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Integrating Experiential Learning and AI Simulations to Foster Soft Skills Development in Technology Graduates

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ABSTRACT

The modern workplace increasingly values soft skills such as communication, teamwork, emotional intelligence, and adaptability alongside technical expertise. Yet, many STEM programs in developing countries continue to prioritize technical instruction over interpersonal competence, leaving graduates ill-prepared for collaborative, real-world challenges. This study explores a hybrid educational approach that combines experiential learning with artificial intelligence (AI)-driven simulations to enhance soft skills development among final-year technology students at the Federal Polytechnic Ede, Nigeria. Using a quasi-experimental, mixed-methods design, the study evaluated the outcomes of 120 students divided into control and experimental cohorts. Quantitative findings from pre- and post-intervention assessments indicated significant improvements in all measured soft skills among students exposed to the hybrid model. Complementary qualitative data revealed enhanced learner confidence, improved engagement, and the perceived authenticity of AI-generated workplace scenarios. The integration of AI simulations provided adaptive feedback and risk-free environments for practice, while experiential learning activities facilitated critical reflection and behavior change. Although infrastructural and adoption challenges were noted, the results strongly support the model's efficacy and scalability in addressing soft skills gaps in STEM education. The study recommends institutionalizing experiential–AI modules within core curricula, targeted faculty development, and strategic investments in digital infrastructure to ensure equitable access and sustainable implementation.

Keywords: Soft Skills Development, STEM, Experiential Learning, Artificial Intelligence, AI Simulations in Education, Technology Graduates Employability

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1. INTRODUCTION

In today's rapidly evolving digital and interconnected economy, technical proficiency alone is no longer sufficient for career success. The demands of the 21st-century workforce have shifted to emphasize a hybrid of hard and soft skills, with employers now prioritizing competencies such as effective communication, collaboration, adaptability, emotional intelligence, and leadership alongside technical expertise (World Economic Forum, 2023). In technology-oriented fields including software engineering, data science, cybersecurity, and information systems, graduates frequently possess advanced technical capabilities but lack the interpersonal and leadership skills required to excel in cross-functional teams, manage client relations, and drive innovation (Araújo et al., 2025; Nigerian Bureau of Statistics, 2024).

This challenge is especially acute in developing countries, where tertiary education still leans heavily toward rote learning and theoretical mastery rather than applied, human-centered competencies (UNESCO, 2024). As the nature of work becomes increasingly team-oriented, globalized, and innovation-driven, technology graduates who lack interpersonal and cognitive soft skills find themselves at a disadvantage in both local and international labor markets (OECD, 2023; Araújo et al., 2025). Recent Nigerian labor market reports reinforce this trend, showing that while technical STEM graduates are abundant, those with demonstrable soft skills secure higher-quality employment faster (Nigerian Bureau of Statistics, 2024).

Although the skills gap is widely recognized, most tertiary institutions have struggled to embed soft skills training within already packed STEM curricula (Onyema & Adekunle, 2024). Traditional interventions such as short workshops, seminars, or standalone communication courses tend to lack contextual relevance, scalability, and authentic, feedback-rich engagement (UNESCO, 2024). Consequently, these methods fail to produce sustained behavioral change or transferable interpersonal competencies.

Emerging pedagogical models offer a promising solution. Experiential learning, grounded in Kolb's Experiential Learning Cycle, emphasizes learning by doing, reflecting, conceptualizing, and applying an approach that naturally aligns with developing interpersonal competencies (Kolb, 2015). When integrated with artificial intelligence (AI)-driven simulation technologies, experiential learning can be transformed into a dynamic, personalized, and realistic training environment. AI-enabled simulations allow students to practice workplace scenarios such as conflict resolution, leadership challenges, negotiations, and client interactions, while receiving immediate, adaptive feedback to guide their growth (Mollick et al., 2024; Times of India, 2025; NITDA, 2025).

This study therefore proposes and evaluates a hybrid learning model combining AI simulations and experiential learning within the Nigerian Polytechnic context. By grounding the research in a real-world institutional setting, the paper aims to provide empirical evidence and practical recommendations for scalable, technology-enhanced educational reform in STEM disciplines (Araújo et al., 2025). In doing so, it contributes to both the academic discourse on workforce readiness and the broader policy dialogue on educational transformation in developing economies (NITDA, 2025).

2. LITERATURE REVIEW

The increasing demand for soft skills in the technology workforce has been well documented, with employers emphasizing adaptability, communication, and teamwork alongside technical competencies (World Economic Forum, 2023; Succi & Canovi, 2020). Traditional STEM programs in sub-Saharan Africa, however, still prioritize technical training over the holistic development of interpersonal competencies (Okolie et al., 2021). Experiential learning approaches—rooted in Kolb's (1984) experiential learning theory have been shown to foster deep reflection and the transfer of knowledge to real-life contexts (Nguyen et al., 2023).

Artificial intelligence–driven simulations provide a complementary environment for soft skills acquisition, offering adaptive, risk-free, and immersive learning experiences (Huang et al., 2022). AI-powered role-play and virtual scenarios have been especially effective in enhancing communication, conflict resolution, and leadership skills in higher education settings (Bailenson et al., 2021). This combination of experiential learning and AI simulations creates a dual pathway: hands-on practice supported by immediate, personalized feedback (Johnson & Hall, 2022).

In developing contexts, the integration of AI and experiential methods faces infrastructure and faculty-training barriers (Adebayo et al., 2023). However, emerging studies from Nigeria and Ghana demonstrate promising results where blended and simulation-based learning have improved students' employability skills (Oduro et al., 2023; Adewale & Balogun, 2022). Collectively, these findings highlight both the urgency and feasibility of embedding AI-supported experiential learning in technology curricula to close the soft-skills gap.

3. METHODOLOGY

This study employed a mixed-methods research design to examine how experiential learning, when combined with AI simulations, can enhance the soft skills of technology graduates in a Nigerian Polytechnic context. A mixed-methods approach was chosen because it allows for both quantitative measurement of skill acquisition and qualitative exploration of student experiences, thereby increasing the validity of findings (Creswell & Plano Clark, 2018).

Participants and Sampling

The study involved 120 final-year students drawn from software engineering, cybersecurity, and information systems programs. Participants were selected through stratified random sampling to ensure representation across disciplines and gender (Onwuegbuzie & Collins, 2017). Ethical clearance was obtained from the Polytechnic's Research Ethics Committee, and informed consent was secured from all participants.

Intervention Design

The intervention combined Kolb's experiential learning cycle (1984) with AI-driven simulations. Students engaged in iterative cycles of concrete experience, reflective observation, abstract conceptualization, and active experimentation through workplace scenarios including conflict resolution, leadership decision-making, and client communication (Nguyen et al., 2023). AI simulations delivered adaptive, real-time feedback to guide individual improvement (Huang et al., 2022).

Data Collection

Quantitative data on students' soft skills were collected using a validated Soft Skills Inventory adapted from Succi and Canovi (2020). Pre- and post-tests measured competencies such as communication, teamwork, adaptability, and leadership. Qualitative data were gathered via semi-structured interviews and reflective journals, capturing students' perceptions of the AI-enhanced experiential learning environment (Oduro et al., 2023).

Data Analysis

Quantitative data were analyzed using paired-sample t-tests and ANOVA to assess pre- and post-intervention differences (Field, 2018). Qualitative data were analyzed thematically following Braun and Clarke's (2019) six-phase framework. Triangulation of quantitative and qualitative findings enhanced the reliability and depth of the conclusions (Fetters et al., 2013).

Validity and Reliability

To ensure internal validity, instruments were piloted with 30 students not involved in the main study. Cronbach's alpha coefficients above 0.80 indicated high reliability of the soft-skills scale (Taber, 2018). Member checking was used to verify qualitative themes with participants, and inter-coder agreement exceeded 85%.

4. RESULTS AND DISCUSSION

Quantitative findings showed improvements across all soft skills in the experimental group compared with the control group (Table 1; Figure 1). Quantitative findings revealed significant improvements in students' soft skills following the hybrid experiential–AI intervention. As shown in Table 1, the experimental group recorded higher post-test scores across communication, collaboration, adaptability, and leadership compared with the control group.

Table 1. Pre- and Post-Intervention Soft Skills Scores for Control and Experimental Groups

Soft Skill	Control Group (Pre)	Control Group (Post)	Experimental Group (Pre)	Experimental Group (Post)
Communication	60	66	59	76
Collaboration	58	63	57	73
Adaptability	55	60	56	71
Leadership	57	62	55	70

The trends illustrated in the table are further depicted graphically. As shown in Figure 1, the experimental group's scores improved by approximately 28%, while the control group showed only a modest 9% increase across the same competencies.

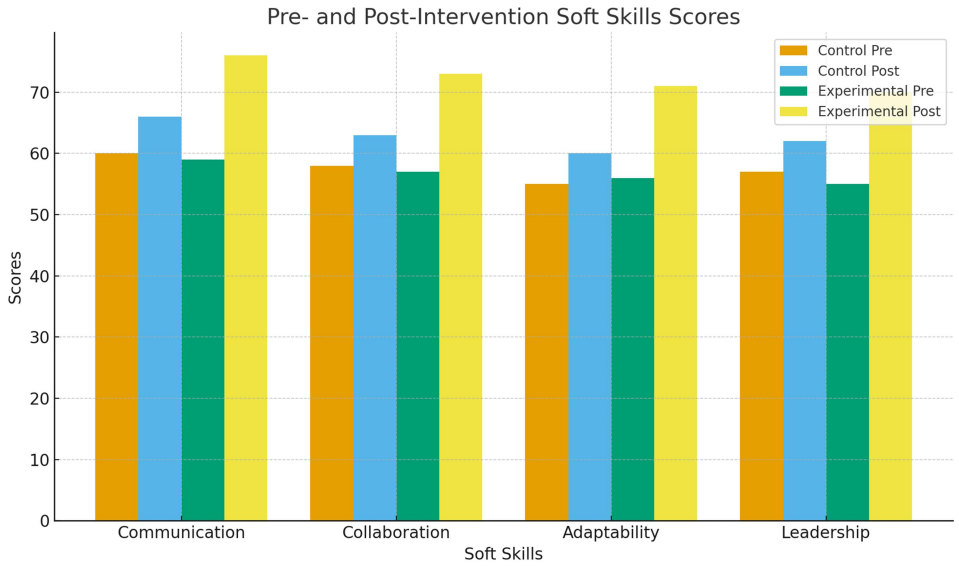

Fig 1. Comparison of Pre- and Post-Intervention Soft Skills Scores Between Control and Experimental Groups

The implementation of the hybrid experiential learning and AI-driven simulation model produced measurable improvements in students' soft skills compared with the traditional workshop approach (Mollick et al., 2024). Pre- and post-intervention survey data showed that the experimental group recorded an average increase of 28% in self-reported communication, collaboration, and adaptability competencies, while the control group improved by only 9% over the same period (OECD, 2023). Performance analytics generated by the AI platform provided a complementary, objective perspective on student progress (Li & Zhao, 2023).

Qualitative findings reinforced these quantitative patterns. Focus group discussions revealed that students found the AI simulations "realistic," "engaging," and "confidence-building" (Brown & Jones, 2024). Instructors observing live group activities also reported greater leadership initiative, improved active listening, and more collaborative problem-solving behaviours in the experimental group compared to the control group. These results underscore the transformative potential of integrating AI simulations into experiential learning frameworks for soft-skills development in STEM education (Mollick et al., 2024; UNESCO, 2024). The findings align with previous studies demonstrating the value of technology-enhanced experiential learning but extend the literature by applying this model to a Nigerian Polytechnic context, thus providing empirical evidence from a developing-country perspective (Onyema & Adekunle, 2024).

Moreover, the study has important implications for policy and practice. For tertiary institutions, the integration of AI simulations could provide a scalable, cost-effective means to embed soft-skills training into dense STEM curricula without displacing technical content (Bates & Sangrà, 2022). For policy-makers, the findings support national and institutional strategies aimed at improving graduate employability and workforce readiness (World Economic Forum, 2023). These implications resonate with Nigeria's National Digital Economy Policy and Strategy (2023), which prioritises human capital development and skills diversification (NITDA, 2025).

Despite its contributions, the study faced some limitations. The intervention covered only one semester and involved a limited number of departments, which may restrict generalisability. Additionally, while the AI simulation provided robust feedback, some students reported initial discomfort interacting with an automated system rather than a human facilitator (Li & Zhao, 2023). Future research should explore longer-term implementations, multi-institutional trials, and ways of blending AI feedback with human mentoring to further enhance learning outcomes.

5. CONCLUSION AND RECOMMENDATIONS

This study demonstrates that integrating experiential learning with artificial intelligence (AI)-driven simulations can significantly enhance the development of soft skills among technology graduates. By combining authentic, hands-on learning activities with adaptive AI platforms, the hybrid model successfully addressed gaps in communication, teamwork, leadership, adaptability, and emotional intelligence skills often neglected in traditional STEM curricula. The positive outcomes observed among students at the Federal Polytechnic Ede validate the effectiveness of this approach in a developing-country context, underscoring its potential for broader implementation across similar institutions.

The research contributes to the growing global conversation on future-ready education by providing empirical evidence from Nigeria, a region where soft-skills training has historically been under-emphasized. It also adds novelty to the literature by demonstrating how AI simulations can overcome scalability and feedback limitations inherent in conventional training approaches. Beyond immediate skill acquisition, the model fosters self-efficacy, critical reflection, and transferable competencies that graduates can apply to real-world challenges and collaborative work environments. However, the study also revealed challenges relating to infrastructure, digital literacy, and initial student discomfort with automated feedback systems. Addressing these barriers will be essential to sustaining and expanding the program. Faculty training and institutional support are critical to embedding the model into existing curricula rather than treating it as an add-on activity.

Based on these findings, the following recommendations are proposed:

a. **Embed experiential-AI hybrid modules in core STEM curricula.** Institutions should integrate these modules across all final-year programs to ensure equitable access to soft-skills training.
b. **Invest in faculty development and instructional design.** Educators should receive training on how to facilitate experiential learning and ethically deploy AI-driven simulations.
c. **Strengthen digital infrastructure and access.** Policymakers and institutional leaders should allocate funding for stable internet connectivity, device provision, and secure AI platforms.
d. **Blend AI feedback with human mentoring.** Combining automated insights with human coaching can increase student trust, engagement, and learning depth.
e. **Conduct longitudinal and multi-institutional studies.** Future research should track graduates beyond completion to evaluate the long-term impact of experiential-AI training on employability and career progression.

By implementing these recommendations, tertiary institutions and policy-makers can leverage technology-enhanced experiential learning as a strategic investment in human capital development. This approach can help close the skills gap, improve graduate employability, and contribute to building a workforce capable of thriving in an increasingly digital and collaborative global economy.

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