FACTORS INFLUENCING BUSINESS START-UPS BASED ON ACADEMIC RESEARCH

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ABSTRACT

The importance of commercializing research outputs by science, technology, engineering, arts and mathematics (STEAM) researchers for technological advancement and socio-economic development cannot be overemphasized. This study thus investigates the factors that motivate researchers in the STEAM field to startup businesses based on their research. A multistage sampling method was used to draw a sample of 201 researchers, consisting of lecturers and students from a top-ranking university in Nigeria. The study used a set questionnaire to elicit information on factors that influence the decision of STEAM researchers to spin off business start-ups from their research. Principal Component Analysis and Binary Logistic Regression were used to determine the association between the dependent and independent variables. The findings revealed that the important driver of academic spin-off for the STEAM researchers was the level of risk tolerance. It was evident that risk-taking had a strong relationship with quality research and business start-up.

Keywords: Academic Spin-off, Research Outputs, STEAM Researchers, Risk Tolerance, Entrepreneurship Education, University.

INTRODUCTION

Academic spin-offs are business start-ups based on knowledge gained from university research (Anderson et al., 2015; Miranda et al., 2017; Hayter et al., 2018). These businesses, which stem from laboratory research, are considered to be the driving force behind technological advancement and economic development (Gilsing et al., 2010; Rasmussen & Borch, 2010; Landoni, 2020; Kim, 2020). Nowadays, the idea of spinning off businesses in such as way is beginning to draw the attention of policymakers and as a result, research which has been commercialized through entrepreneurship is being used to solve sociological problems. Research engagement through social entrepreneurship is thus fast becoming one of the critical activities of academics in universities, alongside the mainstream work of teaching and research (Carrick, 2016; Blundel et al., 2017; Hayter et al., 2018).

Recent studies (Markuerkiaga et al., 2016; Fini et al., 2017; Belitski & Aginskaya, 2018; Civera & Meoli, 2018; Kolb & Wagner, 2018; Adelowo, 2018) have explored the concept as well as the factors fostering academic spin-off. Some of these include:

(i) Institutional support e.g. government policies, fiscal and non-fiscal measures, and the like,

(ii) University policies e.g. intellectual property and technology transfer offices, incubators,

(iii) Local context characteristics e.g. venture capital,

(iv) Entrepreneurial support mechanisms e.g. science parks, industrial parks, special economic zones, export processing centers, free trade zones, and

(v) Technology characteristics e.g. value proposition, commercialization ability.

There is scant research about academic entrepreneurship, and most of the studies which do exist have been conducted in developed nations (Fini et al., 2017; Kim, 2020). Of these studies, none seems to have examined the factors motivating individual researchers (lecturers and postgraduate students) to spin off a new venture from their research, especially from a developing country's perspective. There is an enormous difference in the way knowledge institutions operate in developed and developing countries. These institutions have very different capability as they are faced with different challenges and have different areas of strength. In Africa, and particularly in Nigeria, various studies have attempted to explore this topic using conventional strategies. These include: Adelowo et al., (2017) on how innovation and knowledge are transferred in Nigeria; Adelowo et al., (2018) on student perceptions of the entrepreneurship ecosystem and the state of Nigeria's university entrepreneurship ecosystem; and Aribaba et al., (2019) on the role of educational institutions in fostering entrepreneurship development in Nigeria. Other related studies include those of Adelowo (2018) on factors influencing academic entrepreneurship in Nigerian universities; Adelowo et al., (2018) on the university as the main supply of high-quality entrepreneurs in Nigeria; and Adelowo et al., (2018) on the status of technology entrepreneurship in Nigeria. While the volume of data for Nigeria is still very limited, and all these studies considered entrepreneurs and students from both a science and non-science background, none of them specifically focused on science, technology, engineering, arts and mathematics (STEAM) researchers (lecturers and students) to understand what motivates STEAM researchers to spin off business start-ups from their scientific and technological findings. Moreover, most of these studies recommended that further research be done to fully understand what drives academic researchers to startup businesses based on their findings. This study bridges this gap in literature by exploring what motivates STEAM researchers to become entrepreneurs.

LITERATURE REVIEW AND HYPOTHESES TESTING

Relevant literature on entrepreneurship education, risk tolerance, financial availability, gender roles, government policy and regulations as well as associated hypotheses for this study are discussed in this section.

Entrepreneurship Education

Recent studies (Fayolle & Gailly, 2015; Adekiya & Ibrahim, 2016; Khuong & An, 2016; Walter & Block, 2016; Nabi et al., 2017) speculate that when people go through some form of entrepreneurship training, they develop an inclination towards starting their own businesses. The

question of whether entrepreneurs are trained/made or born has not been fully addressed in literature. To date, there is a growing body of knowledge which posits that entrepreneurship training is closely associated with entrepreneurship intention (Gerba, 2012; Hattab, 2014; Fayolle & Gailly, 2015; Rauch & Hulsink, 2015; Walter & Block, 2016). A study by Rauch and Hulsink (2015) demonstrated that entrepreneurship education has a positive impact on entrepreneurship intention. Similarly, Gerba (2012) examined the impact of entrepreneurship education on engineering students and found that students who had undergone entrepreneurship education tended to have greater entrepreneurial intention than those who had not. In contrast, however, a study by Oosterbeek et al., (2010) found that entrepreneurial training had no significant effect on students' entrepreneurial interest. In fact, the study reported a negative impact of entrepreneurship education or training on the intention of students to become entrepreneurs. Another perspective was identified by studies such as those of Nabi et al., (2017), Potishuk & Kratzer (2017) and Fayolle (2013), which revealed that there could be several other factors other than entrepreneurship education and training responsible for entrepreneurship intention. Based on the discussion above, it is hypothesized that:

> *H1: Entrepreneurship education is significantly associated with the decision of researchers in the STEAM field in Nigeria to start a new business from their research*

Risk Tolerance

In Nigeria there is a general perception that most science and engineering graduates are not prepared for entrepreneurship due to the shortcomings of the former colonial curriculum in this regard (Adejimola & Olufunmilayo, 2009; Garba, 2010). The training mainly prepared graduates to seek employment - either in organisations or factories. It is believed that those who venture into entrepreneurship seem to have a higher tolerance for risk (Van Gelderen et al., 2015; Costa & Mainardes, 2016; Bouchouicha & Vieider, 2019; Kerr et al., 2019). As self-evident as this may seem, some studies show contradictory results. For instance, the work of Fitzsimmons & Douglas (2011) shows a negative interaction between perceptions of feasibility of starting a business and perceptions of desirability in the formation of entrepreneurial intentions. Zhang & Cain (2017) corroborate this view, finding no direct relationship between risk tolerance and entrepreneurial intention. Nonetheless, risk tolerance has been identified as a primary entrepreneurial characteristic and has been associated with planned behaviour such as entrepreneurial intention (Giacomin et al., 2011; Chan et al., 2015; Bosique-Blasco et al., 2018) have been recorded extensively in literature. Based on the discussion above, it is hypothesized that:

> *H2: Risk tolerance is significantly associated with the decision of researchers in the STEAM field in Nigeria to start a new business from their research*

Financial Availability

Cetindamar et al., (2012) maintain that financial availability plays an important role in shaping the decision to venture into entrepreneurship. Consequently, entrepreneurship could be the result of a financial influence process. Access to credit, personal savings and venture capital all represent major agents of financial availability. Cetindamar et al., (2012) therefore calls for policymakers to emphasize access to human and financial capital to promote entrepreneurship. Other studies that support this notion include those of Chowdhury & Amin (2011), Edelman et

al., (2016), Dai et al., (2017), Löher et al., (2018) and Khan et al., (2019). Based on the discussion above, it is hypothesised that:

H3: Financial availability is significantly associated with the decision of researchers in the STEAM field in Nigeria to start a new business from their research

Gender Roles

Recent studies (Chlosta et al., 2012; Karimi et al., 2013, 2014; Tinkler et al., 2015) have sought to explain the role played by gender in entrepreneurship interest. To date, there has been no conclusive evidence that males are better entrepreneurs then females and vice versa. Nonetheless, some studies have identified points of difference. For instance, Wang & Wong (2004) found that gender significantly influences students' interest in starting a business. Their study on Singapore students showed that males were more inclined towards entrepreneurship. Similarly, the Bosma (2020) reported that the proportion of men starting a business and entrepreneurial interest was higher than that of women, implying that men have higher tendencies to become entrepreneurs than women. Using data from 17 countries, Koellinger et al., (2013) found lower rates of female business ownership compared to that of men. The study attributed this finding to women's lower propensity to start businesses. More recent studies that have corroborated this belief, notably those of Czuchry & Yasin (2008), Karimi et al., (2014) and Kanze et al., (2018). In contrast, the study by Santos et al., (2016) showed that gender does not have any significant influence on entrepreneurship intention. However, the study also identified that more males have acted upon their interest and have taken active steps towards becoming entrepreneurs. Generally, the body of literature tends to portray males as having a greater propensity towards becoming entrepreneurs than females. Based on the discussion above, it is hypothesized that:

H4: Gender is significantly associated with the decision of researchers in the STEAM field in Nigeria to start a new business from their research

Government Policy and Regulation

Literature reveals that macroeconomic, sociocultural and politico-legal environmental contexts have a major influence on entrepreneurial intention (Thornton et al., 2011; Teixeira et al., 2018; Akinbola et al., 2020; Lembana et al., 2020). A study by Gnyawali & Fogel (1994) presented five institutional contexts in which government can influence entrepreneurial activity. Firstly, government could influence and regulate the market through policies and procedures. Secondly, government could promote entrepreneurship by providing favourable conditions for entrepreneurship and economic activity. A third channel could be through capacity-building of entrepreneurial knowledge and skills necessary to start a new business. The fourth possibility was the provision of financial assistance for starting a new business. Lastly, non-financial assistance of government could focus on technical support (development of business plan, market research and creation of markets) for new businesses. The recent studies by Saeed et al., (2015) and Ghosh (2017) show that the external entrepreneurial environment significantly affects entrepreneurial intention. Based on the discussion above, it is hypothesized that:

H5: Government policy and regulation is significantly associated with the decision of researchers in the STEAM field in Nigeria to start a new business from their research

RESEARCH METHODOLOGY

This section discusses the conceptual framework, research design, data analysis and interpretation of the data.

Conceptual Framework

Different approaches (economics, sociology, psychology, political sciences and management) have been explored in literature to identify factors influencing entrepreneurship. In earlier studies, the economic approach was the most dominant. Economists have used parametric variables to determine entrepreneurial intention, however, this approach failed to capture the subtle variations in entrepreneurial characteristics which cannot easily be detected through quantitative research. Hence the economist approach, which effectively involves mathematical modeling of the entrepreneurship phenomenon, is unable to answer fundamental questions about the internal mechanisms of entrepreneurial intention (Mitchell et al., 2002a, 2002b; Liñán & Chen, 2009).

The present study explores the sociological perspective, which is a broader, more flexible that has superseded the economic approach. The sociological perspective focuses on a set of non-rational, non-utilitarian, political and altruistic factors such as social networks, cultural factors, gender roles, networks, ethnicity and religion, among others, in entrepreneurial behaviour (Zafirovski, 1999; Granovetter, 2005; Guiso et al., 2006; Welter & Smallbone, 2011). These factors may either enhance or hinder the occurrence of entrepreneurial activity (Welter & Smallbone, 2011).

The present study builds upon the Theory of Planned Behaviour (Ajzen, 1985; 1991), the Theory of Reasoned Action (Madden et al., 1992) and the Integrated Behavioural Model (Montano & Kasprzyk, 2015). Ajzen's (1991) Theory of Planned Behavior (TPB) states that "*attitude, subject norms, and perceived behavioral control, together shape an individual's behavioral intentions and behaviors.*" The TPB builds on an earlier Theory of Reasoned Action (TRA) by including perceived behavioural control, thereby improving the predictive power of the TRA. The Theory of Planned Behaviour posits that attitude, subjective norm and perceived behavioural control are good predictors of intention and that intentions lead to behaviour.

The Theory of Reasoned Action aims to explain the relationship between attitudes and behaviours in human action. It is mainly used to predict how individuals will behave based on their pre-existing attitudes and behavioural intentions. TRA states that "*a person's intention to perform a behavior is the main predictor of whether they perform that behavior (Madden et al., 1992)*". According to the TRA, the intention to perform a certain behaviour precedes the actual behaviour. The Theory of Reasoned Action suggests that stronger intentions lead to increased effort to perform the behaviour, which also increases the likelihood of the behaviour being performed.

The Integrated Behavioural Model (IBM) combines constructs in the Theory of Reasoned Action and the Theory of Planned Behavior. IBM also presents new or changed determinants that affect the intention to perform behaviour. The model cites environmental, personal and behavioural characteristics as the major factors in behavioural determination. Models of behaviour are more diagnostic and geared towards understanding the psychological factors that explain or predict a specific behaviour. Theories of change are more process-oriented and generally aim at changing a given behaviour. IBM uses attitude, perceived norm and personal agency to predict intention and behaviour. At the same time, IBM acknowledges that other

factors (knowledge and skill, salience of the behaviour, environmental constraints and habits) also determine behaviour.

Existing research on entrepreneurial intention discussed in the hypotheses above was consulted to develop five sets of constructs that could possibly drive entrepreneurial intention or activity among researchers in the STEAM field in Nigeria. These constructs are (i) entrepreneurship education, (ii) risk tolerance, (iii) financial availability, (iv) gender roles and (v) government policy and regulation.

Research Design, Instruments and Validation

A structured questionnaire was developed, informed by relevant literature. Prior to the main questionnaire being administered, a pilot was conducted with randomly selected researchers from the College of Business and Economics at a university in South Africa. Feedback from the pilot indicated that the instrument was largely acceptable except for a few minor changes. The questionnaire was revised accordingly before the main field survey.

Data Collection

Data was collected at a university in southwestern Nigeria. The research methodology was principally quantitative, using a survey questionnaire. The questionnaire was designed to elicit information from students and lecturers, drawn from various faculties, schools and departments. Multistage sampling was used. The first stage involved the purposive selection of the highest-ranking university in Nigeria in terms of research outputs (publications and patents). The second stage involved the purposive selection of seven faculties: (i) Science (ii) Engineering and Technology, (iii) Basic Medical Sciences, (iv) Clinical Sciences, (v) Pharmacy, (vi Agriculture, (vii) Environmental Design and Management. The rationale for this was to capture students and lecturers in the STEAM field at the university. The third stage involved the purposive selection of final-year undergraduate and postgraduate students (Postgraduate Diplomas, Master's and PhD) as well as lecturers across all levels. The rationale for this was to exclude non-academic staff and students who were not actively involved with research. The fourth stage was the random selection of 150 students and 60 lecturers across these seven faculties. The study recorded a 100% response rate from the students and an 85% response rate from lecturers, resulting in a total of 201 questionnaires used in the analysis.

Data Analysis and Interpretation

The completed questionnaire was coded and entered into SPSS 26. The coded data was analysed in response to the research objectives. Tests used were the Cronbach's alpha to determine the reliability and internal consistency of the data. Other reliability tests conducted were the Kaiser-Meyer-Olkin Measure of Sampling Adequacy and Bartlett's Test of Sphericity. Principal Component analysis (PCA) was conducted on the 28 independent variables representing factors influencing business start-ups from research. The dependent variables were business start-up activity. PCA is used to explain the variance-covariance structure of a set of variables through linear combinations. It is often used as a dimensionality reduction technique. It reduces the number of variables in a data set by extracting those that are important from a large pool. The PCA used the Varimax with Kaiser Normalization as the Rotation Method. For the extracted factors, Binary Logistic Regression was conducted to test the impact of each

explanatory variable (factors influencing business start-up from academic research) on the outcome variable (business start-up from academic research).

Assumptions of the Principal Component Analysis

- There must be multiple variables that should be measured at the continuous or ordinal level.

- There needs to be a linear relationship between all variables.

- There should be sampling adequacy - the Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy is used to determine sample adequacy.

- Data should be suitable for data reduction. Effectively, there need to be adequate correlations between the variables for variables to be reduced to a smaller number of components.

- There should be no significant outliers. Outliers are components with scores greater than three standard deviations away from the mean.

Assumption of the Binary Logistic Regression

- Logistic regression requires that there is negligible or no multi-collinearity among the explanatory variables.

- Logistic regression accepts that the explanatory variables are linearly associated to the log of odds.

- Logistic regression model ensures the appropriate sample size to predict properly.

- The dependent variable is binary.

- Logistic regression model assumes the observations to be independent of each other.

RESULTS AND DISCUSSION

This section discusses the results, the socio-demographic characteristics of the researchers and students, including the findings related to the dependent and independent variables, the Rotated Component Matrix and the hypotheses.

Socio-Demographic Characteristics of the Researchers

Table 1 shows that majority of the lecturers have doctorate degrees or are at the consultants in the case of those in the clinical faculty This indicates that the respondents (lecturers) are researchers that are knowledgeable in their fields of research. To support this point, Table 1 further shows that most of the respondents (lecturers) have research experience more than 5 years. The STEAM field in Nigeria remains a male dominated field. Table 1 shows that the frequency of male respondents is double that of their female counterpart.

Table 1 BACKGROUND CHARACTERISTICS OF THE LECTURERS	
Highest Educational Qualification	**Percentage**
PhD/FWACS	76
Master's	16
Honours / PGD	4
Graduate Degree	4
Total	100

| Length of Work Experience (in Years)	Percentage
Less than 5	23.1
5 to 10	15.4
11 to 15	15.4
21 to 25	12.8
16 to 20	10.3
Above 35	10.3
26 to 30	7.7
31 to 35	5.1
Total	100
Gender	**Percentage**
Male	66
Female	34
Total	100

Table 2 shows that about equal an amount of undergraduate (final year) and postgraduate students participated in the survey. The bulk of the postgraduate students were Master students. Also, most of the students fall within the age category "*21-40*" representing the most active and productive age among researchers. Also, as observed in the case of the lecturers, the frequency of male students doubles that of the female students.

Table 2 BACKGROUND CHARACTERISTICS OF THE STUDENTS	
Educational Status	**Percentage**
Undergraduate Student	53.1
Honours/PG Diploma Student	7.7
Master Student	30.8
PhD Student	8.4
Total	100
Age	**Percentage**
Below 20	21.8
21 - 40	76.8
41 - 60	1.4
Total	100
Gender	**Percentage**
Female	33.6
Male	66.4
Total	100

Dependent Variable

The dependent variable in the study was business start-ups from research. The aim of the study was to determine whether researchers in the STEAM field extend their research activities from simple publication or registering a patent to starting a new business from the new knowledge they produce. From the survey of lecturers across all levels and students, especially at postgraduate level, 106 (53.3%) researchers had started a business from their research. These represented knowledge-based businesses that had the potential to solve many of society's problems. As such, businesses based on science, technology, engineering, arts and mathematics (STEAM) is important for economic growth and development. Entrepreneurial universities such

as the Massachusetts Institute of Technology (MIT), Harvard University, Stanford University and Yale University amongst others are all well-known for the wealth they create through their scientific and technological discoveries, not just for themselves but also for the economy (Figure 1).
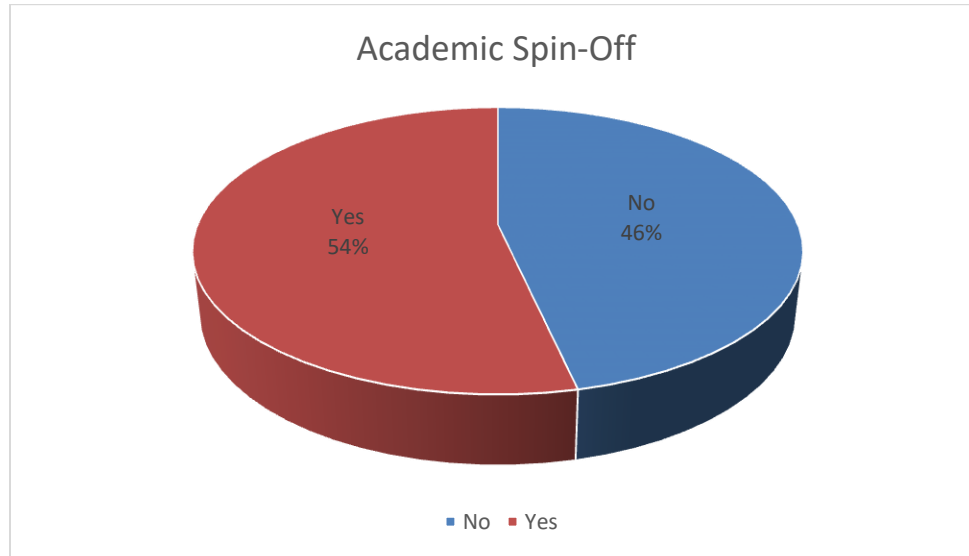
FIGURE 1
ACADEMIC SPIN-OFFS FROM RESEARCH

For instance, a 2015 report by MIT mentions the substantial economic impact of the Institute's alumni entrepreneurs, whose companies have created millions of jobs and generated annual revenues of nearly two trillion US dollars (Roberts et al., 2019). This is a value greater that the gross domestic product (GDP) of the Canada - world's tenth largest economy (Business Insider, 2020). Similarly, in 2017, the Princeton University Endowment Fund was valued at $23.8, the University of Texas Endowment Fund was valued at $26.5 billion, the Yale University Endowment Fund was valued at $27.2 billion and the Stanford University Endowment Fund was valued at $24.2 million (Hamdan et al., 2019).

Independent Variables

The Kaiser-Meyer-Olkin (KMO) sample size measurement of 0.733 was greater than 0.500, indicating that the sample size was adequate for the analysis (Table 3). Bartlett's Test of Sphericity had an approximate chi-squared value of 1443.439 with a significant value of 0.000 (less than 0.05), implying that there were significant correlations between some (or most) of the variables in the data set in Table 3.

Table 3 KMO AND BARTLETT'S TEST		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.733
Bartlett's Test of Sphericity	Approx. Chi-Square	1443.439
	df	378
	Sig.	0.000

According to the scree plot in Figure 2, eight components had eigen values which were greater than one. Therefore, eight components were extracted, explaining 69.7% of the variance in the independent variables (factoring influencing business start-ups). Twenty-eight variables were subjected to Principal Component Analysis using SPSS to determine groups of variables that would be most useful in explaining business start-ups from academic research. All the 28 explanatory variables had communality above 0.3 (Table 4). Consequently, none of the explanatory variables was rejected.
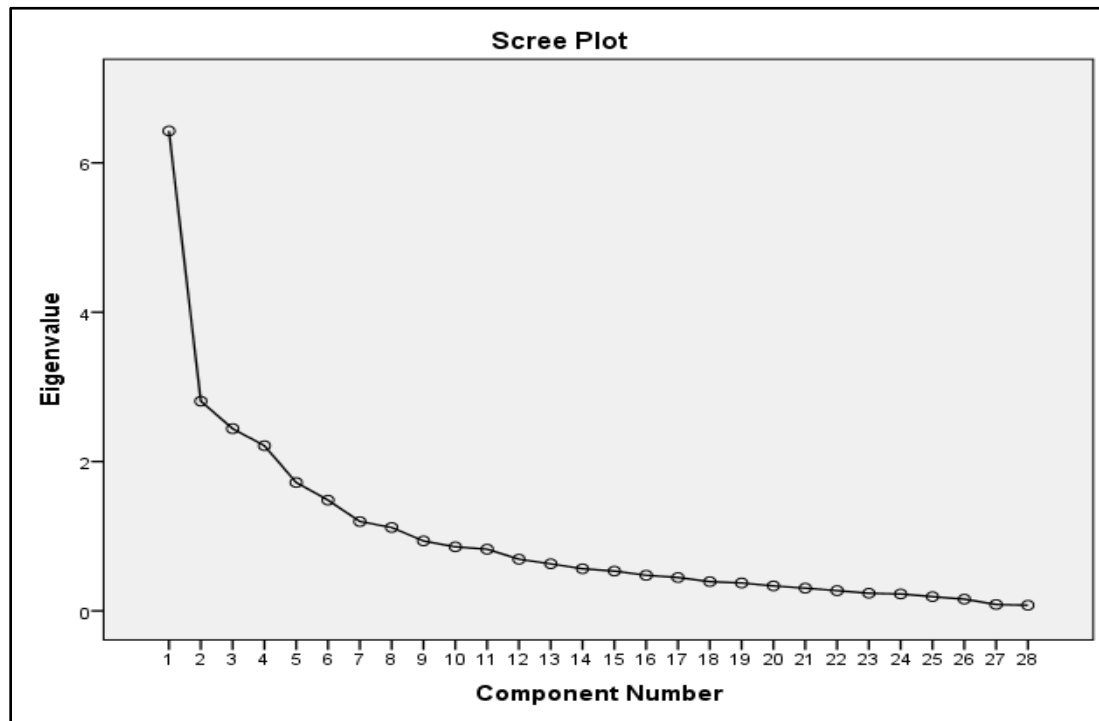

FIGURE 2
SCREE PLOT FOR THE INDEPENDENT VARIABLES

Table 4 COMMUNALITIES FOR THE INDEPENDENT VARIABLES					
The level of prior entrepreneurial training influences the growth of a new business	0.898	Researchers do not easily access loans due to the nature of their work	0.684	Do the university's rules and regulations support researchers/academics to start their own businesses?	0.78
Previous business experience has an impact on the survival of new businesses	0.851	Banks do not have confidence in academics to grant them loans for business	0.716	Do Nigeria's labour laws support researchers venturing into entrepreneurship?	0.69
Entrepreneurship education is important for the survival of new businesses	0.834	Lending conditions and high interest rates serve as a huge barrier	0.645	Government collecting taxes and license fees can be a hindrance to growth of new businesses	0.47

Trained entrepreneurs are better entrepreneurs than born entrepreneurs	0.708	Do you think male researchers are more entrepreneurial than their female counterparts?	0.78	Lack of proper legal regulations is a hindrance to growth of new venture	0.71
Risk-taking is important to be a successful entrepreneur	0.822	Do you think female researchers encounter more difficulties in starting their businesses due to other roles they play at home or how society views them?	0.649	Researchers face many barriers and constraints when venturing into entrepreneurship	0.64
I am willing to leave a paid job to start a business	0.653	Do you think that marriage, pregnancy and child-care distract female researchers from starting/running a business?	0.537	Given a conducive environment, researchers will perform better in business	0.63
I am willing to invest my time and energy to start a business	0.812	Cultural beliefs and practices in Nigeria affect female-owned businesses	0.593		
I am willing to invest my personal savings to start a business	0.729	Family responsibilities greatly influence growth of female-owned businesses	0.718		
I have competent people I can trust to support me if I start my business	0.455	Our culture doesn't support female-owned businesses	0.762		
I am aware that government policies change regularly, and it can have grave consequences on my business	0.506	Religious beliefs usually serve as a hindrance to women's engagement in business	0.752		
Despite incessant unrest that could affect my business, I am still willing to start a business	0.716	Societal negative attitude affects women engaging in business	0.669		

EXTRACTION METHOD: PRINCIPAL COMPONENT ANALYSIS

After applying a varimax rotation which converged in seven iterations, variables which loaded onto each factor were selected, with 0.4 as the cut-off point for explanatory purposes. Eight factors were identified; these were entrepreneurship education, risk tolerance, financial availability, external context in gender, family responsibilities, gender roles, policies and regulations and legal issues (Table 5). All 28 independent variables that loaded significantly were included in the regression analyses, the results of which are presented in Table 10.

Discussion of the Rotated Component Matrix

The first component was strongly correlated with six of the original variables. This component increased as the four entrepreneurship education variables scores increased. This

suggests that these six criteria vary together; if one increases, then the remaining ones tend to increase as well. This component can be viewed as a measure of entrepreneurship education. Furthermore, the first principal component correlated most strongly with the variable "*The level of prior entrepreneurial training influences the growth of a new business*". The correlation of 0.91 indicated that this principal component was primarily a measure of entrepreneurship education.

The second component was strongly correlated with six of the original variables. This component measured how risk tolerance affects business start-ups from research. It correlated most significantly with the variables "*I am willing to invest my time and energy to start a business*" with a score of 0.845.

The third component strongly correlated with three of the original variables, particularly the variable "*Our culture doesn't support female-owned businesses*" with a score of 0.845. This component measured external (cultural, religious or social) influences on gender.

The fourth component was strongly correlated with three of the original variables, particularly the variable "*Do you think female researchers encounter more difficulties in starting their businesses due to other roles they play at home or how society views them?*" with a score of 0.764. This component measured how family responsibilities affect women seeking to start a business from academic research.

The fifth component measured how financial availability affects business start-ups from research. It strongly correlated with three of the original variables. This component increased with all the three variables increasing. The variable "*Researchers do not easily access loans due to the nature of their work*" had the highest correlation with a score of 0.781.

The sixth component was strongly correlated with two of the original variables, representing how policies and regulations affect business start-ups from research. This component correlated most significantly with the variable "*Does the university's rules and regulations support researchers to start their own businesses?*" with a score of 0.865.

The seventh component correlated with four of the original variables, and most significantly with the variable "*Lack of proper legal regulations is a hindrance to growth of a new venture*" with a score of 0.821. Hence, the seventh variable measured how legal issues affect business start-ups from research.

The eight components correlated significantly with two of the original variables, and most significantly with the variable "*Do you think male researchers are more entrepreneurial than their female counterparts?*" with a score of 0.791. This indicates that the eighth component measured how gender affects business start-ups from academic research.

Overall, the 28 variables had a positive relationship with the eight components within which they fell.

Table 5
ROTATED COMPONENT MATRIX FOR THE INDEPENDENT VARIABLES

Entrepreneurial Education		Risk Tolerance		External context in gender	
The level of prior entrepreneurial training influences the growth of a new business	0.91	I am willing to invest my time and energy to start a business	0.845	Our culture doesn't support female-owned businesses	0.845
Previous business experience has an impact on the survival of new businesses	0.885	I am willing to invest my personal saving to start a business	0.833	Religious beliefs usually act as hindrance to women's engagement in business	0.844

Entrepreneurship education is important for survival of new businesses	0.847	Despite incessant unrest that could affect my business, I am still willing to start a business	0.784	Societal negative attitude affects women engaging in business	0.725
Risk-taking is important to be a successful entrepreneur	0.84	I am willing to leave a paid job to start a business	0.571		
Trained entrepreneurs are better entrepreneurs than born entrepreneurs	0.778				
I have competent people I can trust to support me if I start my business	0.504				
Family Responsibilities & Gender		Financial Availability		Policies & Regulations	
Do you think female researchers encounter more difficulties in starting their businesses due to other roles they play at home or how society views them?	0.764	Researchers do not easily access loans due to the nature of their work	0.781	Do the university's rules and regulations support researchers to start their own businesses?	0.865
Do you think that marriage, pregnancy and child-care distract female researchers from starting/running a business?	0.676	Banks do not have confidence in academics to grant them loans for business	0.771	Do Nigeria's labour laws support researchers venturing into entrepreneurship?	0.746
Family responsibilities greatly influence growth of female-owned businesses	0.645	Lending conditions and high interest rates charged serve as a huge barrier	0.567		
		I am aware that government policies change regularly, and it can have grave consequences on my business	0.41		
Legal Issues		Gender Roles			
Lack of proper legal regulations hinder the growth of new ventures	0.821	Do you think male researchers are more entrepreneurial than their female counterparts?	0.791		
Given a conducive environment, researchers will perform better in business	0.753	Cultural beliefs and practices in Nigeria affect female-owned businesses	0.485		

Researchers face many barriers and constraints when venturing into entrepreneurship	0.733				
Government collecting taxes and license fees can be a hindrance to the growth of new businesses	0.633				
Extraction Method: Principal Component Analysis. *Rotation Method: Varimax with Kaiser Normalization.* *Rotation converged in 7 iterations.*					

Discussion of Hypotheses Using Binary Logistic Regression

The results of the binary logistic regression analysis are discussed in the sub-sections below. Table 6 below shows the classification before the explanatory variables were added to the model. This represents the intercept model or the null hypothesis, without any prediction. This effectively presents a situation in which all the 28 explanatory (independent) variables do not predict the outcome variable (researchers spinning-off a business from their research). The accuracy was 56.2% which is directly linked to the fact that as many as 59 researchers had spun-off businesses from their research while 46 researchers had not. A non-significant value of 0.206 as shown in Table 5 below indicates that there was no significant difference in the frequency of researchers who had spun off businesses from their research and those who had not. The odd ratio (exponentiated intercept) with a value of 1.283 indicates that researchers were more likely to spin off businesses at a rate of 128% (Table 7).

Table 6
CLASSIFICATION TABLE[a,b] FOR THE OBSERVED VARIABLE (INTERCEPT MODEL)

			Predicted		
Observed			Spin-offs from business from research		Percentage Correct
			No	Yes	
Step 0	Spin-off businesses from research	No	0	46	.0
		Yes	0	59	100.0
	Overall percentage				56.2
[a]*Constant is included in the model.* [b]*The cut value is .500*					

Table 7
VARIABLES IN THE EQUATION IN THE INTERCEPT MODEL/NULL HYPOTHESIS

		B	Sig.	Exp(B)
Step 0	Constant	.249	0.206	1.283

Table 8 presents the Omnibus test of the model coefficient. The chi-square value of 65.326, which was statistically significant at p = 0.000, implies that there was at least some predictive capacity in the equation/model. The 28 explanatory variables were then added to the equation/model/null hypothesis. Table 9 further shows the predictive capacity of the model. The -2 log likelihood in Table 9 was interpreted very similarly to the chi-square as in Table 8 while

the Cox and Snell R square and Nagelkerke R square value represented the Pseudo R square values. These were based on the maximum likelihood estimation which is quite different from the R square in the linear regression. While Nagelkerke R square ranges from 0 to 1, Cox and Snell R squared ranges from 0 to a maximum of 0.75. Hence, according to Nagelkerke R square in Table 9, it can be assumed that approximately 62.1% in the variability in the dependent variable (academic spin-off) was accounted for by the 28 independent variables (however, this assumption is based on a pseudo R squared). On the other hand, the Hosmer & Lemeshow chi-square test works in the opposite pattern with the Omnibus Tests of Model Coefficients. A good model will have a p-value above 0.05. Because the chi-square of the Hosmer & Lemeshow test was above 0.05 (p=0.731) in the model, as shown in Table 10, this indicates that there was no misspecification in the predictive capacity of the model. Thus, all these tests ensured that the binary logistic regression model was conducted using an adequate sample size and could sufficiently indicate the impact of the predictor/explanatory variables (factors influencing business start-ups from academic research) on the outcome variable (business start-ups from academic research).

Table 8 OMNIBUS TESTS OF MODEL COEFFICIENTS				
		Chi-square	df	Sig.
Step 1	Step	65.326	28	.000
	Block	65.326	28	.000
	Model	65.326	28	.000

Table 9 MODEL SUMMARY			
Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	78.621[a]	.463	.621

Table 10 HOSMER & LEMESHOW TEST			
Step	Chi-square	df	Sig.
1	5.132	8	0.743

Table 11 contains the predicted classification. Table 11 indicates that 51 of the 59 researchers were predicted by the model to have spun-off businesses from research. Eight researchers who had spun off research were not predicted by the model when compared with the observed classification table (Table 6). This represents an accuracy of 86.4%. Moreover, 35 of the 46 researchers were predicted not to have spun off businesses from research. When compared to Table 6, the model failed to predict 11 which indicated a 76.1% accuracy for those who did not spin off businesses from research. Overall, the accuracy of the model's predictive capacity was 81.9%. This implies that the model's predictive capacity had jumped from 56.2% in the null model to 81.9% with the 28 variables. Thus, the predictive capacity of the model has had significantly increased through the addition of the explanatory variables. The 25.7% prediction correctness is quite impressive.

Table 11 CLASSIFICATION TABLE FOR THE PREDICTED MODEL				
Observed		Predicted		
		Spin-offs of business from research		Percentage Correct
		No	Yes	
Spin-off businesses from research	No	35	11	76.1
	Yes	8	51	86.4
Overall percentage				81.9

H1: Entrepreneurship Education

From the rotated component matrix (Table 5), six variables were closely associated and found to address the factor loading "*entrepreneurship education and training*". According to Table 12, none of the six latent variables explaining entrepreneurship education and training were significant predictors of academic spin-off among STEAM researchers in Nigeria. However, two of the four variables on entrepreneurship education were positive influencers. The positive influencers of academic spin-off were past business experiences, and entrepreneurship literacy while the negative influencers were extensive entrepreneurship training and work delegation. The entrepreneurship pattern with STEAM researchers was found to be slightly different from the convention. While extensive literature (Gerba, 2012; Hattab, 2014; Fayolle & Gailly, 2015; Rauch & Hulsink, 2015; Walter & Block, 2016) has shown that entrepreneurship education significantly influences entrepreneurship generally, the study results support those of Oosterbeek et al., (2010), suggesting that entrepreneurial training does not have a significant effect on students' entrepreneurial interest, as well as those of Fayolle (2013), Nabi et al., (2017) and Potishuk & Kratzer (2017) indicating that there are several important factors other than entrepreneurship education and training that influence entrepreneurship intention. However, entrepreneurship education significantly contributed to the model, since all the six variables were not significant influencers of the interest of researchers in the STEAM field to start a new business from their research. Thus, the study does not support the hypothesis which states that entrepreneurship education is significantly associated with the intention of researchers in the STEAM field in Nigeria to start a new business from their research

Risk Tolerance

From the rotated component matrix (Table 5), four variables were closely associated with risk tolerance. According to Table 12, two of the latent variables had positive influence on the interest of researchers in the STEAM field in Nigeria towards starting a new business from their research. While two other latent variables served as negative influencers. However, only one of the positive latent variables had significant impact on the decision of researchers in the STEAM field in Nigeria to start a new business from research. This was "*interest to invest time and energy toward starting a business*". This was in tandem with the convention. This paper agrees with extant literature (Giacomin et al., 2011; Chan et al., 2015., Van Gelderen et al., 2015; Costa & Mainardes, 2016; Bosique-Blasco et al., 2018) that anyone willing to venture into entrepreneurship must have risk-taking propensity. Thus, supports the hypothesis which says that risk taking is significantly associated with the intention of researchers in the STEAM field in Nigeria to start new business from their research.

Financial Availability

Conventional wisdom posits that availability of funds is crucial for business spin-off (Cetindamar et al., 2012). However, the study sought to check if the same applies for researchers in the STEAM field. Three of the four latent variables show a negative effect on the interest of researchers in the STEAM field in Nigeria towards starting a new business from research while only one variable indicated a positive effect. However, none of the four variables significantly influences the academic spin-off among the researchers in the STEAM field. Hence the study does not support the hypothesis which states that financial availability is significantly associated with the intention of researchers in the STEAM field in Nigeria to start a new business from their research.

Government Policy and Regulation

Studies such as those of Thornton et al., (2011), Saeed et al., (2015) and Ghosh (2017) expressly indicate that the external (political and economic) entrepreneurial environment significantly affects entrepreneurial intention. From the rotated component matrix (Table 5), six variables were closely associated and found to address the component "*government policies, institutional regulation and other legal issues*". According to Table 12, none of the six latent variables explaining government policy, institutional regulations and other legal issues was a significant predictor of academic spin-off among STEAM researchers in Nigeria. However, three of the six variables did appear to be positive influencers. The study thus does not support the hypothesis which states that government policy, institutional regulations and other legal issues are significantly associated with the intention of researchers in the STEAM field in Nigeria to start a new business from their research.

Table 12 BINARY LOGISTIC REGRESSION			
	B	Sig	Exp (B)
Entrepreneurship Education			
The level of prior entrepreneurial training influences the growth of a new business	-0.356	0.562	0.701
Previous business experience has an impact on the survival of new businesses	0.542	0.357	1.720
Entrepreneurship education is important for survival of new businesses	0.159	0.760	1.173
Risk taking is important to be a successful entrepreneur	0.383	0.398	1.466
Trained entrepreneurs are better entrepreneurs than born entrepreneurs	0.502	0.226	1.653
I have competent people I can trust to support me if I start my business	-0.418	0.305	0.659
Risk Tolerance			
I am willing to invest my time and energy to start a business	1.365	0.014	3.915
I am willing to invest my personal saving to start a business	0.338	0.545	1.403
Despite incessant unrest that could affect my business, I am still willing to start a business	-0.331	0.537	0.718
I am willing to leave a paid job to start a business	-0.014	0.967	0.986
Financial Availability			
Researchers do not easily access loans due to the nature of their work	0.091	0.779	1.095
Banks do not have confidence in academics to grant them loans for business	-0.093	0.811	0.911
Lending conditions and high interest rates charged serve as a huge barrier	-0.440	0.238	0.644

I am aware that government policies change regularly, and it can have grave consequences on my business	-0.227	0.603	0.797
Gender Roles			
Our culture doesn't support female owned businesses	0.544	0.293	1.723
Religious beliefs usually serve as hindrance to women engagement in business	0.110	0.813	1.117
Societal negative attitude affects women engaging in business	-0.132	0.755	0.876
Do you think female researchers encounter more difficulties in starting their businesses due to other roles they play at home or how society views them	-1.297	0.189	0.273
Do you think that marriage, pregnancy and child-care serve as distraction for female researchers from starting/running a business?	-0.801	0.332	0.449
Family responsibilities greatly influence growth of female-owned businesses	0.668	0.148	1.950
Do you think male researchers are more entrepreneurial than their female counterparts?	1.585	0.097	4.878
Cultural beliefs and practices in Nigeria affect female owned businesses	-0.276	0.476	0.759
Government Policy and Regulations			
Does the university's rule and regulations support researchers to start their own businesses?	-0.767	0.467	0.465
Do Nigeria's labour laws support researchers venturing into entrepreneurship?	0.001	0.999	1.001
Lack of proper legal regulations hindrance to growth of new venture	-0.122	0.762	0.885
Given a conducive environment, researchers will perform better in business	-0.605	0.097	0.546
Researchers face many barriers and constraints when venturing into entrepreneurship	0.552	0.227	1.736
Government collecting taxes and license fees can be a hindrance to growth of new businesses	0.190	0.554	1.210
Constant	-3.008	0.129	0.049

CONCLUSION

The study showed that all the conventional characteristics of an entrepreneur are important qualities that must be possessed by researchers in the STEAM field in order to be successful entrepreneurs. This was demonstrated by the fact that all the variables had communalities above the minimum 0.3 and because all 28 variables had correlation values above 0.4 in the rotated component matrix. However, the most important driver of academic spin-off was the level of risk tolerance, as seen from the regression results. The results of this research provide useful insights into STEAM researchers' ability to take on risk, which determines whether or not they will venture into business from their research. It became evident that there was a strong relationship between risk-taking and business start-up. Quality research requires that researchers explore daring and uncertain approaches to solving problems, which is akin to the risk-taking propensity of the entrepreneur. Thus, there are similarities between the characteristics of good researchers and entrepreneurs. For instance, researchers are driven to seek answers to unknown questions, and they do not rest until they find a plausible answer. They are as explorative as the entrepreneur and persevere even progress is painstakingly slow. Another similar characteristic of researchers and entrepreneurs is a positive attitude. They both learn from their mistakes and failures. While the consequences of risk could be fatal at times, an optimistic researcher and entrepreneur will see failure as an opportunity to learn and gain experience. In addition, successful researchers are those who come up with new inventions and innovations. Hence, STEAM researchers and entrepreneurs accept risk as a cost of innovation when the results turn out to be positive and view it as an opportunity cost should the outcome be negative.

STEAM researchers also believe that risk can be calculated; they therefore calculate the potential results and have contingency plans in place. Based on research, they can take calculated risks and explore. The study results further showed that while other factors such as entrepreneurship education, availability of funds, institutional policies and gender (being male) do encourage STEAM researchers to venture into business, these factors are not necessarily significant drivers of starting up a business from research.

RECOMMENDATION

The study recommends that regular training on entrepreneurship will help the researchers in the STEAM field to be more productive. Since the study showed that the characteristics of researchers and entrepreneurs are similar. Researchers and entrepreneurs like to task risk. Trainings on entrepreneurship will not only increase productivity among the researchers in the STEAM, it will also inspire them to be more entrepreneurial. This will represent a win-win situation. While Nigeria universities needs to increase their entrepreneurial activities, the quality and quantity of research/knowledge supply also needs to improve.

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