Enhancing engineering professional skill development through industry-led guest lectures: A transformative learning approach in African engineering education.

Vicent Rutagangibwa
University of Cape Town, South Africa, *rtgvic001@myuct.ac.za*

Irene Magara
University of Nebraska-Lincoln, USA, *imagara2@huskers.unl.edu*

Comfort Musiimenta
University of Cape Town, South Africa, *msmcom001@myuct.ac.za*

Abstract

This study examined the impact of integrating industry-led guest lectures with reflective learning on the professional skill development of final-year electrical engineering students at Mbarara University of Science and Technology (MUST), Uganda. Grounded in Kolb's Experiential Learning Theory and using Maxwell's interactive research design, the study explored how this combined approach enhances students' professional competencies and industry readiness. A mixed-methods design was employed, involving 73 students who participated in pre- and post-intervention surveys, reflective journals, and sessions led by three expert guest lecturers in maintenance engineering. Quantitative analysis showed statistically significant gains in students' confidence and readiness to tackle industry-related challenges. Reflections further revealed improved problem-solving, deeper understanding of real-world practices, and growth in professional identity. Students reported high motivation and perceived relevance of the sessions. These findings underscore the effectiveness of structured industry engagement in developing both technical and soft skills among engineering students. The study offers practical strategies for bridging the academia–industry divide, particularly in resource-constrained settings, and contributes to emerging scholarship on experiential and practice-oriented engineering education.

Keywords: Industry-led guest lectures, professional skills development, industry readiness, reflective learning, African engineering education.

1. Introduction

Engineering education in Africa faces persistent challenges in effectively equipping graduates with industry-relevant skills due to resource constraints, infrastructural limitations, and insufficient university-industry collaborations (Kehdinga et al., 2020). While traditional interventions such as internships and industrial visits have been implemented to bridge this gap, they often face sustainability issues and limited accessibility in resource-constrained institutions of higher learning (Nawaz et al., 2023). Addressing these challenges is crucial for enhancing the employability of graduates and ensuring that engineering education meets the evolving needs of industry.

Recent studies highlight that university-industry partnerships enhance students' employability and technical competency through direct engagement with industry professionals (Shah & Gillen, 2024). One increasingly recognized approach is the integration of industry-led guest lectures, where experienced professionals deliver targeted industrial knowledge aligned with academic curricula (Gambheer & Acharya, 2024). This approach has been effectively used in controlling engineering education, demonstrating its potential to improve technical comprehension and professional readiness among students (Hoernicke et al., 2017). Moreover, experiential learning frameworks, such as Kolb's Experiential Learning Theory, emphasize the importance of active engagement and reflective practices in reinforcing industry-based learning (Tembrevilla et al., 2024). Given these promising findings, this study explores how integrating such approaches can address the gaps in engineering education in resource-constrained settings, particularly in enhancing industry readiness.

This study explored how industry-led guest lectures, integrated with reflective learning, impacted the development of professional engineering skills and industry readiness among final-year electrical engineering students at Mbarara University of Science and Technology (MUST), a resource-constrained African institution. Guided by Kolb's Experiential Learning Theory, the intervention involved experienced industry practitioners aligned with course content. Using a mixed methods approach, data were collected from students through pre- and post-intervention surveys and bi-weekly reflective journals. Quantitative data were analysed using paired t-tests and effect size, while qualitative data underwent thematic analysis to assess changes in technical skill application and professional growth. This research aimed to create an evidence-based model for incorporating transformative industry experiences into engineering education and provided practical recommendations for African universities seeking to enhance industry readiness within resource limitations. The findings demonstrated how well-structured Industry- led guest lectures could bridge the academia-industry gap in such contexts.

1.1 Research gap

Despite the benefits of industry engagement in engineering education, there is a lack of empirical studies evaluating the effectiveness of industry-led guest lectures, particularly in resource-constrained African universities. While internships and industrial visits have been extensively analyzed, the role of structured industrial-led guest lectures as an alternative means of fostering industry engagement remains underexplored. Furthermore, the integration of reflective learning practices within such models has not been sufficiently

investigated in relation to professional skill development and industry readiness in African higher education institutions.

1.2 Objectives and research question

This study investigates how industry-led lectures, integrated with reflective learning practices guest lectures, contribute to the professional skill development and industry readiness of final-year electrical engineering students in a resource-constrained African university setting. Employing a mixed methods approach, the study examines both quantitative and qualitative data to assess students' skill acquisition, engagement, and perceptions of this learning model. This study explores the following research question:

> *How do industry-led guest lectures, when integrated with reflective learning practices, influence the development of professional engineering skills and industry readiness among final-year* electrical engineering *students at Mbarara University of Science and Technology?*

The study objectives include:

- Evaluating the impact of industry-led guest lectures on students' professional competencies, technical application skills, and industry readiness.
- Analyzing students' experiences on the benefits and limitations of industry-led guest lectures in engineering education.
- Developing strategic recommendations for integrating industry-led guest lectures in resource-limited educational settings.

2. Literature Review

2.1 University–Industry Collaboration in engineering education

University–industry collaboration (UIC) plays a crucial role in bridging the gap between theoretical knowledge and practical application, enhancing graduate employability, and fostering innovation. UIC provides students with hands-on learning, professional networking, and ensures curricula meet industry needs (Mohamedbhai, 2015; Vuoriainen et al., 2025). The success of these partnerships depends on factors such as strong institutional support, effective communication, and alignment between academic and industrial goals (Mohamedbhai, 2015). Vuoriainen et al. (2025) highlight the "Six Cs of collaboration": communication, commitment, clarity, coordination, culture, and capacity, as essential elements for effective UICs. Universities that integrate these principles produce graduates with both advanced technical skills and essential soft skills, such as leadership and interdisciplinary collaboration, which are vital in today's complex professional environments (Morin & Willox, 2022; Pepple et al., 2025; Shah & Gillen, 2024). In resource-constrained settings, where traditional forms of experiential learning may be limited, fostering such collaborations can provide a scalable solution to bridge the gap between academia and industry, enhancing both the quality of education and the employability of graduates.

Despite these advantages, significant disparities persist in the implementation and outcomes of UICs, particularly in Africa. While global studies emphasize the benefits of such collaborations, barriers like weak institutional support and financial constraints remain prevalent in many African nations (Bolu et al., 2024). These challenges

highlight the need for further research on how successful UIC models, developed in more resourced settings, can be adapted to meet the unique socio-economic and institutional needs of African engineering education.

2.2 Industry-led guest lectures as a pedagogical tool

Industry-led guest lectures are increasingly recognized as a valuable pedagogical tool for integrating real-world industry insights into academic curricula. This approach provides students with direct exposure to current industry practices, expectations, and emerging trends, which are often difficult to replicate within traditional classroom settings. Research consistently shows that when guest lectures are aligned with course content, they significantly enhance students' understanding of industry demands and increase engagement (Hoernicke et al., 2017; Pepple et al., 2025). Latorre and Meier (2022) demonstrate that guest lectures focused on leadership help students gain a clearer vision of their future roles and better understand the professional relevance of their academic coursework. This direct exposure creates a stronger connection between theoretical learning and practical application, fostering a deeper and more contextualized understanding of the subject matter.

Moreover, industry-led guest lectures cater to diverse learning styles and foster intrinsic motivation. According to Self-Determination Theory (SDT), guest lectures address students' psychological needs for autonomy, competence, and relatedness (Trenshaw et al., 2016). Exposure to varied perspectives and real-world problem-solving enhances students' autonomy, while understanding the practical applications of theoretical knowledge builds competence. Interaction with professionals in their intended field helps establish relatedness, encouraging students to reflect critically on the content. Trede and Jackson (2021) emphasize that this reflective engagement is key to developing student agency and shaping a robust professional identity, enabling students to visualize their roles within the broader professional landscape.

However, despite the clear benefits, further research is needed to assess the long-term impact of industry-led guest lectures. While existing literature highlights their positive effects on student engagement and relevance, there is a gap in studies that track the sustained influence of these lectures on graduates' career trajectories, problem-solving abilities, and leadership development. A more thorough understanding of these outcomes could provide a stronger case for transitioning from exposure to transformative learning experiences, particularly in educational contexts where resources and access to industry professionals may be limited.

2.3 Engineering education challenges in Africa

Engineering education in Africa faces significant challenges that hinder its ability to produce graduates ready for the workforce. Despite global advancements in pedagogical approaches, systemic issues like outdated curricula, inadequate funding, and a shortage of experiential learning opportunities persist. These factors create a growing gap between academic training and the evolving demands of the industrial sector (Kehdinga et al., 2020). Mohamedbhai (2015) argues that without comprehensive reforms, many African nations will struggle to develop the engineering talent needed for sustainable economic and social growth. Moreover, this disconnect disproportionately affects under-represented and low-income students, exacerbating inequalities within the engineering profession across the continent (Halabieh et al., 2022). Addressing these issues is crucial to ensuring that engineering education in Africa becomes more aligned with industry needs and provides equitable opportunities for all students, particularly in resource-constrained environments.

These challenges highlight the urgent need for innovative and resource-conscious solutions. One promising approach is the integration of industry-led guest lectures with reflective learning practices, which offer a cost-effective alternative to traditional experiential learning methods, such as internships or extensive industry visits. This model has been shown to bridge the academia-industry divide by simulating critical workplace experiences within the classroom, without requiring substantial financial investment (Badenhorst et al., 2020). By strategically leveraging industry partnerships, universities can provide students with valuable exposure to real-world engineering scenarios, fostering critical thinking and professional skills that are essential for employability (Turns et al., 2014). In institutions with limited resources, such as Mbarara University of Science and Technology, this approach offers a practical solution to overcoming financial constraints while improving graduates' readiness for the workforce (Chadha & Heng, 2024). When embedded into institutional policies and curricula, industry-driven initiatives like guest lectures can not only enhance employability outcomes but also contribute to the professional mobility of engineering graduates across the African continent, promoting a more responsive and relevant engineering education system.

2.4 Experiential and reflective learning in engineering education

Experiential learning (EL) and reflective practices are fundamental to effective maintenance engineering education. Based on Kolb's theory, EL remains central to modern engineering pedagogy, fostering deep learning through hands-on experience (Kolb & Kolb, 2018). Research indicates that when engineering students engage in reflective activities, such as journaling, discussions, or writing assignments, they develop a deeper understanding of professional practices (Badenhorst et al., 2020; Turns et al., 2014). These practices enhance metacognitive awareness and help students connect theoretical knowledge to real-world scenarios.

In the context of project-based learning, such as the Shell Eco-Marathon case study, reflection allows students to refine their professional identities and learn from their experiences (Von Solms & Nel, 2017). Similarly, research by Chadha and Heng (2024) emphasizes that reflective learning contributes to the development of critical soft skills, including communication, leadership, and teamwork, which are vital in today's multidisciplinary engineering teams. Badenhorst et al. (2020) further highlight the role of narrative reflection in shaping engineering students' professional identities. While traditional engineering education has focused on technical skills, recent literature underscores the necessity of reflective literacies for 21st-century engineers, who must adapt to an increasingly globalized and interconnected workforce

3. Methodology

3.1 Research design

This study employed a mixed methods research approach to gain a comprehensive understanding of the impact of industry-led guest lectures on engineering students' professional development. The design was framed using Maxwell's interactive research model (Maxwell, 2013) which emphasizes the interconnectedness of research goals, conceptual framework, methods, and validity strategies. This framework provided the flexibility and coherence necessary to explore not only measurable shifts in student confidence and readiness but also the nuanced, reflective experiences that shape professional growth thereby aligning closely with the study's emphasis on experiential and reflective learning within engineering education.

3.2 Participants and sampling

The study was conducted at Mbarara University of Science and Technology (MUST) in Uganda, targeting final-year Bachelor of Science in Electrical Engineering students enrolled in the Maintenance Engineering course (EEE 4102) during the first semester of the academic year 2023/2024. This fourth-year undergraduate course was selected due to its strong emphasis on bridging theoretical knowledge with industry practices, making it an ideal setting for integrating industry-led guest lectures as part of the learning experience.

Of the 92 students registered for the course, 73 voluntarily consented to participate in the study. These students formed the primary sample for the quantitative and qualitative survey, which included both pre- and post-intervention measures. In addition to the student participants, 3 industry practitioners (alumni) working in relevant maintenance engineering sectors were purposively recruited to serve as guest lecturers. Their professional backgrounds were strategically aligned with the course objectives, and the intended learning outcomes extracted from the curriculum were shared with them as a guide for preparing lecture materials. The guest lectures covered topics directly aligned with the course objectives, including preventive and corrective maintenance strategies, troubleshooting of electrical power distribution systems, and the use of industry-standard software tools for maintenance reporting. Each session was designed to connect theoretical concepts taught in class with practical applications in real-world engineering contexts.

To complement the survey data, reflective journal entries submitted by students as part of the course requirements were also reviewed. This document analysis provided deeper insights into students' learning processes and their evolving professional identities. The involvement of industry experts and engineering educators as guest lecturers and facilitators contributed to creating a rich learning environment, which in turn supported the collection of diverse data from the student surveys and reflective journals.

3.3 Data collection methods

This study employed a mixed methods approach to comprehensively investigate the impact of industry-led guest lectures on students' professional skill development and industry readiness. Data was collected through two primary methods: pre- and post-intervention surveys, and reflective journals. Firstly, structured questionnaires were administered to students at two distinct time points: before the commencement of the industry-led guest lectures and upon their completion.

The surveys were designed to assess changes in students' self-reported professional skills, confidence, and industry readiness. Likert-scale questions focused on problem-solving, technical application, communication, and teamwork skills. For example, students rated items such as *"I feel confident in troubleshooting real-world electrical faults"* and *"I can effectively communicate technical information to industry professionals."* Open-ended questions invited reflections on how guest lectures influenced their problem-solving approaches and professional identity. By comparing pre- and post-intervention responses, the study aimed to measure the quantitative impact of the intervention on these outcomes, addressing research objective 1, which evaluates the impact of industry-led guest lectures on students' professional competencies and industry readiness.

In addition, students maintained bi-weekly reflective journals to document their learning experiences, critically analyse skill development, and identify areas for improvement. Prompts guided their reflections, encouraging them to connect lecture content with existing knowledge, identify learning gaps, and outline action points for addressing those gaps. This process also allowed students to track their evolving perceptions of professional growth and readiness for industry.

3.4 Data analysis

Quantitative data from pre- and post-intervention surveys were analysed using paired t-tests to assess changes in students' self-reported professional skills, confidence levels, and industry readiness. This method was chosen to compare related data points from the same individuals, effectively measuring changes over time.

Qualitative data from reflective journals and open-ended survey responses underwent thematic analysis. This process involved coding and categorizing data to identify key themes related to professional skill development, problem-solving approaches, and professional growth. The integration of quantitative and qualitative findings provided both breadth and depth, with the surveys capturing the extent of change and the reflective narratives explaining how and why those changes occurred, offering deeper insights into the impact of the guest lecture intervention.

3.5 Ethical considerations

Informed consent was obtained from all participants, who were informed about the study's purpose, their involvement (surveys, reflective journals), and assured of confidentiality. Participation was voluntary, and students were told they could withdraw at any time without academic consequences. To minimize potential bias, special care was taken given that one researcher was also the course instructor. Data were anonymized, with unique participant codes assigned, and securely stored. Methodological rigor, including mixed methods, data triangulation, and reflexivity, ensured the validity and trustworthiness of the data. Peer debriefing and maintaining an audit trail helped minimize bias during analysis.

4. Results and discussion

4.1 Results

This section presents the results from both the quantitative and qualitative data analyses. First, the quantitative findings are discussed, focusing on key measures such as student confidence, readiness for industry, motivation, and perceived benefit of the industry-led guest lectures. These are followed by the qualitative findings, which explore the students' reflections on skill development, problem-solving approaches, and professional growth. The results from both data sources are integrated to highlight the impact of the guest lectures on students' learning outcomes.

4.1.1 Quantitative findings

Quantitative data were analysed to process pre- and post-survey responses. Table 1 and Figure 1 summarize the key findings:

- Confidence increased from a mean of 3.5 to 4.3, with a Cohen's d of 0.39, indicating a small-to-moderate effect size.
- Readiness for industry challenges rose from 3.77 to 4.19, yielding a Cohen’s d of 0.51, which reflects a moderate effect.

- Motivation and Perceived Benefit received post-intervention scores of 4.25 and 4.40, respectively, indicating strong student engagement and appreciation of the relevance of the guest lectures.

These findings suggest that the guest lecture intervention had a positive impact on both cognitive and motivational outcomes.

Table 1 Pre- and Post-Intervention Student Ratings and Effect Sizes Across Key Learning Outcomes

Measure	Mean (Pre)	Mean (Post)	Cohen's d	Notes
Confidence	3.5	4.3	0.39	Small-to-moderate effect
Readiness	3.77	4.19	0.51	Moderate effect
Motivation	N/A	4.25	N/A	Only post-intervention rating
Perceived Benefit	N/A	4.40	N/A	Only post-intervention rating

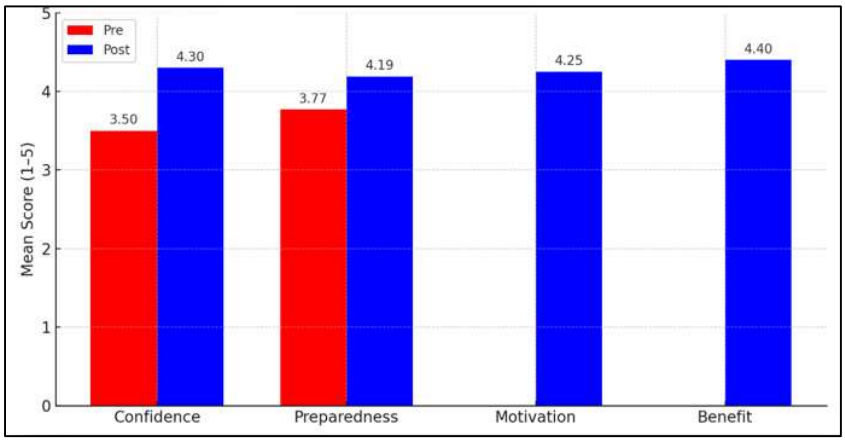

Figure 1 Student Ratings Pre- and Post-Intervention for Confidence, Readiness, Motivation, and Benefit

4.1.2 Qualitative findings

The thematic analysis of the reflective journals and open-ended survey responses from 73 students revealed three major themes that underscore the positive impact of industry-led guest lectures on skill development and professional readiness. The analysis was guided by Braun and Clarke (2006) principles, ensuring a comprehensive and systematic interpretation of the qualitative data. The following themes emerged:

(1) Professional Skill Development: Students frequently reported gaining hands-on knowledge and practical insights that bridged the gap between academic theory and industry practice. One student remarked, *"The guest lecture gave me the skills to handle real maintenance challenges,"* particularly in *"troubleshooting electrical faults in power distribution."* Another noted, *"The session on using PowerPoint for maintenance reports was something I hadn't considered, but it's an invaluable tool for professional communication."* These responses show that the guest lectures provided not only technical skills but also industry-specific practices directly applicable to students' future roles. Additionally, many

students highlighted the acquisition of transferable skills, such as "interpersonal communication," "project management," and "task scheduling," which are essential in real-world engineering environments.

(2) **Problem-Solving and Innovation:** A prominent theme was the shift in students' approaches to problem-solving. Several students noted that the guest lectures provided tools to think more systematically and analytically about engineering challenges. One student shared, *"I now gather all the necessary information and plan before starting any task,"* reflecting a more structured problem-solving approach. Another remarked, *"The real-world examples helped me see the practical side of problem-solving and think through constraints in ways I hadn't before."* This suggests that the guest lectures enhanced students' critical thinking skills, enabling them to apply theoretical knowledge to real-world scenarios and develop innovative solutions.

(3) **Strengthening of Professional Growth:** A key finding from the qualitative data was the strengthening of students' professional identities and career direction. Many students reported that the guest lectures deepened their understanding of the engineering profession. One student remarked, *"I now understand why maintenance is critical in ensuring the reliability of engineering systems,"* while another shared, *"I feel more competent and prepared to enter the workforce after these sessions."* These responses suggest that, in addition to developing technical skills, the lectures had a significant impact on students' professional confidence and their evolving sense of identity as engineers.

(4) **Breadth and Variation in Responses:** While most students reported positive outcomes from the guest lectures, there were variations in responses, particularly regarding the relevance of industry-specific knowledge. Some students felt certain topics, like advanced technical tools, were beyond their current level of study. One student noted, *"While the session on advanced fault diagnosis was interesting, I feel it was a bit ahead of where I am right now."* This highlights the need to tailor guest lectures to students' educational stages and technical proficiency levels. Overall, the findings underscore the multifaceted impact of industry-led guest lectures and the depth of student engagement, with a nuanced appreciation for how the content relates to both their career goals and current learning needs.

4.2 Discussion

The results of this study provide strong evidence that industry-led guest lectures significantly impact students' professional development. The positive quantitative changes in confidence and readiness (with moderate effect sizes) suggest that guest lectures help bridge the gap between academic learning and real-world application. This finding aligns with previous research that highlights the value of industry exposure in enhancing students' self-efficacy and preparing them for future careers in engineering (Pepple et al., 2025; Vuoriainen et al., 2025).

The high post-intervention scores for motivation and perceived benefit (4.25 and 4.40) further confirm the value students place on guest lectures. Although no pre-intervention baseline was available for these variables, the strong post-only ratings support the idea that students found the lectures highly engaging and relevant to their career aspirations. These results echo similar studies showing that guest lectures can stimulate students' interest in their fields and increase their commitment to professional growth (Morin & Willox, 2022; Shah & Gillen, 2024).

The qualitative data complement the quantitative findings by providing insights into how students internalized the information shared during the guest lectures, highlighting the development of practical skills and a deeper understanding of problem-solving, consistent with prior research on experiential learning in engineering

education (Braun & Clarke, 2006). The theme of professional growth underscores the broader value of guest lectures, fostering not only technical knowledge but also the confidence and mindset necessary for success in the professional world. While the results are promising, further research is needed to evaluate the long-term impact of guest lectures on career outcomes, such as job placement and leadership development, and to explore how to integrate them into resource-constrained institutions like many African universities to maximize their effectiveness.

5. Implications and future work

The findings highlight the potential of industry-led guest lectures as an alternative to traditional internships in resource-constrained settings, providing authentic industry exposure when placement opportunities are limited. To maximize their impact, these lectures should be strategically integrated into curricula with strong institutional and policy support. Additionally, the study emphasizes the value of structured reflective practice, which deepens understanding and fosters professional growth, helping students transition confidently into the engineering workforce. Future work will include follow-up studies to examine long-term impact on career outcomes, as well as extending the study across departments and institutions. Comparative studies with traditional experiential methods (e.g., internships, industrial visits) would further strengthen the evidence base for this intervention.

6. Limitations

This study relied on self-reported data, which may introduce bias and affect the accuracy of the findings. Additionally, the lack of a control group limits the ability to directly attribute improvements solely to the guest lectures, as we cannot rule out other external factors that may have influenced the results. The instrument used to measure these outcomes was not validated, which further impacts the generalizability and robustness of the findings. Furthermore, this study was conducted as a single-institution case study, meaning the results may not be generalizable to diverse educational settings or institutions with different resource contexts. Despite these limitations, the study offers valuable insights into scalable, low-cost interventions for improving the relevance of engineering education, particularly in resource-constrained environments in Africa and similar contexts worldwide.

7. Conclusion

This study shows that industry-led guest lectures, when integrated into engineering education, can enhance student confidence, preparedness, and motivation. These findings contribute to the discourse on context-sensitive pedagogies, particularly in Africa, where traditional experiential learning may be limited. The combination of guest lectures and reflective practice offers a promising approach to developing professional competencies and bridging the gap between academia and industry. Expanding this model can help cultivate holistic, employable, and globally competent engineers, especially in resource-constrained settings.

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