2016). Nevertheless, the contributory effect of this finding could not be adequate for a length of time to come.

How EE Connects with KTS

The connection between EE and knowledge-thinking competencies has proven remarkable among female Estate Students of polytechnics. This implies that the EE's pedagogies, course contents and extracurricular activities have a little way of arousing disciplinary and trans-disciplinary awareness among female estate students of polytechnics. Where such knowledge is connected through creative thinking, critical thinking, systems thinking, computational thinking, decision-making and ethical thinking can easily prompt technical and vocational need. The finding is seemingly consistent with that of Mets et al., (2022) who found how entrepreneurship students engaged in competitions can develop generic competencies. This submission is equally consistent with the findings of Walter and Dohse (2009) that active modes of entrepreneurship education like practical seminars directly influence entrepreneurial intentions and attitudes, whereas the impact of reflective modes such as formal lectures depends on the regional context of knowledge. They use the context of knowledge in terms of awareness of the activities of role models and work experiences. This further corroborates the tenets of SCT of how students can acquire specific knowledge which are needed to power ideas, experiences and opportunities into active intention and subsequent entrepreneurial activities.

V. Conclusion and Recommendations

This study combined the concepts of entrepreneurship education and STEM competencies and TVET entrepreneurial intention to develop an entrepreneurship model for female students. This is meant for promoting women in STEM for personnel readiness that foster industrial revolution framework of the technical education and skills development. Outcomes were deduced from the study and the influence of EE on TVET EI was found to vary. In most cases EE could influence TVET EI directly, but could not do so in few cases. Additionally, the pedagogical arrangement, course contents enrichment and extracurricular meaningfulness of EE, as they interact with the dimensions of STEM competencies can impact TVET EI to a large extent. The interactions of STEM competencies with entrepreneurship education could foster specialised entrepreneurial mastery of female estate students of polytechnics with relevant skills to maximise the appraisal, acquisition, development, marketing, and management of property in the future than what was obtainable in the past. The study recommended the following suggestions:

- The institutions of higher learning like polytechnics should utilise and introduce the STEM competencies framework into entrepreneurship education by leveraging on course content enrichment, pedagogical flexibility, and extracurricular activities that strengthen TVET EI of female students.
- Entrepreneurship course should be made more active, gender-oriented and practical in nature so as to sustain high feminine interest.
- Further studies are called upon to extend this research scope to determine the actual positions of the interactions EE and the dimensions of STEM competencies on the effectiveness of TVET EI of female students.

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