

From Innovation Intention to Practice in Teacher Education: Commercialisation Awareness, Ethical Motivation and Institutional Support Among Pre-Service Teachers in Nigeria

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Abstract: This study examined how commercialisation awareness, ethical motivation, institutional support and prior innovation or entrepreneurship experience are associated with science innovation engagement among pre-service teachers in Nigeria. A cross-sectional survey was conducted with 300 National Certificate in Education students drawn from a state college of education in Southern Kaduna. Data were collected with the Science Innovation, Commercialisation, and Ethical Motivation Scale and analysed using descriptive statistics, Pearson correlations, multiple regression, t-tests and ANOVA. Students reported favourable innovation orientations, but institutional support and direct participation in practical innovation activities were comparatively weaker. Commercialisation awareness, ethical motivation and institutional support jointly explained 60.7% of the variance in innovation engagement. Prior innovation or entrepreneurship experience was associated with higher engagement and commercialisation awareness. The findings suggest an intention-to-practice gap in teacher education and indicate the value of experiential innovation opportunities, commercialisation literacy, ethical reflection and stronger institutional support for pre-service teachers.

Keywords: Commercialisation Awareness; Ethical Motivation; Institutional Support; Pre-Service Teachers; Science Innovation; Teacher Education.

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I. INTRODUCTION

Teacher education is expected to prepare future teachers not only to transmit established knowledge but also to respond to changing social, technological and economic conditions. For pre-service teachers in science and vocational fields, this expectation includes the capacity to recognise problems, generate workable ideas, evaluate their social consequences and translate knowledge into forms that can be used in schools and communities. Innovation in teacher education is therefore not reducible to entrepreneurship training. It concerns whether future teachers develop the knowledge, confidence, ethical

orientation and institutional opportunities required to move from interest in innovation to practical engagement.

Higher education research increasingly treats innovation as an ecosystem process in which learners interact with institutional structures and wider social and economic actors. The Triple Helix perspective, for example, emphasises relationships among higher education, government and industry in knowledge mobilisation (Etzkowitz & Zhou, 2018). Research with non-business students similarly suggests that entrepreneurship education becomes more meaningful when learners interact with university and external ecosystems rather than encountering entrepreneurship only as an abstract

curricular topic (Rocha et al., 2024). These arguments are relevant to teacher education because pre-service teachers may eventually influence how school learners encounter creativity, enterprise and responsible problem-solving.

A central difficulty is the gap between favourable attitudes toward innovation and the practical knowledge required to develop an idea. Commercialisation literacy includes awareness of processes such as intellectual-property protection, funding, market assessment, prototyping, partnership and implementation. Yedgenov et al. (2025) show that effective commercialisation depends on both competence and institutional conditions. In teacher education, commercialisation should not be interpreted as directing all students toward business careers. It can instead refer to understanding how scientific, educational or community-oriented ideas move from conception to usable products, services or interventions.

Innovation also has an ethical dimension. Decisions about what problems deserve attention, who benefits, what risks are acceptable and how communities are involved are part of responsible innovation. Stilgoe et al. (2013) conceptualised responsible innovation through anticipation, reflexivity, inclusion and responsiveness, while Ogoh et al. (2023) emphasised the need to develop capabilities for responsible research and innovation. Børsen and Mehlich (2024) further demonstrate the relevance of responsible innovation to tertiary science education. For future teachers, ethical motivation may therefore shape whether innovation is understood merely as novelty or as socially responsible problem-solving.

Nigerian research on entrepreneurship education has often concentrated on university students, entrepreneurial intention and start-up readiness. Adeniyi (2023), for example, found entrepreneurial self-efficacy to be important in the relationship between entrepreneurship education and start-up readiness. Such research is useful, but colleges of education remain less visible in the literature. This matters because teacher-education institutions occupy a distinctive position: their students are simultaneously higher-education learners and future professionals who may transmit innovation-related dispositions to subsequent generations.

The present study addresses this gap by examining innovation engagement among pre-service teachers in a Nigerian college of education. Rather than asking only whether students are interested in innovation, it considers whether their engagement is associated with commercialisation awareness, ethical motivation, perceived institutional support and prior practical experience. The study is guided by four questions: What are the levels of science innovation engagement, commercialisation awareness and attitudes, ethical motivation and perceived institutional support? How are these constructs related? To what extent do commercialisation awareness, ethical motivation and institutional support statistically predict innovation engagement? Do the constructs vary by gender, prior innovation or entrepreneurship experience and level of study? The study contributes to educational innovation research by

locating the intention-to-practice problem within initial teacher preparation in a resource-constrained higher-education context.

➤ *Theoretical and Empirical Framework*

• *Social Cognitive Theory and innovation engagement*

The study is anchored in Social Cognitive Theory (SCT), which explains human functioning through reciprocal relations among personal factors, behaviour and environmental conditions (Bandura, 1986, 1997, 2001). This framework is appropriate because innovation engagement is unlikely to depend on a single attitude. A student may value innovation but lack opportunities to practise it, receive encouragement but lack procedural knowledge, or develop stronger confidence after successful prior experience.

In this study, commercialisation-related cognition and ethical motivation are treated primarily as personal factors, prior innovation or entrepreneurship experience as behavioural history and mastery exposure, and institutional support as an environmental condition. SCT therefore provides a coherent way to interpret how these domains may coexist and reinforce one another. Because the design is cross-sectional, however, reciprocal causation is not tested. Regression coefficients are interpreted as statistical prediction and association rather than evidence that one construct temporally causes another.

• *Innovation, Commercialisation and Institutional Opportunity*

An ecosystem perspective complements SCT by drawing attention to the institutional conditions through which individual capability can become action. Etzkowitz and Zhou (2018) emphasise interaction among higher education, government and industry, while Rocha et al. (2024) show that entrepreneurship education for non-business students is strengthened by social learning across students, universities and external actors. Where mentoring, collaborative spaces, prototyping opportunities or routes to external knowledge are weak, curricular encouragement may not translate into practical participation.

Commercialisation awareness is especially relevant because it connects idea generation with implementation. Yedgenov et al. (2025) identify competence, institutional support and market-oriented processes among the determinants of scientific-project commercialisation. For pre-service teachers, this knowledge may support educational or community innovation even where students do not intend to establish conventional businesses. The educational issue is therefore whether teacher preparation equips students to understand pathways by which ideas become usable solutions.

• *Ethical Motivation and Prior Experience*

Responsible innovation scholarship challenges the assumption that innovation quality can be assessed solely by novelty or market potential. Ethical reflection requires attention to anticipated consequences, inclusion and responsiveness (Stilgoe et al., 2013). More recent work argues that responsible research and innovation requires deliberate

capability development (Ogoh et al., 2023), while Uriarte et al. (2025) show that ethics and entrepreneurship increasingly intersect around sustainability, social entrepreneurship and responsible decision-making.

SCT also gives particular importance to mastery experience as a source of self-efficacy (Bandura, 1997). Students who have participated in innovation projects, competitions, exhibitions or entrepreneurship activities may therefore possess more concrete reference points for evaluating opportunities and constraints. Newman et al. (2019), in a systematic review of entrepreneurial self-efficacy, similarly identify experience and contextual antecedents as important to entrepreneurial cognition. This provides a basis for comparing students with and without prior innovation or entrepreneurship experience.

II. MATERIALS AND METHODS

➤ *Design, Setting and Participants*

A quantitative cross-sectional survey design was used to describe the study constructs and examine statistical relationships among them without manipulating the study environment. The study was conducted in a state college of education in Southern Kaduna, Nigeria. The target population comprised 1,828 National Certificate in Education (NCE) students from the School of Sciences and Vocational Technology across NCE I, II and III and twelve departments.

The initial sample allocation was 328 students, determined using Yamane's (1967) formula. Stratified proportionate random sampling was applied across departments and levels of study, with a minimum-quota adjustment for smaller departments. Data screening addressed duplicate identification numbers, missing values, out-of-range responses and incorrectly calculated composite scores. After screening, 300 usable records were retained.

➤ *Instrument and Measures*

Data were collected using the 55-item Science Innovation, Commercialisation, and Ethical Motivation Scale (SICEMS). The administered instrument contained four subscales: Science Innovation Engagement Scale (SIES, 15 items), Commercialisation Awareness and Attitudes Scale (CAAS, 15 items), Ethical Motivation Scale (EMS, 15 items) and Institutional Support Scale (ISS, 10 items). Responses were recorded on a four-point Likert-type scale. Following scoring-key review and item-level reliability diagnostics, 52 items were retained for final analytical composites: SIES (14), CAAS (14), EMS (15) and ISS (9). For descriptive interpretation, means of 1.00-1.49 were classified as very low, 1.50-2.49 as low, 2.50-3.49 as high and 3.50-4.00 as very high.

Expert review was used to assess content and face validity. Internal consistency was examined with Cronbach's alpha, corrected item-total correlations and alpha-if-item-deleted diagnostics. In the initial 55-item configuration, alpha was .735 for SIES, .662 for CAAS, .830 for EMS, .717 for ISS and .900 overall. A scoring review showed that CAAS30 and EMS41 had been marked for reversal although agreement

represented higher levels of their intended constructs; both were therefore retained in their original response direction. Three negatively worded items behaved inconsistently after reverse scoring: SIES12 (corrected item-total $r = -.069$), CAAS23 ($r = -.267$) and ISS51 ($r = -.242$). Their removal improved subscale consistency. The refined scales produced alpha values of .769 for SIES, .727 for CAAS, .830 for EMS, .788 for ISS and .915 for the 52-item overall SICEMS.

The refinement was undertaken in the same sample used for substantive analysis. The resulting 52-item configuration is therefore treated as a sample-refined analytical structure rather than an independently validated measurement model. Independent replication and factor-analytic validation are required before the refined configuration is treated as established.

➤ *Data Analysis*

Descriptive statistics summarised respondent characteristics and construct scores. Two missing ISS48 responses were replaced using respondent-level person-mean imputation across the remaining available ISS items; all other item responses were complete. Pearson correlations assessed bivariate relationships. Multiple linear regression estimated the independent statistical contribution of commercialisation awareness and attitudes, ethical motivation and institutional support to science innovation engagement. Independent-samples t-tests and one-way ANOVA examined group differences. Statistical significance was set at $p < .05$, and variance inflation factor (VIF) values were inspected for multicollinearity. Because the study is cross-sectional, all regression results are interpreted as predictive associations rather than causal effects.

➤ *Ethical Procedures*

The study institution granted permission before data collection. Participants were informed about the purpose of the study, that participation was voluntary, that they could withdraw without penalty, and that responses would be treated confidentially. Informed consent was obtained before participation. No personally identifiable information was collected. The study did not receive separate approval from a formal institutional research ethics board; the manuscript therefore reports institutional permission and informed consent without representing these procedures as formal ethics-board clearance.

III. RESULTS

➤ *Respondent Characteristics*

The analysed sample comprised 300 students: 162 (54.0%) female and 138 (46.0%) male. Most respondents were aged 18-21 years (63.3%), followed by 22-25 years (34.0%). NCE II students represented 49.3% of the sample, NCE I 40.7% and NCE III 10.0%. Slightly more than half (54.7%) reported prior innovation or entrepreneurship experience.

Table 1 Selected Demographic and Background Characteristics (N = 300).

Characteristic	Category	n (%)
Gender	Male	138 (46.0)
	Female	162 (54.0)
Age	18-21 years	190 (63.3)
	22-25 years	102 (34.0)
	26-29 years	2 (0.7)
	30 years and above	6 (2.0)
Level	NCE I	122 (40.7)
	NCE II	148 (49.3)
	NCE III	30 (10.0)
Prior innovation/entrepreneurship experience	No	136 (45.3)
	Yes	164 (54.7)

➤ Levels and Relationships Among the Constructs

All four refined constructs fell within the study's high interpretive range. Ethical motivation recorded the highest mean ($M = 3.204$, $SD = 0.407$), followed by commercialisation awareness and attitudes ($M = 3.105$, $SD = 0.348$), science innovation engagement ($M = 3.095$, $SD = 0.382$) and institutional support ($M = 2.799$, $SD = 0.541$). Institutional support also showed the greatest variability. At item level, interest in further science and technology training

and in using science for community development was stronger than direct participation in product design, competitions and exhibitions. Commercialisation attitudes were favourable, while practical knowledge of intellectual property, funding mechanisms and commercialisation processes was comparatively weaker. This pattern suggests an intention-to-practice gap rather than a simple absence of innovation interest.

Table 2 Descriptive Statistics and Reliability of the Refined SICEMS Constructs.

Construct	Items	M	SD	Cronbach's α
SIES	14	3.095	0.382	.769
CAAS	14	3.105	0.348	.727
EMS	15	3.204	0.407	.830
ISS	9	2.799	0.541	.788
Overall SICEMS	52	3.078	0.337	.915

All correlations among the four constructs were positive and statistically significant ($p < .001$). The strongest association was between science innovation engagement and commercialisation awareness and attitudes ($r = .751$). Science innovation engagement was also positively associated with ethical motivation ($r = .607$) and institutional support ($r = .508$). Commercialisation awareness correlated with ethical motivation ($r = .636$) and institutional support ($r = .512$), while ethical motivation and institutional support were more moderately associated ($r = .423$).

➤ Statistical Predictors of Innovation Engagement

Commercialisation awareness and attitudes, ethical motivation and institutional support jointly explained 60.7% of the variance in science innovation engagement, $R^2 = .607$, adjusted $R^2 = .603$, $F(3, 296) = 152.38$, $p < .001$. Commercialisation awareness and attitudes made the largest independent statistical contribution ($\beta = .555$), followed by ethical motivation ($\beta = .195$) and institutional support ($\beta = .141$). VIF values of 1.385-1.910 did not indicate problematic multicollinearity.

Table 3 Multiple Regression Predicting Science Innovation Engagement.

Predictor	B	SE	β	p	VIF
Commercialisation awareness & attitudes	0.610	0.055	.555	< .001	1.910
Ethical motivation	0.183	0.045	.195	< .001	1.715
Institutional support	0.100	0.030	.141	.001	1.385

➤ Group Comparisons

No statistically significant gender differences were found on the refined constructs or overall SICEMS score (all $p > .05$). Students with prior innovation or entrepreneurship experience recorded higher scores than those without such experience on science innovation engagement ($p < .001$), commercialisation awareness and attitudes ($p = .009$), institutional support ($p = .025$) and overall SICEMS ($p = .008$), but not ethical motivation ($p = .581$). ANOVA by level of study showed no statistically significant differences in science innovation engagement ($F = 3.00$, $p = .051$) or ethical

motivation ($F = 0.37$, $p = .689$), but small differences for commercialisation awareness ($F = 3.58$, $p = .029$, $\eta^2 = .024$), institutional support ($F = 5.14$, $p = .006$, $\eta^2 = .033$) and overall SICEMS ($F = 3.45$, $p = .033$, $\eta^2 = .023$). Tukey comparisons indicated that NCE III students scored higher than NCE II students on commercialisation awareness ($p = .030$), while NCE I students reported higher institutional support than NCE II students ($p = .016$).

IV. DISCUSSION

The findings indicate that the central educational issue is not a lack of interest in innovation but a gap between favourable orientation and practical opportunity. Students reported high science innovation engagement, commercialisation awareness and ethical motivation, yet institutional support had the lowest mean and practical participation in product development, competitions and exhibitions was comparatively weaker. In a teacher-education context, this distinction is consequential. Future teachers may value innovation while still lacking the institutional pathways through which innovative ideas can be tested, refined and translated into practice.

The strong association between commercialisation awareness and innovation engagement suggests that practical knowledge about how ideas move toward implementation may be closely connected to students' willingness to engage in innovation. This is consistent with the social-learning argument that entrepreneurship education for non-business students is strengthened when learners interact with broader institutional and external ecosystems (Rocha et al., 2024). It also accords with evidence that innovation intentions are shaped by both psychological and opportunity-related resources (Tahan, 2025). For teacher education, commercialisation literacy can therefore be understood as implementation literacy: knowledge that helps future teachers see a route from an idea to a usable educational, scientific or community solution.

Institutional support recorded the lowest construct mean and the greatest variability. This suggests that encouragement and personal readiness may develop more quickly than infrastructure and opportunity. Ecosystem perspectives emphasise collaborative spaces, external knowledge and institutional capability as conditions for open innovation (Jekabsone & Anohina-Naumeca, 2024). The present results extend that concern to initial teacher preparation. A teacher-education institution may communicate that innovation is desirable while providing uneven access to mentors, prototyping resources, competitions, funding information or external partnerships.

Ethical motivation remained independently associated with innovation engagement after commercialisation awareness and institutional support were included in the regression model. This finding supports treating responsible innovation as part of innovation capability rather than as an additional compliance topic. It is compatible with the emphasis on anticipation, reflexivity and responsiveness in responsible innovation (Stilgoe et al., 2013) and with arguments for deliberate capability development (Ogoh et al., 2023). For pre-service teachers, this is particularly relevant because professional preparation already involves questions of responsibility, learner welfare, community needs and the social consequences of educational decisions.

Prior innovation or entrepreneurship experience was associated with higher innovation engagement, commercialisation awareness, institutional support and overall

SICEMS scores. This pattern is consistent with SCT's emphasis on mastery experience (Bandura, 1997) and with broader evidence that experience and contextual antecedents contribute to entrepreneurial self-efficacy (Newman et al., 2019). Ethical motivation, however, did not differ significantly by prior experience. The data do not identify the sources of ethical motivation, so explanations based on culture, religion, family or community would require separate investigation.

No statistically significant gender differences were observed in the measured constructs. This should not be interpreted as evidence that gender is irrelevant to innovation opportunities. Rather, within this sample and these measures, male and female students reported broadly comparable orientations. Future research should distinguish mean attitudinal differences from possible differences in access to resources, mentoring, networks and opportunities.

Taken together, the findings support a teacher-education model in which innovation preparedness involves personal cognition and values, behavioural experience and environmental opportunity. The contribution to SCT is deliberately limited: the cross-sectional design cannot establish reciprocal causation. Nevertheless, the study demonstrates how the SCT triad can organise an educational innovation problem in which personal readiness appears stronger than institutional opportunity. The Nigerian college-of-education setting also broadens a literature that has more often examined university students and conventional entrepreneurship outcomes.

V. IMPLICATIONS FOR TEACHER EDUCATION

Teacher-education institutions can respond to the intention-to-practice gap by embedding structured innovation experiences within initial preparation. These experiences could include interdisciplinary challenges, prototype development, exhibitions, community problem-solving, mentoring and guided participation in innovation or entrepreneurship programmes. Commercialisation education should be adapted to the professional context of future teachers and include practical knowledge of intellectual property, funding, user needs, implementation and partnership.

Responsible innovation should be integrated into these activities rather than taught separately. Students can be required to consider who benefits from an innovation, what evidence supports it, what risks it creates and how users or communities should participate in its development. Institutional support also needs to move beyond encouragement toward accessible infrastructure and relationships with universities, industry, government agencies and community organisations. Such arrangements would allow teacher education to connect creativity with implementation while retaining its educational and social mission.

VI. LIMITATIONS AND FUTURE RESEARCH

The findings should be interpreted within several limitations. First, the study was conducted in one college of education and should not be generalised to all Nigerian teacher-education institutions without replication. Second, the cross-sectional design does not establish temporal or causal direction. Third, all measures were self-reported and may be affected by social desirability and common-method variance. Fourth, the 52-item analytical configuration was refined using item diagnostics from the same sample in which substantive analyses were conducted; independent validation is therefore required. Fifth, NCE III students and some smaller departments were underrepresented. Future studies should use multi-institutional and longitudinal designs, behavioural indicators of innovation participation, and independent exploratory and confirmatory factor analysis of SICEMS. Qualitative work could also examine how pre-service teachers understand commercialisation, ethical responsibility and the institutional conditions that enable or constrain innovation.

VII. CONCLUSION

Pre-service teachers in this study reported favourable orientations toward science innovation, commercialisation and ethical responsibility, but their practical participation and perceptions of institutional support were less developed. Commercialisation awareness showed the strongest statistical association with innovation engagement, while ethical motivation and institutional support also contributed independently. Prior innovation or entrepreneurship experience was associated with stronger engagement and commercialisation awareness. The findings therefore locate a significant teacher-education challenge between intention and practice. Preparing future teachers for innovation requires more than encouraging creativity: it requires practical implementation knowledge, ethically informed decision-making, experiential learning and institutional pathways through which ideas can be developed and tested.

DECLARATIONS

- Competing interests: The authors declare no competing interests.
- Funding: This research was funded by the Tertiary Education Trust Fund (TETFund).
- Data availability: Anonymised data supporting the findings are available from the corresponding author upon reasonable request, subject to the confidentiality and consent conditions under which the data were collected.
- Ethics and consent: The study followed the approval procedure available for this project at the study institution. College management granted institutional permission before data collection. Participants were informed about the purpose of the study, voluntary participation, confidentiality and their right to withdraw, and informed consent was obtained before participation. No personally identifiable information was collected. Separate formal research ethics board approval was not obtained.

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