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Environmental and National Economic Sustainability, Through Science Laboratory Technology in Small Scale Enterprises

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Abstract **Original Research Article**

In the quest of sustainable economic growth and development, the role of entrepreneurship and technological advancements has gained paramount importance. This study explores the connection of entrepreneurial practices and science laboratory technology (SLT) as catalysts for national economic development and focusing on sustainable practices with the integration of entrepreneurship and SLT for innovative solutions, increased competitiveness, and enhanced resource utilization. The study examines the symbiotic relationship between entrepreneurial initiatives and SLT within the context of national economic development. By leveraging on SLT, entrepreneurs can identify market gaps, create novel products, and improve existing processes. The design adopts a mixed-method research design, combining both quantitative and qualitative approaches. A stratified random sampling method was used to ensure representation from diverse regions among 113 Scientists, Technologists, entrepreneurs SLT students/Graduates and Small-Scale business owners in Nigeria. Descriptive statistics, correlation analysis, and regression models were used to identify patterns and relationships between variables.

The result revealed the relationship of Independent Variables (SLT Sustainability, SLT Competitiveness, SLT Innovations, SLT Growth & Development and SLT Quality Standards) with the Dependent Variable (Entrepreneurial Sustainability). The independent variables indicated a positive correlation with Entrepreneurial Sustainability. SLT sustainability ($r = 0.492$, $p < 0.001$), SLT Competitiveness ($r = 0.268$, $p < 0.005$), SLT Innovations ($r = .577$, $p < 0.001$), SLT Growth & Development ($r = .586$, $p < 0.001$), SLT Quality Standards ($r = .541$, $p < 0.001$). The result shows the impact of Science Laboratory Technology on entrepreneurial sustainability with a moderate effect of SLT on Entrepreneurial sustainability which could be due to certain factors considered as important contributors for entrepreneurship sustainability. The study concluded that SLT foster a culture of innovation, collaboration, and sustainable business practices preparing countries to position themselves at the forefront of global competitiveness.

Keywords: Economic development, Entrepreneurial sustainability, Science laboratory technology (SLT), SMEs.

1. Introduction

Science is a systematic body of knowledge that aims, through experiment, observation and deduction, at producing reliable explanations of phenomena, with reference to the material and physical world (Chalmers, 1999).

Science is also concerned with classification of facts and formulation of general truth. It suggests ideas and technology, operationalizes them. Science clarifies and justifies how an objective may be achieved. The "how" is translated into practical realization and from here, technology takes over and compliments science (Williams, 1998). It is this searched idea that is harnessed by technology to better modify this planet 'earth" to bring comfort for our living.

Nigeria is a country rife with talents and abundance of natural resources but is yet to achieve its potential in the development and application of science, technology and innovation (STI) effectively in national sustainable development initiatives (Ihueze et al., 2015). Sustainable development which has been the target of Nigeria's socioeconomic development plans comprises four cardinal sub-targets: economic development, population management, environmental/natural resources stewardship and social equity (United Nations, 2015).

The economic development component is usually the primary target of development plans and initiatives. Population is a significant factor because by necessity most improvements in socio-economic indices are usually normalized with population and assessed on per capita basis. Environmental stewardship is one of the determinants of quality of life, Its impacts on human well-being, health and even, occupational stability. Social equity is a factor in peace and stability of any country or lesser political jurisdiction, and a requirement for the implementation of economic development programs equity (United Nations, 2015).

Nigeria is at low scoring levels in the operational factors of system planning, system analysis, system design, and system maintenance/improvement. Most of the development plans have been much better than their implementation (Siyanbola et al., 2016). Science and technology is a major factor in the improvement and harvesting of the asset base as well as implementation of operations.

Even as a result of the increasing awareness of the need for Nigeria to be a producing economy towards the sustainability of the economy, for a regional development and economic dynamism amidst the globalizing economy of the world, there has not been a systematic effort to observe it from the angle of science and laboratory technology discipline. Hence this study probes the rate at which SLT as a discipline embrace the sustenance of the environment and the economy of the nation in small and medium scale enterprise (SME) and also to awake entrepreneurial eagerness among those who studied and those still in the process as well as those intending or contemplating to study SLT in higher institution. This should however aid the study to appraise or assess the effectuality of SLT in our institution of learning, to inform the student that they are trained to be employers of labour through the skills and knowledge gained to make, research and formulate beneficial needs for economic growth. The second part of this paper reviews the existent literature while the third part covers methodology as the fourth part presents the findings and discussion while the last part recommends proper policy and conclusion.

2. Materials and methods

Table 1: **Population of the selected target audience**

CATEGORY	NUMBERS
Entrepreneurial sustainability through SLT	113

Data Collection

The primary data for this study was gathered through questionnaire via Google forms to target audiences (Scientists, technologists, SLT students and Entrepreneurs). The questionnaire consists of 18 questions. Items related to the dimension of Science Laboratory Technology (SLT) as the independent variables, while Entrepreneurial sustainability as dependent variable. The questionnaire is divided into two parts; the first part contains the demographic information such as; gender, age, marital status, educational qualification, and category of business. The second part covered the areas with regards to entrepreneurial sustainability through SLT. The questions are as follows:

- Science laboratory technology plays a crucial role in fostering entrepreneurial sustainability.
- The utilization of science laboratory technology enhances the competitiveness of entrepreneurial ventures.
- Science laboratory technology facilitates innovation and the development of new products/services in entrepreneurial ventures.
- The adoption of science laboratory technology improves the efficiency and productivity of entrepreneurial ventures.
- Science laboratory technology helps entrepreneurial ventures in identifying and exploiting market opportunities.
- The implementation of science laboratory technology leads to sustainable growth and expansion of entrepreneurial ventures.
- Science laboratory technology enables entrepreneurial ventures to meet quality standards and regulatory requirements.
- Entrepreneurial ventures investing in science laboratory technology are more likely to attract funding or investment.
- Science laboratory technology contributes to the development of a skilled workforce in entrepreneurial ventures.
- The use of science laboratory technology in entrepreneurial ventures positively impacts the overall national economic development.
- Entrepreneurial ventures that incorporate science laboratory technology are more likely to create employment opportunities.
- Science laboratory technology fosters collaboration and knowledge-sharing among entrepreneurial ventures.

All were measured on a four (4) point scale format (strongly agree, agree, neutral and disagree).

3. Result

Table 2: Demographic analysis based (Gender, Age, Educational level, Employment status, professionals Affiliation and Occupational status)

Gender	Frequency	Percentage (%)
Male	58	51.3
Female	54	47.8
Empty	01	0.9
Total	**113**	100
Age		
18-24	49	43.4
25-34	29	25.6
35-44	16	14.2
45-54	14	12.4
55 and above	05	4.4
Total	**113**	100
Educational level		
O'level	28	24.7
Undergraduate	58	51.3
Postgraduate	24	21.2
Others	03	2.8
Total	**113**	100
Employment status		
Full time	48	42.5
Part time	05	4.4
Unemployed	12	10.6
Not working	04	3.5
Student	44	39
Total	**113**	100
Are you a member of:		
Environmental groups	07	6.0
or org.	67	59.0
Scientific groups or org.	39	35.0
Others	**113**	100
Total		
Are you a/ an:		
Small scale entrepreneur	29	25.7
Economist	02	1.7
Scientist	70	62.0
Others	12	10.6
Total	**113**	100

Source: Authors' Computation 2025

Table 3: Summary of Raw data collected

S/N		SA	A	N	D	SD
1.	Science laboratory technology plays a crucial role in fostering entrepreneurial sustainability	51 (43.6%)	57 (48.7%)	7 (6%)	6 (5.1%)	-
2.	The utilization of science laboratory technology enhances the competitiveness of entrepreneurial ventures	43 (36.8%)	57 (48.7%)	16 (13.7%)	3 (2.6%)	1 (0.9%)
3.	Science laboratory technology facilitates innovation and the development of new products/services in entrepreneurial ventures	50 (42.7%)	59 (50.4%)	6 (5.1%)	4 (3.4%)	1 (0.9%)
4.	The adoption of science laboratory technology improves the efficiency and productivity of entrepreneurial ventures	44 (37.6%)	63 (53.8%)	6 (5.1%)	5 (4.3%)	-
5.	Science laboratory technology helps entrepreneurial ventures in	33 (28.2%)	61 (52.1%)	13 (11.1%)	11 (9.4%)	-

	identifying and exploiting market opportunities					
6.	The implementation of science laboratory technology leads to sustainable growth and expansion of entrepreneurial ventures	38 (32.5%)	58 (49.6%)	12 (10.3%)	7 v(6%)	2 (1.7%)
7.	Science laboratory technology enables entrepreneurial ventures to meet quality standards and regulatory requirements	55 (47%)	52 (44.4%)	11 (9.4%)	1 (0.9%)	-
8.	Entrepreneurial ventures investing in science laboratory technology are more likely to attract funding or investment	41 (35%)	57 (48.7%)	18 (15.4%)	2 (1.7%)	1 (0.9%)
9.	Science laboratory technology contributes to the development of a skilled workforce in entrepreneurial ventures	45 (38.5%)	54 (46.2%)	16 (13.7%)	4 (3.4%)	2 (1.7%)
10.	The use of science laboratory	47 (40.2%)	56 (47.9%)	14 (12%)	3 (2.6%)	1 (0.9%)

	technology in entrepreneurial ventures positively impacts the overall national economic development					
11.	Entrepreneurial ventures that incorporate science laboratory technology are more likely to create employment opportunities	56 (47.9%)	43 (36.8%)	13 (11.1%)	5 (4.3%)	1 (0.9%)
12.	Science laboratory technology fosters collaboration and knowledge-sharing among entrepreneurial ventures	50 (42.7%)	54 (46.2%)	9 (7.7%)	5 (4.3%)	1 (0.9%)

Source: Authors' Computation 2025

Note: SA, A, N, D and SD denotes Strongly Agree, Agree, Neutral, Disagree, Strongly Disagree.

Test of Hypothesis

H_0: Science laboratory technology (SLT) does not support entrepreneurial (SMEs) sustainability for national economic development.

In testing the hypothesis, questions 10 &11 as contained in the table were used

Table 4: Responses to questions 10 &11 from targeted Audience

Responses Required	Responses from question 10	Responses from question 11
Strongly Agree	42.2 %	47.9
Agree	47.9%	36.8
Neutral	12	11.1
Disagree	2.6	4.3
Strongly disagree	0.9	0.9

Source: Authors' Computation 2025

Table 5 Descriptive statistics

	Mean	Std. Deviation	N
Entrepreneurial-Sustainability	4.2035	.70912	113
SLT Feasibility	4.2655	.62862	113
SLT Competitiveness	4.1858	.76238	113
SLT Innovations	4.2153	.62666	113
SLT Growth & Development	4.1283	.73125	113
SLT Quality Standards	4.3982	.64835	113

Table 6: Correlation of the variables

		Entrepreneurial Sustainability	SLT Feasibility	SLT Competitiveness	SLT Innovations	SLT Growth & Development	SLT Quality Standards
Entrepreneurial Sustainability	Pearson Correlation	1	.492**	.268**	.577**	.586**	.541**
	Sig. (2-tailed)		.000	.004	.000	.000	.000
	N	113	113	113	113	113	113
SLT Feasibility	Pearson Correlation	.492**	1	.617**	.727**	.790**	.563**
	Sig. (2-tailed)	.000		.000	.000	.000	.000
	N	113	113	113	113	113	113
SLT Competitiveness	Pearson Correlation	.268**	.617**	1	.588**	.477**	.373**
	Sig. (2-tailed)	.004	.000		.000	.000	.000
	N	113	113	113	113	113	113
SLT Innovations	Pearson Correlation	.577**	.727**	.588**	1	.790**	.593**
	Sig. (2-tailed)	.000	.000	.000		.000	.000
	N	113	113	113	113	113	113
SLT Growth & Development	Pearson Correlation	.586**	.790**	.477**	.790**	1	.682**
	Sig. (2-tailed)	.000	.000	.000	.000		.000
	N	113	113	113	113	113	113
SLT Quality Standards	Pearson Correlation	.541**	.563**	.373**	.593**	.682**	1
	Sig. (2-tailed)	.000	.000	.000	.000	.000	
	N	113	113	113	113	113	113

****. Correlation is significant at the 0.01 level (2-tailed).**

Discussion

The descriptive statistics (Table 1) shows the mean, standard deviation, and sample size (N) for each variable. The mean is the average value for each variable. The standard deviation is a measure of how spread out the data is. The sample size (N) is the number of observations in the data set.

- Entrepreneurial Sustainability: The mean score for entrepreneurial sustainability is 4.20, which indicates that respondents generally believe that their businesses are sustainable. The standard deviation is 0.70, which suggests that there is a moderate amount of variation in the data.

- SLT Feasibility: The mean score for SLT feasibility is 4.27, which indicates that respondents generally believe that their business models are feasible. The standard deviation is 0.63, which suggests that there is a moderate amount of variation in the data.
- SLT Competitiveness: The mean score for SLT competitiveness is 4.19, which indicates that respondents generally believe that their businesses are competitive. The standard deviation is 0.76, which suggests that there is a moderate amount of variation in the data.
- SLT Innovations: The mean score for SLT innovations is 4.22, which indicates that respondents generally believe that their businesses are innovative. The standard deviation is 0.63, which suggests that there is a moderate amount of variation in the data.
- SLT Growth & Development: The mean score for SLT growth & development is 4.13, which indicates that respondents generally believe that their businesses are growing and developing. The standard deviation is 0.73, which suggests that there is a moderate amount of variation in the data.
- SLT Quality Standards: The mean score for SLT quality standards is 4.39, which indicates that respondents generally believe that their businesses meet high quality standards. The standard deviation is 0.65, which suggests that there is a moderate amount of variation in the data.

Overall, the descriptive statistics suggest that the respondents generally believe that their businesses are sustainable, feasible, competitive, innovative, growing, and developing. However, there is also some variation in the data, which suggests that there are a range of experiences among the respondents.

Table 2: Revealed the relationship of each Independent Variable (SLT Feasibility, SLT Competitiveness, SLT Innovations, SLT Growth & Development and SLT Quality Standards) with the Dependent Variable (Entrepreneurial Sustainability). SLT Feasibility is positively correlated with Entrepreneurial Sustainability(r=0.492, p< 0.001), SLT Competitiveness is positively correlated with Entrepreneurial Sustainability (r= 0.268, p<0.005), SLT Innovations is positively correlated with Entrepreneurial Sustainability (r= .577, p<0.001), SLT Growth & Development is positively correlated with Entrepreneurial Sustainability (r= .586, p<0.001) while SLT Quality Standards is also positively correlated with Entrepreneurial Sustainability (r= . 541, p<0.001).

From the above interpretation, there is a significant relationship between all the independent variables and the dependent variable. The first independent variable (SLT Sustainability) shows the higher the Sustainability of SLT the higher the Entrepreneurial sustainability (dependent variable). The size of effect (r^2=0.242) revealed that SLT Sustainability explained 24.2 % variance in Entrepreneurial sustainability i.e SLT sustainability had small effect on Entrepreneurial sustainability.

The second independent variable (SLT competitiveness) showed that the higher SLT Competitiveness the higher the Entrepreneurial sustainability and vice versa. The size of effect (r^2 = 0.072) revealed that SLT competitiveness explained 7.2% variance in Entrepreneurial sustainability i.e SLT competitiveness has very small effect on Entrepreneurial sustainability.

The third independent variable (SLT Innovations) showed that the higher the SLT innovation the higher the Entrepreneurial sustainability. The size effect (r^2= 0.333) revealed that SLT innovation explained 33.3% variance in Entrepreneurial sustainability i.e SLT innovation has moderate effect on Entrepreneurial sustainability.

The fourth independent variable (SLT Growth and development) showed that the higher the SLT growth and development the higher the Entrepreneurial sustainability. The size effect (r^2 =0. 343) revealed that SLT growth and development explained 34% variance in Entrepreneurial sustainability i.e., SLT growth and development has a moderate effect on Entrepreneurial sustainability.

The fifth independent variable (SLT quality standards) showed that the higher the SLT quality standards the higher the Entrepreneurial sustainability. The size effect (r^2= 0.293) revealed

that SLT quality standards explained 29% variance in the Entrepreneurial sustainability i.e. SLT quality standards has a low effect on Entrepreneurial sustainability. The correlation analysis shows that there are significant positive correlations between all of the variables. This means that there is a positive relationship between each independent variable and entrepreneurial sustainability.

In other words, as one variable increases, entrepreneurial sustainability is also likely to increase. The strongest correlation is between entrepreneurial sustainability and SLT growth & development ($r = .586$, $p < .01$). This means that entrepreneurial sustainability is most strongly associated with the ability of a business to grow and develop over time. Other strong correlations include those between entrepreneurial sustainability and SLT feasibility ($r = .492$, $p < .01$), SLT innovations ($r = .577$, $p < .01$), and SLT quality standards ($r = .541$, $p < .01$).

These results suggest that entrepreneurial sustainability is a complex construct that is influenced by a variety of factors. However, the strongest predictions of entrepreneurial sustainability appears to be the ability of a business to grow and develop, the feasibility of its business model, its ability to innovate, and its commitment to quality standards.

Recommendations

- Entrepreneurs should focus on growing and developing their businesses. This will help to increase entrepreneurial sustainability.
- Entrepreneurs should make sure that their business models are feasible. This will help to reduce risk and increase the chances of success.
- Entrepreneurs should be innovative employing the knowledge of and SLT expertise. This will help them to stay ahead of their competition and attract new customers.
- Entrepreneurs should commit to quality standards. This will help to build trust with customers and increase customer loyalty.

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