

Industry-based Learning and Entrepreneurial Competency Development in Higher Education: Evidence from University of Delta, Nigeria

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Abstract

In the 21st century, industry-based learning has gained prominence across many emerging economies as a transformative pedagogical approach in higher education for entrepreneurial capacity development. Despite the benefits of entrepreneurship education, many graduates still lack entrepreneurial competencies required to start and manage business ventures. This study investigates how industry-based learning (IBL) influences entrepreneurial competency development among students, focusing on exposure factors and outcomes at the University of Delta, Nigeria. It is an empirical study, anchored on a quantitative case-study design, involving eight-six entrepreneurship students at the University of Delta, Nigeria in 2024/2025 academic session. Data were collected through a structured questionnaire and analyzed using frequency tables, mean scores, standard deviation and Spearman rank-order correlation matrix. Findings revealed a high level of exposure to industry-based learning activities. Industrial tour engagement, fieldwork participation and the quality of industry learning environment emerged as significant drivers of students' exposure to industry-based learning; supervision and mentorship demonstrated a moderate significant effect while students' interest and commitment showed a very weak and non-significant relationship (ρ (p) = 0.144, p -value = 0.187). Industry-based learning showed significant positive relationships with problem-solving ability, creative and innovative skills, entrepreneurial self-efficacy, business operations competence, opportunity recognition and planning skills, interpersonal relations and leadership capacity. This study suggests that strengthening IBL integration could enhance entrepreneurial competencies among university entrepreneurship students in Nigeria.

Keywords: Entrepreneurial Competency Development, Entrepreneurship Education, Experiential Learning, Higher Education, Industry-Based Learning.

Introduction

In the last few decades, the demand for graduates who possess theoretical knowledge and practical entrepreneurial competencies for self-employment, innovation and sustainable economic development has been on the increase (1, 2). This scenario has made entrepreneurship education a priority for higher education worldwide and a phenomenon that continues to attract global interest (2). Within the domain of entrepreneurship education, the inclusion of practical and experience-driven learning bridges the gap between classroom theory and practice (3). Industry-based learning is a pedagogical approach that provides students with experiential opportunities to develop entrepreneurial skills, problem-solving abilities and innovative capacities

required to thrive in dynamic global business environments (4). Industry-based learning is a work integrated learning (WIL) that exposes students to structured workplace experiences through internships, industrial attachments and business incubation schemes (5, 6). Participants in such programmes often develop stronger competencies in opportunity recognition, problem solving, business planning and risk-taking skills for successful enterprise development (7).

Entrepreneurship education in the 21st century is tailored toward globally aligned models to allow work-integrated learning to take place for skills development, venture creation and start-up outcomes and to foster entrepreneurial competencies (8-12). The quality of students' exposure to

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industry experiences vary across different regions of the world (13). Industry-based learning programmes contribute to students' entrepreneurial capacity (13, 14). The intense need for job creation and innovation engenders the priority for entrepreneurial skills development (15, 16). By subjecting students to real-world business environments enable them to identify market opportunities, manage risk and develop successful ventures (9, 17). The benefits of these programmes notwithstanding, notable challenges constrain the effectiveness of any form of industry-based learning (18, 19).

Prior studies have demonstrated the essence of industry-based learning in entrepreneurship education, benefits and challenges of industry-based learning, there remains insufficient empirical evidence regarding specific factors that determine students' exposure to industry-based learning. This study addresses this gap by examining the factors influencing students' exposure to IBL and its effects on entrepreneurial competency development by providing context-specific evidence on what facilitates students' industry exposure and whether such exposure promotes entrepreneurial competencies. The study tends to contribute to entrepreneurship education by linking industry-based learning exposure, determining factors of IBL and competency outcomes within the context of a Nigerian university. Thus, the study seeks to:

- (a) Identify the factors significantly influencing students' exposure to industry-based learning at the University of Delta, Nigeria
- (b) Examine the effect of industry-based learning on entrepreneurial competency development among entrepreneurship students at the University of Delta, Nigeria.

Concepts of Industry-based Learning and Entrepreneurial Competency Development

Industry-based learning (IBL) is a learning framework that embeds student learning directly within a professional work environment (5, 6). It is a practical framework that utilizes internships, industrial placements or attachments, industrial tours, business incubations, apprenticeship training, mentorship systems and collaboration with industries (5-7). In Nigeria, it is formalized through the Students' Industrial Work Experience Scheme (SIWES). Entrepreneurial competency

development (ECD) is a systematic process of cultivating distinctive entrepreneurial qualities, unique characteristics, specific traits, behaviours, skills, competencies to successfully launch, manage and scale a business enterprise (8, 11, 13).

Nexus Between Industry-based Learning and Entrepreneurial Competency Development

Industry-based learning in higher education is aimed at bridging the gap between theory and practice. It allows theoretical concepts to be translated into practical experiences (16, 20). This framework helps students cultivate practical abilities and entrepreneurial mindsets (6, 7, 21-23). Today's global labour markets require creative and innovative entrepreneurial skills (19). Many reforms in entrepreneurship education are oriented towards development of entrepreneurial competencies (12). Experiential learning activities and university-industry collaboration strengthen students' thinking ability, business acumen and entrepreneurial readiness (23-25). Students who had completed their industrial placements were reported to have high scores of self-efficacy and improved problem-solving abilities (5, 22).

Arising from this line of reasoning, we formulate two testable hypotheses:

H1: There are no factors significantly influencing students' exposure to industry-based learning

H2: Industry-based learning does not significantly enhance entrepreneurial competencies among entrepreneurship students at the University of Delta, Nigeria.

Theoretical Framework

This study hinges on the Experiential Learning Theory (ELT), Social Cognitive Theory (SCT) and Human Capital Theory (HCT). Experiential Learning Theory (ELT) emerged as a framework for understanding learning through experience (26). The theory explains how knowledge is developed through experience and emphasizes that that effective learning occurs through a cyclical process involving concrete experience (CE), reflective observation (RO), abstract conceptualization (AC) and active experimentation (AE). ELT assumes that learning is process-oriented; continuous and grounded in experience; individuals learn best when they actively engage in real-world situations and reflect on experiences; knowledge is constructed through the interaction between experience, perception, cognition and behavior

(27). This theory provides a pedagogical foundation for understanding how industry-based learning facilitates development of entrepreneurial competencies through active engagement and reflection.

The Social Cognitive Theory (SCT) explains how learning and behavior occurs within a social context through interaction of personal factors, behavior and environmental influences (28). It provides support that people could develop through social interactions and accentuates that abilities are developed through social exposure. This theory provides that entrepreneurs could develop entrepreneurial behavior and competencies through observation, social interaction, imitation, modeling, mentorship and self-efficacy.

The Human Capital Theory (HCT) posits that education, training and development are human capital investments that promote, increase and sustain productive and economic values of individuals (29-32). This theory demonstrates how entrepreneurial skills and knowledge gained from industry-based learning promote work readiness, employability, productivity, lifelong career and economic value.

Methodology

The study adopted a quantitative case-study research design to examine industry-based learning among entrepreneurship students. The study was conducted at the University of Delta (UNIDEL), Nigeria, a public university comprising three campuses with the main campus at Alihame, located at approximately 6.25461°N latitude and 6.20315°E longitude; the Owa-Alero Campus, located at approximately 6.74928°N latitude and 6.08600°E longitude; and the Owa-Oyibu Campus, located at approximately 6.7311°N latitude and 6.0785°E longitude. These three campuses constitute the geographical study area within which the university-based and industry-linked learning activities examined in the study were situated. Given the small and accessible population, the study adopted a census approach, involving the entire population of 86 eligible 200, 300 and 400 level entrepreneurship students who had undertaken industry-based training. The data used for the study were obtained from entrepreneurship students who had participated in industry-based training during the 2024/2025

academic session at the University of Delta, Nigeria. A structured questionnaire based on a five-point Likert scale was used as the principal data collection instrument. The questionnaire was administered with the assistance of a trained undergraduate research assistant, who distributed the instruments, monitored their completion and retrieved the completed questionnaires to ensure adequate coverage of the census population.

Following retrieval, the completed questionnaires were sorted, checked, coded, collated and prepared for statistical analysis. The responses were first examined for completeness and consistency before being assigned numerical codes corresponding to the response categories on the five-point Likert scale. IBM SPSS Statistics Version 26 was used to create the variable names, variable labels and numerical values for each questionnaire item. The responses were initially collated in a spreadsheet to facilitate systematic organization and verification of the dataset before being imported into SPSS for statistical analysis. This process enabled the researchers to maintain a consistent link between the original questionnaire responses and their corresponding coded variables. The survey responses underpinning the analysis of hypotheses 1 and 2 are presented in Tables S1 and S2 respectively (Appendix).

For data synthesis, frequency tables, mean scores and standard deviation were used for the descriptive analysis while Spearman rank-order correlation matrix was employed for the inferential analysis. Responses to the questionnaire items were aggregated according to the constructs and variables specified in the study objectives. The resulting dataset was subjected to Spearman's rank-order correlation analysis, a non-parametric statistical technique appropriate for examining the direction and strength of associations involving ordinal or Likert-scale data. The analysis was used to determine the relationship between the relevant industry-based learning variables and entrepreneurial competency development, as well as the statistical significance of the observed relationships. Statistical decisions were based on the coefficient value and p-value, with a significance level of 0.01. A relationship was considered statistically significant where the p-value was less than 0.05 ($p < 0.05$); where $p \geq 0.05$, the null hypothesis was not rejected. The coefficient value was further

considered in interpreting the direction and strength of the relationship between the variables.

Thus, the study covered a nine-month period, which spanned from October 2024 to June 2025.

Results and Discussion

Table 1: Frequency and Percentage Distribution of Responses on Factors Influencing Students' Exposure to IBL

Constructs/Variables	VHE 5	HE 4	ME 3	LE 2	VLE 1	Total
My interest and commitment in IBL programmes have given me a wide degree of exposure	39 (45%)	34 (40%)	4 (5%)	4 (5%)	5 (6%)	86 (100%)
University facilitated learning opportunities has provided me with IBL experience	28 (33%)	35 (41%)	13 (15%)	8 (9%)	2 (2%)	86 (100%)
My participation in internship and fieldwork/apprenticeship training has exposed me to workplace practice	23 (27%)	32 (37%)	13 (15%)	7 (8%)	11 (15%)	86 (100%)
Industrial visits or tours have increased my exposure to industry practices	24 (28%)	26 (30%)	15 (18%)	12 (14%)	9 (10%)	86 (100%)
Industry-based learning environments have provided me with meaningful exposure to professional work settings	22 (26%)	26 (30%)	14 (16%)	17 (20%)	7 (8%)	86 (100%)
The quality of supervision and mentorship has enhanced my exposure to industry-based learning.	26 (30%)	23 (27%)	29 (34%)	6 (7%)	2 (2%)	86 (100%)

Note: VHE = Very High Exposure, HE = High Exposure, ME = Moderate Exposure, LE = Low Exposure, VLE = Very Low Exposure. Independent Variable (FISE = Factors Influencing Students' Exposure): FISE1 = Students' Interest & Commitment, FISE2 = University Facilitated Learning Opportunities, FISE3 = Students' Participation in Field Work, FISE4 = Industrial Tour Engagement, FISE5 = Industry Learning Environment, FISE6 = Quality of Supervision & Mentorship. Dependent Variable: Industry-Based Learning Exposure, % = Percentage.

Table 1 presents the frequency and percentage distribution of respondents' perception of the factors influencing students' exposure to IBL. Across all identified factors, majority of the respondents reported very high and high exposure. Students' interest and commitment recorded the highest level of exposure with 85%; university-facilitated learning opportunities 74%; participation in internship, fieldwork and apprenticeship training 64%; industrial tour engagement 58%; quality of supervision and mentorship 57% and industry-based learning environment 56% of the respondents indicating very high and high. The percentage scores across the constructs imply that experiential learning

opportunities provided through multidimensional factors of students' interest and commitment, university-facilitated learning opportunities, participation in internship, fieldwork and apprenticeship training, industrial tour engagement; quality of supervision and mentorship and industry-based learning environment contributed significantly to students' practical learning experiences. The industry-based learning exposure among the respondents was largely influenced by a combination of factors, which play important roles in promoting students' engagement in industry-based learning experiences.

Table 2: Descriptive Statistics of Factors Influencing Students' Exposure to Industry-based Learning

Construct/Variable	Mean Score	Standard Deviation	Interpretation
Students' interest and commitment (FISE1)	4.14	0.94	High
University facilitated learning opportunities (FISE2)	3.92	0.85	High
Students' participation in fieldwork (FISE3)	3.57	1.08	High
Industrial visit or tour engagements (FISE4)	3.51	1.12	High
IBL environments (FISE5)	3.45	1.12	Moderate
Quality of supervision and mentorship (FISE 6)	3.76	0.99	High

Table 2 presents the mean scores and standard deviation values of factors influencing students' exposure to industry-based learning. The mean scores between 3.50 and 5.00 are interpreted as

high; scores between 2.50 and 3.49 as moderate and scores below 2.50 as low. The mean scores range from 3.45 to 4.14, indicating that most students either strongly agreed or agreed with the

statements. The findings suggest that entrepreneurship students at the University of Delta, Nigeria, are well exposed to industry-based learning experiences. The standard deviation values, ranging between 0.85 and 1.12 suggest moderate variability in students' responses, indicating that the overall trend leans toward high exposure or experience and that the individual

experience differs slightly. The analysis reveals that students generally reported a high level of exposure to industry-based learning across the six constructs and a moderate level of exposure from the industry learning environment.

H1: There are no factors significantly influencing students' exposure to industry-based learning.

Table 3: Spearman's rho (ρ) Correlation Analysis of Factors Influencing Students' Exposure to Industry-based Learning

Statistical method	Variables	Metric	Students' Interest and Commitment	Exposure to IBL
Spearman's rho	Students' Interest and Commitment	Correlation Coefficient	1.000	0.144
		Sig. (2-tailed)	.	0.187
		N	86	86
	Exposure to IBL	Correlation Coefficient	0.144	1.000
		Sig. (2-tailed)	0.187	.
		N	86	86
Spearman's rho	University Facilitated Learning Opportunities	Correlation Coefficient	University Facilitated Learning Opportunities	Exposure to IBL
		Sig. (2-tailed)	1.000	0.345**
		N	.	0.001
	Exposure to IBL	Correlation Coefficient	86	86
		Sig. (2-tailed)	0.345**	1.000
		N	0.001	.
Spearman's rho	Students' Participation in Fieldwork	Correlation Coefficient	Students' Participation in Fieldwork	Exposure to IBL
		Sig. (2-tailed)	1.000	0.855**
		N	.	0.000
	Exposure to IBL	Correlation Coefficient	86	86
		Sig. (2-tailed)	0.855**	1.000
		N	0.000	.
Spearman's rho	Industrial Tour Engagements	Correlation Coefficient	Industrial Tour Engagements	Exposure to IBL
		Sig. (2-tailed)	1.000	0.893**
		N	.	0.000
	Exposure to IBL	Correlation Coefficient	86	86
		Sig. (2-tailed)	0.893**	1.000
		N	0.000	.
Spearman's rho	Industry-Based Learning Environment	Correlation Coefficient	Industry-Based Learning Environment	Exposure to IBL
		Sig. (2-tailed)	1.000	0.893**
		N	.	0.000
	Exposure to IBL	Correlation Coefficient	86	86
		Sig. (2-tailed)	0.893**	1.000
		N	0.000	.
Spearman's rho	Quality of Supervision and Mentorship	Correlation Coefficient	Quality of Supervision and Mentorship	Exposure to IBL
		Sig. (2-tailed)	1.000	0.554**
		N	.	0.000
		Correlation Coefficient	86	86
		Sig. (2-tailed)		
		N		

Exposure to	Correlation Coefficient	0.554**	1.000
IBL	Sig. (2-tailed)	0.000	.
	N	86	86

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

Independent Variable (FISE = Factors Influencing Students' Exposure): FISE1 = Students' Interest & Commitment, FISE2 = University Facilitated Learning Opportunities, FISE3 = Students' Participation in Field Work, FISE4 = Industrial Tour Engagement, FISE5 = Industry Learning Environment, FISE6 = Quality of Supervision & Mentorship. Dependent Variable: Industry-Based Learning Exposure (IBLExp).

Table 3 presents the Spearman's rho (ρ) correlation analysis of factors influencing students' exposure to industry-based learning. The results indicate that students' interest and commitment had a weak and non-significant positive relationship with exposure to IBL ($\rho = 0.144$, $p = 0.187$), which means that the students' personal interest alone did not significantly influence their level of industry-based learning exposure. In contrast, university-facilitated learning opportunities exhibited a positive, significant and weak relationship with exposure to IBL ($\rho = 0.345$, $p < 0.01$); students' participation in fieldwork ($\rho = 0.855$, $p < 0.01$), industrial tour

engagement ($\rho = 0.893$, $p < 0.01$) and industry learning environment ($\rho = 0.893$, $p < 0.01$) demonstrated very strong positive and significant relationships with students' exposure to IBL while quality of supervision and mentorship showed a moderate positive and significant relationship with IBL exposure ($\rho = 0.554$, $p < 0.01$). The analysis results on university facilitated learning opportunities, students' participation in fieldwork, industrial tour engagement, industry learning environment and quality of supervision and mentorship resonate with the research findings of some researchers (5-13, 21).

Table 4: Summary of Spearman's rho (ρ) Correlation Analysis of Factors Influencing Students' Exposure to IBL

Hypothesis	Variable	N	Spearman's rho (ρ)	Sig. (p-value)	Result
H1:	FISE1	86	0.144	0.187	Not Significant
	FISE2	86	0.345**	0.001	Significant
	FISE3	86	0.855**	0.000	Significant
	FISE4	86	0.893**	0.000	Significant
	FISE5	86	0.893**	0.001	Significant
	FISE6	86	0.554**	0.000	Significant

Note: FISE = Factors Influencing Students' Exposure, FISE1 = Students' Interest & Commitment, FISE2 = University Facilitated Learning Opportunities, FISE3 = Students' Participation in Field Work, FISE4 = Industrial Tour Engagement, FISE5 = Industry Learning Environment, FISE6 = Quality of Supervision & Mentorship.

Table 4 summaries the Spearman correlation analysis results of factors influencing students' exposure to IBL. The results indicate varying degrees of association, ranging from very strong positive correlations to non-significant. The results show the strength and direction of relationships between the various independent variables and the dependent variable examined at 0.01 significance level (2-tailed). The students' interest and commitment showed a very weak and not significant relationship ($\rho = 0.144$, p -value = 0.187), meaning that the variable was not a driver of students' exposure as the observed p -value = 0.187 was greater than the threshold significance level set at alpha value (α) of 0.05 (p -value = 0.187 > alpha value (α) = 0.05). The correlation between university facilitated learning opportunities and students' exposure to IBL is

positive, significant and weak ($\rho = 0.345$, p -value = 0.001) compared to other factors having positive and significant relationship. The coefficient and p -values of industrial tour engagements and industry learning environment ($\rho = 0.893$, p -value = 0.000) and students' participation in fieldwork ($\rho = 0.855$, p -value = 0.000) are closer to 1, which indicate a very strong, positive and significant relationship with students' exposure to IBL. The quality of supervision and mentorship has a moderate, positive and significant relationship with students' exposure to IBL ($\rho = 0.554$, p -value = 0.000). The results suggest that the factors with positive and significant influence are primary drivers of students' exposure to IBL.

Table 5 presents the frequency and percentage distribution of respondents' perceptions of the

influence of industry-based learning (IBL) on entrepreneurial competencies. The results indicate that a substantial majority of the respondents either strongly agreed or agreed that IBL enhanced their entrepreneurial competencies across all the measured dimensions. Specifically, 78% of the respondents agreed that IBL improved their problem-solving skills, while 73% reported improvements in creativity and innovation skills. Similarly, 85% affirmed that industry exposure enhanced their entrepreneurial self-efficacy, resilience and adaptability, while 83% indicated

that IBL improved their understanding of business operations and resource leverage. The findings further reveal that 81% of the respondents agreed that industry-based training strengthened their opportunity recognition, business planning and risk mitigation skills, while 76% acknowledged improvements in interpersonal relations and leadership skills. These results suggest that industry-based learning provides valuable experiential opportunities that enhance students' entrepreneurial capabilities, practical competence and workplace readiness.

Table 5: Frequency and Percentage Distribution of Responses on Industry-based Learning and Entrepreneurial Competencies

Constructs/Variables	SA 5	A 4	N 3	D 2	SD 1	Total
Industry-based learning has improved my ability to identify and solve practical problems	37 (43%)	30 (35%)	8 (9%)	3 (4%)	8 (9%)	86 (100%)
Industry-based learning has enhanced my creativity and ability to generate innovative ideas	35 (40%)	28 (33%)	10 (12%)	9 (11%)	4 (4%)	86 (100%)
Industry-based learning has increased my confidence, resilience and adaptability skill in pursuing entrepreneurial activities	41 (48%)	32 (37%)	8 (9%)	2 (2%)	3 (4%)	86 (100%)
Industry-based learning has improved my ability to understand business operations and effective resource utilization	39 (46%)	32 (37%)	8 (9%)	6 (7%)	1 (1%)	86 (100%)
Industry-based learning has enhanced my ability to identify and evaluate business opportunities, develop appropriate business plans and manage entrepreneurial risks	37 (43%)	33 (38%)	9 (11%)	4 (5%)	3 (3%)	86 (100%)
IBL has strengthened my interpersonal relations and leadership skills	33 (38%)	33 (38%)	13 (15%)	6 (8%)	1 (1%)	86 (100%)

Note: SA = Strong Agree, A = Agreed, N = Neutral, D = Disagree, SD = Strongly Disagree.

Independent Variable: Industry-Based Learning (IBL). Dependent Variable (ECD = Entrepreneurial Competency Development): ECD1 = Problem Solving Skill, ECD2 = Creativity & Innovation Skills, ECD3 = Entrepreneurial Self-Efficacy, Resilience & Adaptability Skills, ECD4 = Business Operations & Resource Leverage Skills, ECD5 = Opportunity Recognition, Business Planning & Risk Mitigation Skills, ECD6 = Interpersonal Relations and Leadership Skills.

Table 6: Descriptive Statistics of Industry-based Learning and Entrepreneurial Competencies

Constructs/Variables	Mean Score	Standard Deviation	Interpretation
Problem-solving skill (ECD1)	3.99	1.22	High
Creative and innovation skills (ECD2)	3.94	1.17	High
Entrepreneurial self-efficacy, resilience & adaptability skills (ECD3)	4.23	0.96	High
Business operations & resource leverage skills (ECD4)	4.19	0.95	High
Opportunity recognition, business planning & risk mitigation skills (ECD5)	4.13	1.01	High
Interpersonal relations & leadership skills (ECD6)	4.06	0.96	High

Table 6 shows the descriptive statistics of industry-based learning and entrepreneurial competencies of students. The analysis of the mean scores suggests that the respondents generally had a positive perception that industry-based learning (IBL) influences entrepreneurial skill

development. Across all the six constructs, the mean values ranged between 3.94 and 4.23, which indicate a trend toward agreement and strong agreement. Standard deviations ranged from 0.95 to 1.22, which reflects moderate consistency in responses. The lowest variation was found in the

item related to business operations skill [0.95] while slightly higher variability [1.22] appeared in the item that is related to problem solving skill. With the means score of 3.94 for creativity and innovativeness, it may require more tailored interventions to ensure uniform impact. The overall results indicate that industry-based

learning significantly contributes to entrepreneurial competencies.

H2: Industry-based learning does not significantly enhance entrepreneurial competencies among entrepreneurship students at the University of Delta, Nigeria.

Table 7: Spearman's rho (ρ) Correlation Analysis of Industry-based Learning and Entrepreneurial Competencies

Statistical method	Variables	Metric	IBL	Problem Solving Skill
Spearman's rho	IBL	Correlation Coefficient	1.000	0.556**
		Sig. (2-tailed)	.	0.000
		N	86	86
	Problem Solving Skill	Correlation Coefficient	0.556**	1.000
		Sig. (2-tailed)	0.000	.
		N	86	86
Spearman's rho	IBL	Correlation Coefficient	1.000	0.405**
		Sig. (2-tailed)	.	0.000
		N	86	86
	Creative and Innovation Skills	Correlation Coefficient	0.405**	1.000
		Sig. (2-tailed)	0.000	.
		N	86	86
Spearman's rho	IBL	Correlation Coefficient	1.000	0.437**
		Sig. (2-tailed)	.	0.000
		N	86	86
	Entrepreneurial Self-Efficacy, Resilience & Adaptability Skills	Correlation Coefficient	0.437**	1.000
		Sig. (2-tailed)	0.000	.
		N	86	86
Spearman's rho	IBL	Correlation Coefficient	1.000	0.505**
		Sig. (2-tailed)	.	0.000
		N	86	86
	Business Operations & Resource Leverage Skills	Correlation Coefficient	0.505**	1.000
		Sig. (2-tailed)	0.000	.
		N	86	86
Spearman's rho	IBL	Correlation Coefficient	1.000	0.430**
		Sig. (2-tailed)	.	0.000
		N	86	86
	Opportunity Recognition, Business Planning and Risk Mitigation Skills	Correlation Coefficient	0.430**	1.000
		Sig. (2-tailed)	0.000	.
		N	86	86
Spearman's rho	IBL	Correlation Coefficient	1.000	0.424**

	Sig. (2-tailed)	.	0.000
	N	86	86
Interpersonal	Correlation Coefficient	0.424**	1.000
Relations and	Sig. (2-tailed)	0.000	.
Leadership Skills	N	86	86

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

Independent Variable: Industry-Based Learning (IBL). Dependent Variable (ECD = Entrepreneurial Competency Development): ECD1 = Problem Solving Skill, ECD2 = Creativity & Innovation Skills, ECD3 = Entrepreneurial Self-Efficacy, Resilience & Adaptability Skills, ECD4 = Business Operations & Resource Leverage Skills, ECD5 = Opportunity Recognition, Business Planning & Risk Mitigation Skills, ECD6 = Interpersonal Relations and Leadership Skills.

Table 7 presents the Spearman's rho (ρ) correlation analysis of the relationship between industry-based learning (IBL) and entrepreneurial competencies of students. The results reveal that IBL had a positive and significant relationship with entrepreneurial competencies of students. The analysis showed that IBL had positive, significant and moderate correlations with problem-solving skills ($\rho = 0.556$, $p < 0.01$), creative and innovation skills ($\rho = 0.405$, $p < 0.01$), entrepreneurial self-efficacy, resilience and adaptability skills ($\rho = 0.437$, $p < 0.01$), business operations and resource leverage skills ($\rho = 0.505$, $p < 0.01$), opportunity recognition, business planning and risk mitigation skills ($\rho = 0.430$, $p < 0.01$) and interpersonal relations and leadership skills ($\rho = 0.424$, $p < 0.01$). The strongest relationship among the competency

dimensions was observed between IBL and problem-solving skills. The findings therefore demonstrate that industry-based learning serves as an effective experiential learning approach for developing entrepreneurial competencies among students. Hence, exposing learners to practical industry experiences, enhances their entrepreneurial capabilities, workplace readiness, capacity to identify and exploit business opportunities, plan and evaluate risk. These results corresponded with some research findings that exposing learners to practical industry experiences, enhances their entrepreneurial skills and capabilities, workplace readiness and preparedness for real-world business challenges (7, 21-22).

Table 8: Summary of Spearman's rho (ρ) Correlation Analysis of Industry-Based Learning and Entrepreneurial

Competencies					
Hypothesis	Variables	N	Spearman's rho (ρ)	Sig. (p-value)	Result
H1:	IBL_ECD1	86	0.556**	0.000	Significant
	IBL_ECD2	86	0.405**	0.000	Significant
	IBL_ECD3	86	0.437**	0.000	Significant
	IBL_ECD4	86	0.505**	0.000	Significant
	IBL_ECD5	86	0.430**	0.000	Significant
	IBL_ECD6	86	0.424**	0.000	Significant

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

Independent Variable: Industry-Based Learning (IBL). Dependent Variable (ECD = Entrepreneurial Competency Development): ECD1 = Problem Solving Skill, ECD2 = Creativity & Innovation Skills, ECD3 = Entrepreneurial Self-Efficacy, Resilience & Adaptability Skills, ECD4 = Business Operations & Resource Leverage Skills, ECD5 = Opportunity Recognition, Business Planning & Risk Mitigation Skills, ECD6 = Interpersonal Relations and Leadership Skills.

Table 8 summaries the Spearman correlation analysis results of industry-based learning and entrepreneurial competencies. The results indicate positive, significant and moderate relationship between IBL and problem-solving skill ($\rho = 0.556$, $p\text{-value} = 0.000$); IBL and business operations and resource leverage skills ($\rho = 0.505$, $p\text{-value} = 0.000$); IBL and entrepreneurial self-efficacy, resilience and adaptability skills ($\rho = 0.437$, $p\text{-value} = 0.000$); IBL and opportunity recognition, business planning and risk mitigation skills ($\rho = 0.430$,

$p\text{-value} = 0.000$); IBL and interpersonal relations & leadership skill ($\rho = 0.424$, $p\text{-value} = 0.000$); IBL and creative & innovation skills ($\rho = 0.405$, $p\text{-value} = 0.000$). These results imply that industry-based learning is a robust driver for developing entrepreneurial competencies

Conclusion

This study provides quantitative evidence that industry-based learning (IBL) is a significant driver of entrepreneurial competency development in higher education. The findings reveal that

entrepreneurship students at the University of Delta, Nigeria are significantly exposed to industry-based learning activities through industrial tours, fieldwork/apprenticeship training and structured industry learning environment. These factors demonstrated significant, positive and strong relationships with industry-based learning exposure, while supervision and mentorship showed a statistically significant, positive and moderate correlation while students' interest and commitment did not significantly predict exposure level. Industry-based learning exhibited consistent, positive and statistically significant relationships with all measured dimensions of entrepreneurial competencies, including problem-solving skill, creative and innovative skills, entrepreneurial self-efficacy, resilience and adaptability skills, business operations and resource leverage skills, opportunity recognition, planning and risk mitigation skills, interpersonal relations and leadership capacity. The study confirms that work-integrated and experiential learning models are not supplementary but core and basic mechanisms for developing innovation-driven graduates. These findings underscore the essence of academia-industry collaboration and experiential structures in maximizing the benefits of work-integrated learning. Industry-based learning, as an experiential pedagogical strategy, bridges the entrepreneurship education gap between theoretical instructions and practical application by equipping students with entrepreneurial competences. The study reaches a conclusion that structured industry-based learning strengthens entrepreneurial human capital development and enhances graduate readiness in the competitive labour markets for venture creation, growth and sustainability in the emerging economies. This study suggests that strengthening IBL integration could enhance entrepreneurial competencies, while further research is needed to validate these effects across diverse contexts.

Contribution to Knowledge

The study contributes to knowledge by providing empirical evidence on the determinants and competency outcomes of industry-based learning among entrepreneurship students in Nigerian higher education. It establishes that well-organized or formalized university-facilitated learning opportunities, fieldwork participation,

industrial tours, supportive industry-learning environments and effective supervision and mentorship are significant predictors of students' IBL exposure, while students' interest and commitment alone is a non-significant driver. The study further demonstrates that IBL is significantly associated with problem-solving, creativity and innovation, entrepreneurial self-efficacy, resilience and adaption, business operations and resource leverage, opportunity recognition, business planning and risk mitigation and interpersonal and leadership competencies. These findings broaden the horizon of entrepreneurship education literature through industry-based learning model that translate academic knowledge into measurable entrepreneurial competencies and provide empirical evidence for strengthening university-industry partnerships and experiential entrepreneurship curricula.

Implications and Recommendations

The findings of the study hold significant theoretical, practical and policy implications within higher education system in Nigeria under the oversight of the National Universities Commission (NUC). The results of this empirical investigation have theoretically reinforced experiential learning theory that structured industry exposure amplifies knowledge acquisition, with institutional factors expending greater influence than individual motivation in shaping industry-based learning (IBL) experiences. From the practical standpoint, the Nigeria's higher education institutions are required to reposition IBL as a key or core component of entrepreneurship education, in alignment with NUC's Core Curriculum and Minimum Academic Standards (CCMAS), a recent curriculum framework designed to improve graduate employability and align education with societal needs. The practical implication involves embedding structured internships, industrial tours, apprenticeship training and mentorship systems into entrepreneurship curricula as core requirements subject to NUC accreditation and periodic programme review. From a policy perspective, the findings accentuate the need for the National Universities Commission, in collaboration with policymakers, to institutionalize standardized IBL framework across universities in Nigeria and to strengthen university-industry partnerships for the purpose of driving sustainable

human capital development and national economic competitiveness. In the light of these implications, the study proposes the following recommendations for the Nigeria's National Universities Commission to:

- (a) Develop a mapping framework and integrate it into accreditation and quality assurance processes that will enable universities to effectively track students' IBL engagements, learning progress and entrepreneurial outcomes.
- (b) Make it mandatory for universities to establish accredited co-creation hubs through structured academia-industry partnerships that will service as innovation ecosystems to support entrepreneurship development
- (c) Promote and standardize digital collaboration platforms in line with global frameworks and initiatives that will enable students to participate in remote and hybrid industry-based learning experiences.
- (d) Facilitate the crafting of enabling policies that support global mentorship networks within the Nigerian universities to connect students with international entrepreneurs and industry experts.
- (e) Incorporate reflective journals, peer-learning platforms and collaborative knowledge-sharing mechanisms into its curriculum guidelines and accreditation benchmarks to promote continuous learning, innovation exchange and global best practices.

Abbreviations

CCMAS: Core Curriculum and Minimum Academic Standards, ECD: Entrepreneurial Competency Development, ELT: Experiential Learning Theory, FISE: Factor Influencing Students' Exposure, HCT: Human Capital Theory, IBL: Industry-Based Learning, NUC: National Universities Commission, SCT: Social Cognitive Theory, SPSS: Statistical Package for the Social Sciences, WIL: Work Integrated Learning.

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Author Contributions

The authors were responsible for the manuscript drafting, data analysis and editing.

Conflict of Interest

The authors confirm that there are no conflicts of interest regarding the publication of this work.

Data Availability

The data used in this study are available from the corresponding author upon reasonable request.

Declaration of Artificial Intelligence (AI) Assistance

The authors affirm that AI tools, including ChatGPT were used for language editing and to enhance the clarity of expression within the manuscript. The authors take full responsibility for the content's originality, interpretation and accuracy.

Ethics Approval

Ethical approval was not required for this study, as it involved minimal risk and did not include personally identifiable data. All data were handled confidentially in line with established ethical standards.

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Appendix

Table S1: Survey Responses for Testing Hypothesis One (H1)

FISE1	FISE2	FISE3	FISE4	FISE5	FISE6	Σ =FISE	WA=FISE
5.0	4.0	4.0	4.0	4.0	3.0	24	4
4.0	5.0	5.0	5.0	5.0	5.0	29	4.8
5.0	3.0	3.0	3.0	3.0	4.0	21	3.5
4.0	4.0	4.0	4.0	4.0	3.0	23	3.8
3.0	2.0	2.0	2.0	2.0	2.0	13	2.2
5.0	5.0	5.0	5.0	5.0	5.0	30	5
4.0	4.0	4.0	4.0	4.0	3.0	23	3.8
5.0	3.0	1.0	3.0	3.0	4.0	19	3.2
2.0	4.0	3.0	1.0	1.0	3.0	14	2.3
4.0	5.0	4.0	4.0	4.0	5.0	26	4.3
5.0	4.0	5.0	5.0	5.0	4.0	28	4.6
4.0	2.0	2.0	2.0	2.0	2.0	14	2.3
1.0	4.0	4.0	4.0	4.0	3.0	20	3.3
5.0	5.0	5.0	5.0	5.0	5.0	30	5
4.0	3.0	3.0	3.0	3.0	4.0	20	3.3
5.0	4.0	4.0	4.0	4.0	3.0	24	4
3.0	5.0	5.0	5.0	5.0	5.0	28	5
4.0	4.0	4.0	4.0	4.0	3.0	23	3.8
5.0	2.0	1.0	2.0	2.0	4.0	16	2.7
4.0	4.0	4.0	4.0	4.0	3.0	23	3.8
5.0	5.0	5.0	5.0	5.0	5.0	30	5
2.0	3.0	3.0	3.0	3.0	3.0	17	2.8
4.0	4.0	4.0	4.0	4.0	4.0	24	4
5.0	5.0	1.0	1.0	1.0	1.0	14	2.3
4.0	4.0	5.0	5.0	5.0	5.0	28	4.7
5.0	1.0	4.0	4.0	4.0	3.0	21	3.5
1.0	5.0	3.0	3.0	3.0	4.0	19	3.2
4.0	4.0	4.0	4.0	4.0	3.0	23	3.8
5.0	3.0	5.0	5.0	5.0	5.0	28	4.7
4.0	4.0	2.0	2.0	2.0	2.0	16	2.7
5.0	5.0	4.0	5.0	4.0	4.0	27	4.5
3.0	4.0	5.0	4.0	5.0	5.0	26	4.3
4.0	2.0	3.0	3.0	3.0	3.0	18	3
5.0	5.0	4.0	4.0	4.0	4.0	26	4.3
4.0	4.0	5.0	5.0	5.0	5.0	28	4.7
5.0	3.0	2.0	2.0	2.0	2.0	16	2.7
2.0	4.0	4.0	4.0	4.0	3.0	21	3.5
4.0	5.0	5.0	5.0	5.0	5.0	29	4.8
5.0	4.0	3.0	3.0	3.0	4.0	22	3.7
4.0	2.0	4.0	4.0	4.0	3.0	21	3.5
5.0	4.0	1.0	1.0	1.0	5.0	17	2.8
1.0	5.0	5.0	5.0	5.0	4.0	25	4.2
4.0	3.0	4.0	4.0	4.0	3.0	22	3.7
5.0	4.0	3.0	3.0	3.0	2.0	20	3.3
4.0	5.0	2.0	2.0	2.0	3.0	18	3
5.0	4.0	4.0	4.0	4.0	5.0	26	4.3
3.0	2.0	5.0	5.0	5.0	4.0	24	4
4.0	5.0	3.0	3.0	3.0	3.0	21	3.5
5.0	4.0	4.0	4.0	4.0	5.0	26	4.3
4.0	3.0	5.0	5.0	5.0	4.0	26.0	4.3
5.0	4.0	1.0	2.0	2.0	3.0	17.0	2.8
2.0	5.0	4.0	4.0	4.0	2.0	21.0	3.5
4.0	4.0	5.0	5.0	5.0	3.0	26.0	4.3

5.0	2.0	3.0	3.0	3.0	5.0	21.0	3.5
4.0	4.0	4.0	4.0	4.0	4.0	24.0	4
5.0	5.0	1.0	1.0	1.0	3.0	16.0	2.7
1.0	3.0	5.0	5.0	5.0	5.0	24.0	4
4.0	4.0	4.0	4.0	4.0	4.0	24.0	4
5.0	5.0	3.0	3.0	3.0	3.0	22.0	3.7
4.0	4.0	2.0	2.0	2.0	2.0	16.0	2.7
5.0	2.0	4.0	4.0	4.0	3.0	22.0	3.7
4.0	5.0	5.0	5.0	5.0	5.0	29.0	4.8
5.0	4.0	3.0	3.0	3.0	4.0	22.0	3.7
4.0	3.0	4.0	4.0	4.0	3.0	22.0	3.7
5.0	4.0	5.0	5.0	5.0	5.0	29.0	4.8
4.0	5.0	1.0	1.0	2.0	4.0	17.0	2.8
5.0	4.0	4.0	4.0	4.0	3.0	24.0	4
4.0	1.0	5.0	5.0	5.0	1.0	21.0	3.5
5.0	5.0	3.0	3.0	3.0	3.0	22.0	3.7
4.0	4.0	2.0	2.0	2.0	5.0	19.0	3.2
5.0	3.0	4.0	4.0	4.0	4.0	24.0	4
4.0	4.0	5.0	5.0	5.0	3.0	26.0	4.3
5.0	5.0	3.0	3.0	3.0	5.0	24.0	4
4.0	4.0	4.0	4.0	4.0	4.0	24.0	4
5.0	2.0	1.0	1.0	1.0	3.0	13.0	2.2
4.0	5.0	5.0	5.0	5.0	4.0	28.0	4.7
5.0	4.0	2.0	2.0	2.0	5.0	20.0	3.3
4.0	3.0	4.0	4.0	4.0	3.0	22.0	3.7
5.0	4.0	5.0	5.0	5.0	4.0	28.0	4.7
4.0	5.0	1.0	3.0	3.0	5.0	21.0	3.5
1.0	4.0	4.0	1.0	1.0	3.0	14.0	2.3
5.0	5.0	1.0	4.0	2.0	4.0	21.0	3.5
4.0	4.0	2.0	2.0	2.0	5.0	19.0	3.2
5.0	5.0	5.0	5.0	5.0	3.0	28.0	4.7
4.0	4.0	1.0	1.0	2.0	4.0	16.0	2.7
5.0	5.0	4.0	4.0	4.0	5.0	27.0	4.5

Note: FISE = Factors Influencing Students' Exposure, FISE1 = Students' Interest & Commitment, FISE2 = University Facilitated Learning Opportunities, FISE3 = Students' Participation in Field Work, FISE4 = Industrial Tour Engagement, FISE5 = Industry Learning Environment, FISE6 = Quality of Supervision & Mentorship.

Table S2: Survey Responses for Testing Hypothesis Two (H2)

IBL_ECD1	IBL_ECD2	IBL_ECD3	IBL_ECD4	IBL_ECD5	IBL_ECD6	Σ =IBL_ECD	WA=IBL_ECD
5.0	5.0	5.0	5.0	5.0	5.0	30	5
4.0	4.0	4.0	4.0	4.0	4.0	24	4
3.0	2.0	3.0	3.0	3.0	3.0	17	2.8
5.0	5.0	5.0	5.0	5.0	5.0	30	5
1.0	3.0	4.0	2.0	4.0	4.0	18	3
4.0	4.0	5.0	4.0	5.0	5.0	27	4.5
5.0	5.0	1.0	5.0	2.0	2.0	20	3.3
2.0	1.0	4.0	4.0	4.0	4.0	19	3.2
4.0	4.0	5.0	5.0	5.0	5.0	28	4.7
5.0	5.0	3.0	3.0	1.0	3.0	20	3.3
3.0	2.0	5.0	5.0	4.0	4.0	23	3.8
4.0	5.0	4.0	4.0	5.0	5.0	27	4.5
5.0	4.0	5.0	5.0	3.0	4.0	26	4.3
1.0	3.0	2.0	2.0	4.0	5.0	17	2.8
5.0	5.0	4.0	4.0	5.0	3.0	26	4.3
4.0	4.0	5.0	5.0	2.0	4.0	24	4
2.0	2.0	3.0	3.0	5.0	5.0	20	3.3
5.0	5.0	4.0	4.0	4.0	2.0	24	4
3.0	4.0	5.0	5.0	5.0	4.0	26	4.3

4.0	5.0	4.0	4.0	3.0	5.0	25	4.2
5.0	1.0	1.0	5.0	4.0	3.0	19	3.2
5.0	3.0	5.0	3.0	5.0	4.0	25	4.2
1.0	4.0	3.0	4.0	4.0	5.0	21	3.5
4.0	5.0	4.0	5.0	5.0	4.0	27	4.5
3.0	2.0	5.0	2.0	1.0	5.0	18	3
5.0	5.0	5.0	4.0	4.0	3.0	26	4.3
4.0	4.0	4.0	5.0	5.0	4.0	26	4.3
5.0	5.0	5.0	4.0	3.0	5.0	27	4.5
2.0	3.0	4.0	5.0	5.0	2.0	21	3.5
4.0	4.0	3.0	3.0	4.0	4.0	22	3.7
5.0	5.0	5.0	5.0	5.0	5.0	30	5
1.0	2.0	4.0	4.0	2.0	4.0	17	2.8
5.0	4.0	5.0	5.0	4.0	5.0	28	4.7
4.0	5.0	4.0	4.0	5.0	3.0	25	4.2
3.0	3.0	5.0	5.0	3.0	4.0	23	3.8
5.0	5.0	3.0	3.0	4.0	5.0	25	4.2
5.0	4.0	4.0	4.0	5.0	4.0	26	4.3
4.0	1.0	5.0	5.0	4.0	5.0	24	4
1.0	5.0	4.0	2.0	5.0	3.0	20	3.3
3.0	2.0	5.0	4.0	1.0	4.0	19	3.2
5.0	4.0	2.0	5.0	3.0	5.0	24	4
4.0	5.0	4.0	3.0	5.0	2.0	23	3.8
5.0	3.0	5.0	4.0	4.0	4.0	25	4.2
1.0	4.0	3.0	5.0	5.0	5.0	23	3.8
4.0	5.0	4.0	5.0	4.0	3.0	25	4.2
5.0	2.0	5.0	4.0	5.0	4.0	25	4.2
3.0	5.0	5.0	5.0	2.0	5.0	25	4.2
4.0	4.0	4.0	4.0	4.0	4.0	24	4
5.0	3.0	5.0	5.0	5.0	5.0	28	4.7
5.0	5.0	4.0	2.0	3.0	3.0	22	3.7
1.0	4.0	1.0	4.0	4.0	4.0	18.0	3
4.0	5.0	5.0	5.0	5.0	5.0	29.0	4.8
3.0	2.0	4.0	3.0	4.0	4.0	20.0	3.3
5.0	4.0	3.0	4.0	5.0	5.0	26.0	4.3
4.0	5.0	5.0	5.0	4.0	3.0	26.0	4.3
5.0	3.0	4.0	4.0	5.0	4.0	25.0	4.2
5.0	4.0	5.0	5.0	3.0	5.0	27.0	4.5
4.0	5.0	4.0	4.0	4.0	2.0	23.0	3.8
5.0	1.0	5.0	5.0	5.0	4.0	25.0	4.2
3.0	5.0	5.0	2.0	4.0	5.0	24.0	4
4.0	4.0	4.0	4.0	5.0	4.0	25.0	4.2
5.0	3.0	5.0	5.0	4.0	5.0	27.0	4.5
4.0	5.0	4.0	4.0	5.0	3.0	25.0	4.2
5.0	4.0	5.0	5.0	4.0	4.0	27.0	4.5
5.0	5.0	4.0	1.0	5.0	5.0	25.0	4.2
4.0	2.0	5.0	4.0	4.0	4.0	23.0	3.8
5.0	4.0	4.0	5.0	5.0	5.0	28.0	4.7
4.0	5.0	5.0	4.0	4.0	3.0	25.0	4.2
5.0	3.0	4.0	5.0	5.0	4.0	26.0	4.3
5.0	4.0	5.0	4.0	3.0	5.0	26.0	4.3
4.0	5.0	4.0	5.0	4.0	2.0	24.0	4
5.0	4.0	5.0	4.0	5.0	4.0	27.0	4.5
4.0	5.0	4.0	5.0	4.0	5.0	27.0	4.5
5.0	4.0	5.0	4.0	5.0	4.0	27.0	4.5
5.0	5.0	4.0	5.0	4.0	5.0	28.0	4.7
4.0	4.0	5.0	4.0	5.0	3.0	25.0	4.2

5.0	5.0	4.0	5.0	3.0	4.0	26.0	4.3
4.0	4.0	5.0	4.0	4.0	5.0	26.0	4.3
5.0	5.0	4.0	5.0	5.0	4.0	28.0	4.7
5.0	4.0	5.0	4.0	4.0	5.0	27.0	4.5
4.0	5.0	4.0	5.0	5.0	3.0	26.0	4.3
5.0	4.0	5.0	4.0	4.0	4.0	26.0	4.3
4.0	5.0	4.0	5.0	5.0	5.0	28.0	4.7
5.0	4.0	5.0	4.0	4.0	1.0	23.0	3.8
5.0	5.0	4.0	5.0	5.0	4.0	28.0	4.7
4.0	5.0	5.0	4.0	4.0	5.0	27.0	4.5

Note: Industry-Based Learning (IBL), ECD = Entrepreneurial Competency Development, ECD1 = Problem Solving Skill, ECD2 = Creativity & Innovation Skills, ECD3 = Entrepreneurial Self-Efficacy, Resilience & Adaptability Skills, ECD4 = Business Operations & Resource Leverage Skills, ECD5 = Opportunity Recognition, Business Planning & Risk Mitigation Skills, ECD6 = Interpersonal Relations and Leadership Skills.