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Enhancing employability through collaborative project-based learning.

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Enhancing Employability through Collaborative Project-Based Learning

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Abstract: There is a gap between the skills taught in higher education and those needed in the workplace, with employers often finding engineering graduates lacking in soft and digital skills. Traditional university courses may not adequately prepare students for the job market as they are content-focused and educator-centered. To address this gap, formal education should incorporate essential pedagogy strategies and technology needed in the workplace, especially in the post-COVID-19 era. Many universities are updating their curricula to align with industry demands. This study explores the role of technology and pedagogy-based solutions in enhancing the employability of engineering students engaged in collaborative project-based learning activities. The aim is to improve teaching and learning effectiveness and offer interdisciplinary courses that enhance students' job prospects. Data were collected from 205 project students through questionnaires, and qualitative data were gathered from interviews with 35 students and 25 supervisors, employing a mixed-methods research approach. Analysis revealed that students actively participated in group discussions, decision-making, and information sharing for the project. Collaborating within their learning community enhanced their learning experience through communication and involvement in group activities. Collaborative approach enhances creativity, sustainability, and innovation in engineering. Working together allows students to share ideas and develop creative solutions for complex problems, deepening their understanding of the subject. Collaborative learning has improved students' comprehension and career opportunities by integrating pedagogical techniques with technology. This approach has enhanced academic achievement and developed digital and soft skills, making students more competitive in the dynamic job market.

Keywords: *Engineering, Collaborative Learning, Soft Skills, Digital Skills.*

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I. INTRODUCTION

The education system needs to evolve to better prepare individuals for life and future employment opportunities (World Economic Forum, 2016). There is a gap between the skills taught in higher education and those needed in the workplace, with employers often finding engineering graduates lacking in soft and digital skills. The current courses do not adequately prepare students for the demands of the job market. Traditional teaching method is inadequate in developing innovative graduate engineers prepared to face new challenges in today's fast-paced world. To address this issue, it is recommended to update the syllabus to incorporate practical work experiences and soft skills that complement technical knowledge (Amish, 2024). Additionally, the digital transformation accelerated by COVID-19 has reshaped the skills needed in today's job market. The demand for engineers with digital skills is increasing, highlighting the need to provide engineering students with digital literacy. Proficiency in digital technologies is now essential for driving innovation, fostering growth, and creating job opportunities (Saari, et al., 2021; Amish. 2024). Today, education needs to adjust to evolving needs. Educators need to adapt their approaches to incorporate these identified soft and digital skills, and one effective method is through collaborative learning (CL) techniques (Chanpet, Chomsuwan, and Murphy 2020). Participating in online interactions enriches students' educational experiences, satisfaction, and academic achievements (Al-rahmi & Othman, 2013). It enables them to understand new ideas, connect prior knowledge, and cultivate problem-solving and critical thinking abilities. Educators can encourage student-student interaction by organising collaborative tasks and providing clear instructions to support valuable discussions (Frisen & Kuskis, 2013). Transitioning from individual work to collaboration and community engagement is crucial for students to develop communication, problem-solving, time management, and teamwork skills. Working together allows students to combine strengths, perspectives, and achieve shared goals. Engaging with the community provides a real-world application of learning and the opportunity to make a

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difference, enhancing the overall learning experience and preparing students for the future.

II. OBJECTIVE OF THE STUDY

The courses integrate technology with a focus on energy and environmental sustainability, emphasising practical applications of artificial intelligence and machine learning. (Amish and Khodja, 2024; Amish and Etta-Agbor, 2023; Mahdi, Amish, and Oluyemi, 2023; Khodja, Debih, Lebtahi, and Amish, 2022). The study aims to establish best practices in engineering education for teaching and learning effectiveness and to offer courses that enhance students' job prospects. Therefore, it is important to transform traditional projects into virtual collaborative learning formats through pedagogical design using the ADDIE instructional model and technology tools. This research integrates a Learning Management System with sustainable online collaborative project-based learning (COPBL) to enhance engineering graduates' employability. User Acceptance Testing was conducted using a customised and revised questionnaire. This study found that a collaborative approach in engineering education positively impacted access, sustainability, quality of education, health, well-being, inequality reduction, clean energy, and economic growth. These advancements support Sustainable Development Goals 3, 4, 7, 9, 10, 11, 13, and 16 (Transforming our World, 2023).

III. RATIONALE AND CONCEPT OF CL

The shift in education toward active learning centers on CL through discussions, exploration, and professional assistance. Employers have noted that students are lacking in soft skills, which are essential for success in the workplace (White, 2013). Workplace assessments place a strong emphasis on the value of soft skills for job retention in addition to hard skills (Arnolds & Smeets, 2015). Teamwork, communication, problem-solving, decision-making, information processing, and task organisation are the five fundamental soft skills that individuals need to succeed (Adams, 2014). To enhance a university's reputation for producing job-ready graduates, it is essential to ensure that students possess the necessary skills for success in the workplace. This involves updating the curriculum to include essential soft skills that are crucial for competitiveness in the job market. Educators should adopt a new approach that focuses on integrating these identified soft skills. Traditional content-based, educator-centered teaching methods have been found to be inadequate in preparing students for the challenges of the job market. Scholars recommend a more engaging approach, such as CL approach, which can address these shortcomings while also enhancing student learning outcomes and meeting industry expectations (Chanpet, Chomsuwan, and Murphy, 2020; Lin and Tsai, 2016; Yu-Hui and Yu-Chang, 2013). CL is an instructional approach where small groups of students work together to enhance individual and group learning. Students collaborate on organised activities with individual responsibilities towards a common goal (Ormrod, 2008), fostering a positive learning environment and encouraging mutual support and learning. CL helps students develop conflict resolution, self-evaluation, and interpersonal skills while gaining a deeper understanding of the subject. Different CL models, such as Learning Together and Group Project-Based Investigations, have been successful in promoting knowledge acquisition and soft skill development. CL is an authentic approach to learning that involves collaboration among students to align content with curriculum standards and establish clear objectives. This programme encourages student participation and utilises various technologies for effective instruction. In addition to traditional educator assessments, collaborative project-based learning incorporates innovative assessment techniques such as self and peer evaluation (Ning, 2010). Engaging in CL enhances retention, academic performance, and soft skills like collaboration, communication, and problem-solving, leading to overall educational satisfaction (Zhu, 2012). Interaction during the learning process is most effective when students collaborate, share ideas, engage in dialogue, challenge each other, and work together on issues. Peer interaction positively impacts undergraduate performance (Chen, 2011), and integrating CL into courses helps students enhance their soft skills (Ballantine & Larres, 2007).

IV. CHALLENGES OF CL

CL is not always successfully implemented in classrooms due to issues such as unequal participation, ineffective communication, and group composition (Baker & Clark, 2010). Educators face challenges in designing activities, creating tasks, forming groups, scheduling class time, and monitoring activities (Van Leeuwen, Janssen, Erkens, & Brekelmans, 2013). Challenges to CL effectiveness include lack of collaboration, free riding, low competence, and participant friendships (Ha Le, Jeroen, and Theo 2018). Teaching group learning requires different methods and has advantages over educator-centered tutorials in terms of deeper learning and skill development. Graduates often lack soft skills due to difficulties in implementing CL methods, such as inactive participation (Chiong & Jovanovic, 2012). Collaborative group work requires intentional effort and should not rely on the assumption that all group members contribute equally. It is important for educators to assess individual contributions and assign grades accordingly to motivate students to participate fully in group projects (Swan, Shen & Hiltz, 2006). To effectively monitor class discussions and evaluate students' involvement in group work, educators should have access to online learning tools. This paper aims to introduce an online learning management system to support CL.

V. METHODOLOGY

A. Research Design:

This study employed a mixed-method research approach to evaluate the influence of COPBL on engineering education. This research design follows an explanatory sequential approach, with the quantitative phase preceding the qualitative phase and data integration (Creswell and Creswell, 2018). The reason for integrating quantitative and qualitative methods in the present study was

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that each method alone was insufficient to fully understand the intricacies of collaborative practices and their impact on learners' academic performance in engineering education. This study included two levels of integration. To determine the sampling criteria for the subsequent qualitative phase, the researcher first examined the quantitative data at the method level and applied the findings (Fetters, Curry, and Creswell, 2013). Second, narratives and collaborative displays were used to integrate the reporting and interpretation processes (Guetterman, Fetters and Creswell, 2015).

B. Participants in the Research:

The proposed respondents for the study were engineering school students in their final year of group projects, academic supervisors, and school experts in the design phase. The students had completed the group project module in engineering, with supervisors overseeing the module. Mugenda and Mugenda (2008) argue that a sample size of 10% to 30% of the target population is adequate. For this study, author utilised two common sampling techniques: sample size and selection. The sample size of 205 respondents was selected from a population of 440 using the criteria established by Krejcie and Morgan (1970). The respondents were chosen using a simple random sampling method. Kothari (2014) defines random sampling as a statistical method for selecting a representative sample from a larger population. This technique ensures that each individual in the population has an equal opportunity of being selected, reducing bias, and allowing for the transferability of outcomes. Random sampling is commonly used in research to ensure sample representativeness and generalisability to the population. The survey questionnaires are validated, and pilot tested for reliability and validity before being distributed to participants.

C. Instruments for Collecting Data:

The study aimed to implement the COPBL framework strategy to enhance employability and gather feedback from project students and supervisors on the effectiveness of COPBL The COPBL platform provides a virtual learning environment based on the ADDIE model, allowing students to collaborate on real-world engineering projects in a secure setting. Educators can create groups, monitor discussions, and assess student performance using the learning management system. This study gathered data through surveys and interviews. The research utilised a mixed-method approach, with a pre-designed questionnaire as the primary tool. Quantitative data was collected through questionnaires, while qualitative data was obtained through interviews with a selected group of students. Data were collected through qualitative and quantitative methods from project students and supervisors. Quantitative data were gathered from students (n=205) through anonymous questionnaires with a five-point Likert scale ranging from strongly agree to strongly disagree, while qualitative data were obtained through interviews with students (n=35) and supervisors (n=25). This improved the clarity and coherence of the findings, confirming the consistency of information gathered from various sources (Creswell and Creswell, 2018). Alpha and Beta testing were carried out to verify that the developed prototype is fully functional and meets user expectations as outlined in the project module.

D. Research Instrument Validity:

The instrument's construct validity was confirmed through an expert validation process (Taherhoost, 2016; Sangoseni, Hellman, and Hill, 2012; Olson, 2010). School staff familiar with module curriculum and instructional design provided feedback on the questionnaire's content, criterion, construct validities, and clarity, leading to revisions for the final version. Following validation and pilot testing, survey questionnaires were distributed to participants with the approval of the supervisor and module leader. Students were informed about the study's objectives, the data being gathered, and the expected survey completion time. Confidentiality and anonymity of participants will be ensured in accordance with research ethics. The study used descriptive statistics to examine students' preferences. To better understand overall trends, frequencies and percentages were calculated. Mean scores were calculated using a five-point Likert scale (1-strongly disagree, 2-disagree, 3-neutral, 4-agree, 5-strongly agree) for each question, evaluating various aspects and interpreting the results accordingly. It aimed to gather feedback on supervisor readiness, students' soft and digital skills, and support a proposed framework for the school strategy. Interviews focused on participants' understanding of COPBL, differences from traditional project styles, roles of students and educators, benefits, and challenges. Expert curriculum and instruction professionals reviewed and provided input on the interview questions, leading to refinements based on their feedback. The COPBL framework is a digital learning environment integrated into the university Campus Moodle platform.

It aligns with the ADDIE model (Morrison, 2010) as illustrated in Figure 1, adapted from Amish and Jihan (2023). The instructional method aimed to create an interactive and flexible learning environment that promotes creative engagement among engineering students with the project's content, peers, and educators (Alario-Hoyos, et al., 2013). Additionally, the COPBL strategy allows educators to form teams, encourage collaboration within them, monitor their progress, and assess students' achievements. During the development stage, create modern information to improve project outcomes. In the analysis phase of the ADDIE model, learning theory is established, incorporating constructivism and online collaborative learning. This phase involves examining objectives, content, resources, and tools to create project-based activities aligned with industry standards. Collaborative learning is encouraged through peer engagement and problem-solving. The project module structure facilitates interaction and coordination of different stages, focusing on content study, teaching methods, processes, and scheduling. Key factors influencing effective online collaborative learning are identified, and learning outcomes, resources, and assessment methods must align with the curriculum (Olivo, 2012). Educators play a crucial role in grouping students into teams, developing project specifications, and establishing an implementation schedule. Exemplary projects are presented, drop-in sessions are organised, and communication at individual and group levels is encouraged. Project requirements are detailed, a project guide is distributed, and a student survey is administered for feedback. Alpha and Beta acceptance testing were conducted to verify that the prototype functions correctly.

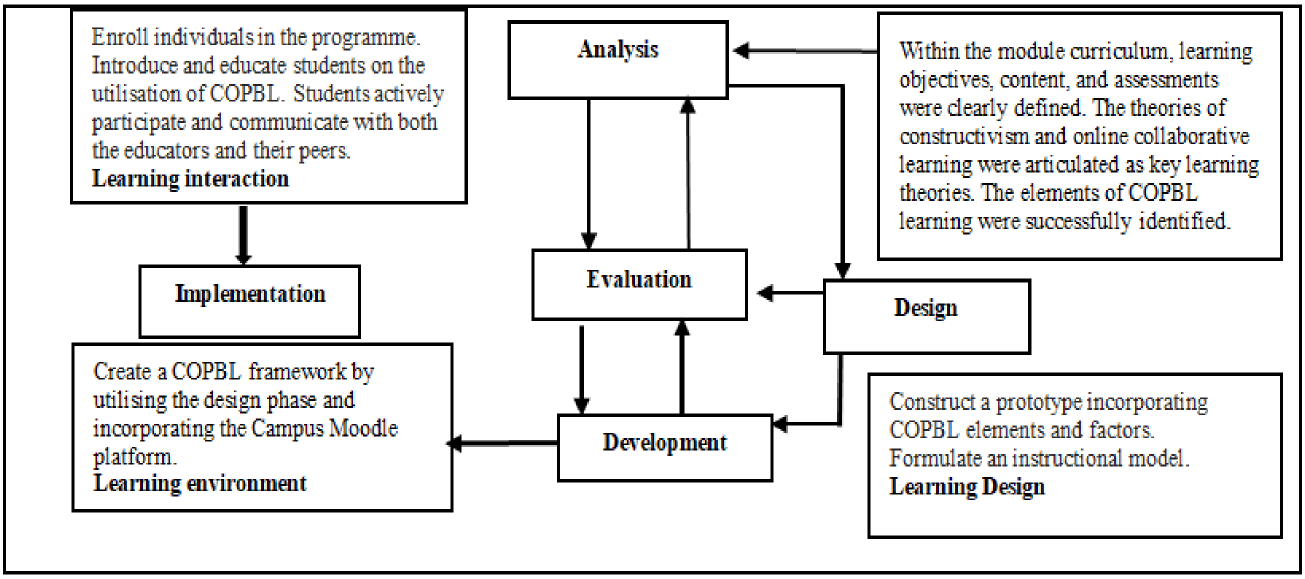

Fig 1. COPBL framework

VI. RESULTS AND DISCUSSIONS

In recent years, educational institutions have increasingly adopted learning management systems like Moodle and Aula to centralise teaching materials and activities (Carlos et al., 2013; Coates, James and Baldwin, 2005). Campus Moodle learning data was collected to accommodate student and educator preferences. A formative evaluation involving subject-matter experts ensured alignment between analysis data and module curriculum. Campus Moodle at the university offers tools for educators and students to manage teaching and learning effectively. Features like discussion forums facilitate communication and collaboration among students, allowing the use of external applications alongside the system's built-in tools. The COPBL instructional design supported the CL subject approach during the design phase, following modifications based on Ellis and Hafner (2009) to support data analysis. Feedback from subject-matter experts and online system designers was gathered through formative evaluations and redesigns to ensure data validity. Students engaged with project content and interacted with each other and educators using the designed system. A draft COPBL architecture was integrated into the university Campus Moodle after the design phase, addressing implementation, support, collaboration, hardware facilities, and teaching environment.

Formative evaluation forms were provided to staff and students for final revisions based on user feedback. The prototype was implemented and evaluated, with formative evaluation conducted to improve the COPBL management system and summarise learning satisfaction and outcomes. Evaluation leads to COPBL improvements and revision of insufficient content, as well as standardisation and value assessment of teaching modules. The ADDIE model is a systematic tool used by teaching designers to ensure quality in teaching design projects. It helps in constructing learning activities and provides a flexible structure for higher education teaching design (Fang, Zheng; Hu, and Shen, 2011).

Alpha testing is a necessary step to verify the quality of the prototype before moving on to Beta testing (Oladimeji, 2007). This testing phase involves school staff, specifically the subject matter expert in this study. During the Alpha testing phase, the staff conducted tests before evaluating the prototype's quality. Participants were asked about collaborating in a group setting (Q1) and using a learning management system in Campus Moodle (Q2). Beta testing requires educators and students to ensure that the proposed system is operational. Questions raised during this stage include: (Q1) ease of use, (Q2) clarity of instructions, (Q3) system stability, (Q4) suggestions for improvements, and (Q5) feedback on interface design. Tables 1 and 2 present the findings.

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Table 1. Findings of Alpha testing

Examiner	Response
1	Q1: Ideal for improving student outcomes. Q2: This tool can be used to support teaching and learning in any setting.
2	Q1: Students are able to communicate, interact, and share knowledge. Q2: Using Campus Moodle can improve student learning experience.
3	Q1: Utilising technology in engineering education has its benefits. Q2. It can help students better understand and engage with the material.
4	Q1. Improved communication among students can be facilitated. Q2. Effective techniques are essential for student skill development.
5	Q1: Employability skills can be enhanced. Q2: Yes
6	Q1. Promote student-centered learning. Q2. Utilise video recordings in the demonstration tab and dedicate another tab for additional information, readings, and background knowledge.

Table 2. Findings of Beta testing

Examiner	Response
Lecturer 1	The student instructions are clear, the menu is user-friendly, and the project handbook provides helpful guidance.
Lecturer 2	The student-friendly information, visually appealing colour scheme, and user-friendly login process make this project easy to conduct.
Lecturer 3	The system is flexible, with simple instructions and easy-to-use interfaces that make learning more accessible. The design is efficient and supports effective learning.
Lecturer 4	The Campus Moodle project guidelines are easy to follow. Well-structured layout.
Lecturer 5	The system icon the user needs can be located by following the on-screen instructions. Consistent text and colour are advantageous.
Students (group 1)	It equipped me with the necessary tools for effective communication with my colleagues.
Students (group 2)	All required information is accessible to complete tasks.
Students (group 3)	It is user-friendly. The learning environment facilitated the integration of theory and practice.

Students often face challenges in group projects, and educators play a crucial role in ensuring fair assessment methods. Educators helped groups establish norms, clarify roles, and set expectations. They built trust, provided individual support, and fostered a sense of community online. Collaborative project-based learning enhanced student engagement, with educators guiding the process. Students were grouped into teams, project details were defined, and a timeline was set. Educators recommended providing sample projects, hosting virtual drop-in sessions, and encouraging communication. Comprehensive project specifications and a project guide handbook were explained and distributed. Feedback from students was collected to address any concerns. The development phase involved creating training modules and activities using modern platforms to support project outcomes. Table 3 outlines the project proposal and execution phases.

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Table 3. A Roadmap to Optimal Results in COPBL Strategy Implementation

Duties	Task
Project Leader	Organises project seminars for students and supervisors, introduces COPBL, and promotes early involvement in project-based learning.
Project Administrator	Register students for the COPBL project module on CampusMoodle.
Students	Required to source a suitable project and submit a proposal that includes a Gantt Chart.
Project Moderators	Evaluates the project proposal and either approves it and assigns an academic supervisor or offers feedback and sets a resubmission deadline. Establishes the project goal and develops a schedule for execution. Organises students into teams for teamwork.
Students	Once the proposal is approved, students begin project work. Each group then starts the design phase of their project.
Students	Students in each group work together through campusMoodle forums to tackle online challenges and obstacles. Educators are tasked with offering guidance during this process.
Students	Regularly communicate with the academic supervisor and maintain a work diary. Students are responsible for project management.
Supervisors	Progress and monitoring: Supervision: improving supervisory skills, refining communication, and addressing negative attitudes. Collaboration: promoting interpersonal skills and teamwork among students and educators. Communication: enhancing communication skills for students and supervisors. Creative thinking and problem-solving: educators are fostering creativity and problem-solving skills through regular brainstorming sessions.
Students/supervisors	Submits projects and presents them to an assessment panel for evaluation. The panel assesses their presentation and projects and confirms the grades.
Projects Leader	COPBL appraises

A study was conducted to confirm that the prototype functioned as intended and met user expectations in alignment with the curriculum (Sefton-Green, Julian, Helen and Ola, 2009). This assessment was crucial to ensure the prototype could be effectively used for further research. Analysis of 195 students (~95%) showed that they actively engaged in group discussions, collaborative decision-making, and information sharing for the project. They effectively collaborated within their learning community on the online project-based content, enhancing their learning experience through communication and involvement in group activities. Students also actively participated in group problem-solving, primarily using technology for task completion, finding collaborative learning more effective than working alone. They stated that this approach enabled them to fully understand the subject matter and acquire deep knowledge. To enhance student engagement and collaboration, various methods were employed, such as discussion forums, emails, and meetings. Students were assessed individually based on collaborative work practices, with each team member completing a task component and sharing it for feedback. Peer feedback workshops were conducted to develop content for final projects, where students exchanged constructive feedback with random peers. Educators provided feedback on final project drafts, and students reflected on their learning experiences. Formative assessments were used to gauge engagement and address knowledge gaps, while summative assessments evaluated students' understanding of project concepts. A mid-project evaluation questionnaire measured student engagement and effectiveness of the project structure. The COPBL strategy combined traditional and e-learning benefits, fostering learning efficiency, academic comprehension, self-growth, participation, and empathy development. Educators can create groups, interact with students, track their progress, and evaluate their work through the learning management system. The strategy leveraged technology to facilitate access to information and promote communication through various media. Face-to-face lectures encouraged interaction, and the Likert scale questionnaire assessed self-assessment (Table 4).

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Table 4. Project Progress Evaluation from Student and Supervisor Perspectives

Tasks	Students' viewpoints Average (std. dev)	Students' viewpoints Evaluation	Supervisors' viewpoints Average (std. dev)	Supervisors' viewpoints Evaluation
1. The project resources enhance my learning.	4.20 (±0.2)	Agree	4.60 (±0.1)	Strongly Agree
2. I have set project objectives with my supervisor.	4.60 (±0.1	Strongly Agree	4.70 (±0.1)	Strongly Agree
3. The project module is well-organized and efficiently managed.	4.60 (±0.1)	Strongly Agree	4.70 (±0.1)	Strongly Agree
4. COBPL enhances problem-solving skills.	4.80 (±0.1)	Strongly Agree	4.80 (±0.1)	Strongly Agree
5. My supervisor has the necessary technical expertise.	4.20 (±0.2)	Agree	4.50 (±0.1)	Strongly Agree
6. My supervisor provides effective guidance.	4.20 (±0.2)	Agree	4.50 (±0.1)	Strongly Agree
7. The content is intellectually stimulating and well-delivered.	4.60 (±0.1)	Strongly Agree	4.60 (±0.1)	Strongly Agree
8. Assessment requirements and criteria are clearly defined.	4.50 (±0.1)	Strongly Agree	4.70 (±0.1)	Strongly Agree
9. I collaborate with my team to manage project information.	4.30 (±0.1)	Agree	4.40 (±0.1)	Strongly Agree
10. I am actively engaged in my learning experience.	4.50 (±0.1)	Strongly Agree	4.80 (±0.1)	Strongly Agree
11. Students seek guidance from the supervisor when issues arise.	4.20 (±0.2)	Agree	4.50 (±0.1)	Strongly Agree
12. I receive valuable feedback and guidance for improvement.	4.50 (±0.1)	Strongly Agree	4.80 (±0.1)	Strongly Agree

The questions were grouped based on soft skills dimensions and the Framework for Digital Competence. Overall, COPBL enhanced student learning experiences and skills development.

The five-point Likert scale was utilised to assess different aspects and yield clear outcomes. Students expressed their preferences based on Tables 5 and 6. Analysis of average scores revealed that the COPBL approach enhanced the quality of learning, understanding, and success. It also enhanced self-confidence, self-worth, accountability, engagement, and empathy. The combination of traditional and technology methods facilitated the practical application of academic concepts to project work, acquisition of advanced content, and development of soft skills. Creative, critical thinking skills scored highest, with improvements in time management, communication, and interpersonal skills. In a collaborative problem-based learning setting, students share knowledge, actively engage, and build connections around common learning objectives. Students found the COPBL work engaging for improving their digital skills. They valued the platform's diverse communication tools and the opportunity to share their experiences. COPBL is a user-friendly and adaptable learning platform that enhances course material, boosting student engagement in engineering subjects through technology, and enhancing student learning results. Throughout the process of acquiring knowledge, students are active participants rather than passive recipients, engaging in information-seeking and idea-sharing with their peers. This collaborative learning approach fosters a sense of connection and mutual dependence among learners, leading to the development of higher-level thinking skills and deeper levels of understanding. The outcomes of COPBL are typically assessed through measures such as student grades, satisfaction, and knowledge and skill gains demonstrated in student design projects. The positive impact of COPBL on creating a collaborative learning environment is evident through measurable outcomes and student feedback. To address the lack of real-life case studies in COPBL, industry projects-based and interactive practice videos have been incorporated to provide students with practical experiences. Workshops have been conducted to gather feedback and improve the inclusion of industry-related resources in COPBL. The implementation of a COPBL template with flexible access and multiple feedback channels has enhanced the interactive learning experience for students, fostering critical thinking and skill development. In order to improve accessibility to engineering simulators, the learning platform has been redesigned to integrate instructions for first-time users. The standard interface includes key information and interactive elements to engage students in the engineering process, promoting active participation and collaboration. Students have reported that COPBL stimulates their learning by exposing them to various digital technologies and allowing them to apply their knowledge to real-world tasks. Overall, COPBL is recognised as an effective and user-friendly learning environment that supports the development of digital skills. The survey results highlight the positive impact of project-based tasks on enhancing students' digital skills and problem-solving abilities. The detailed findings are presented in Tables 5 and 6.

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Table 5. Results of Soft Skills

Skills	Group Comment	Average (std. dev)	Evaluation
1. Problem solving	The use of COPBL enabled me to tackle specific problems, engage in a collaborative problem-solving process, enhance my creative thinking skills, and learn how to apply disciplinary knowledge.	4.90 (±0.05)	Strongly Agree
2. Communication	The communication tools provided by COPBL enabled me to effectively engage with colleagues and educators. This programme played a crucial role in enhancing my communication skills and fostering the development of my interpersonal skills through interactions with others, whether in one-on-one scenarios or group settings. I have the necessary technical expertise for the project and managed it efficiently.	4.80 (±0.1)	Strongly Agree
3. Collaboration	Engage in team meetings to enhance collaborative skills. Group tasks are advantageous for both the team and individual. Acquiring knowledge is more effective when learning within a group setting.	4.70 (±0.1)	Strongly Agree
4. Content creation	The COPBL played a crucial role in enabling me to develop digital products, improve my time management abilities, and acquire the art of giving and receiving constructive feedback.	4.60 (±0.1)	Strongly Agree
5. Processing information	Utilising COPBL enabled me to communicate information with my colleagues effectively. It is necessary to have group discussions as part of the decision-making process.	4.20 (±0.2)	Agree

Table 6. Results of Digital Skills

Project-based Activity	Digital Skill	Average (std. dev)	Evaluation
1. Employing simulator tools and applying personal knowledge.	Problem solving	4.90 (±0.05)	Strongly Agreed
2. Information is synthesised into a report.	Content creation	4.60 (±0.1)	Strongly Agreed
3. Collaboration through the utilization of various communication tools	Communication	4.60 (±0.1)	Strongly Agreed
4. Developing solutions for measuring, controlling, and monitoring operations.	Content creation	4.60 (±0.1)	Strongly Agreed
5. Remote access to digital environments is allowed.	Security	4.20 (±0.2)	Agree
6. Employ the use of online manuals, video tutorials, and technology to effectively search the internet for precise information.	Information processing	4.20 (±0.2)	Agree

VII. CONCLUSIONS

Engineering students need a combination of soft skills and digital proficiency to succeed in a competitive global market and meet industry requirements (Cascio & Montealegre, 2016). The COBPL management solution, developed using the ADDIE instructional design approach, aims to create an interactive project-based learning environment for students to engage with project content, peers, and educators. This collaborative approach allows educators to form groups, facilitate communication, track progress, and assess performance. A mixed-methods research methodology was used to analyse the benefits of the COPBL approach, which include promoting positive student interactions, enhancing comprehension of project tasks, and improving project management and development skills. The study found that integrating pedagogical strategies with technology enhanced employability skills, sustainability, innovation, academic performance, and marketable skills for engineering students. COPBL empowers students to apply knowledge to real-world challenges, fostering innovation to address the UN Sustainable Development Goals. Students work in small teams to develop and refine ideas that have a positive societal impact, market potential, and commercial viability, with a focus on creating new ventures. Research has shown that using COBPL improves student performance and helps students acquire digital skills and various soft skills like communication, collaboration, critical thinking, problem-solving, time management, and creativity. These skills enhance the hard skills required in today's competitive job market (Arnold-Smeets, 2015), ultimately improving students' employability prospects. The school can enhance graduates' employability and innovation by incorporating project-based learning with a student-centered collaborative approach that integrates pedagogy and technology. Robert Gordon University (RGU) has won the Energy Institute's Best Innovative Energy Project competition for the tenth year in a row, demonstrating its commitment to developing future leaders in innovation, sustainability, and entrepreneurship. This achievement showcases the RGU's dedication to providing high-quality education in sustainable energy engineering and producing highly employable graduates. The university received a certificate from the Energy Institute, the leading professional body in the energy industry, in recognition of 10 years of success in the best energy project competition. The consistent success of RGU students in the Energy Institute's competitions reflects their exceptional skills, employability, and RGU's dedication to providing top-notch sustainable energy engineering education.

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