UMS-ALIEN: UMS Active Learning in Engineering Education

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Abstract
The Universiti Malaysia Sabah Active Learning in Engineering Education (UMS-ALIEN) initiative, part of the UMS Future Ready Engineering Educators (UMS-Future) framework, introduces a structured, hierarchical approach to engineering education. The framework consists of ten progressive competency levels, starting with foundational active learning techniques and advancing to blended cooperative problem-solving methodologies. UMS-ALIEN integrates strategies such as cooperative learning, problem-based learning, and blended learning, supported by tools like Learning Management Systems (e.g., Moodle) and discipline-specific simulators (e.g., Aspen HYSYS). The initiative transitions educators from traditional roles to facilitators, fostering participatory learning environments that prepare students for real-world challenges. Implemented across multiple engineering courses, UMS-ALIEN demonstrates improvements in student performance and skill acquisition, earning international recognition for its innovative contributions to active and blended learning in engineering education.

Keywords: Active Learning; Blended Learning; Engineering Education; Cooperative Learning.

Introduction

The Universiti Malaysia Sabah (UMS) Active Learning in Engineering Education (UMS-ALIEN) initiative, refer to Figure 1, part of the UMS Future Ready Engineering Educators (UMS-Future) framework (see Figure 2), addresses the urgent need for innovation in engineering education. Traditional lecture-based approaches, while effective for content delivery, often fail to actively engage students, foster critical thinking, or bridge the gap between theoretical knowledge and practical applications. In response, UMS-ALIEN adopts a structured, hierarchical framework designed to transform engineering education through active and blended learning methodologies.

UMS-ALIEN features ten progressive competency levels, beginning with foundational active learning techniques and advancing to collaborative and cooperative problem-solving approaches. Each level represents an evolution in teaching strategies, enabling educators to transition from traditional roles to facilitators of student-centered learning. This progression emphasizes the cultivation of critical skills, including collaboration, problem-solving, and adaptability, which are essential for preparing industry-ready graduates (Felder, & Brent, 2007).

The framework is adaptable across various engineering disciplines, integrating both general and discipline-specific tools tailored to course objectives. For instance, Moodle serves as a versatile Learning Management System (LMS), while tools like Aspen HYSYS for chemical engineering, CAD software for mechanical engineering, and Python or MATLAB for computational tasks enhance discipline-specific learning. These tools enable the framework to support diverse instructional needs while maintaining a unified focus on active learning.

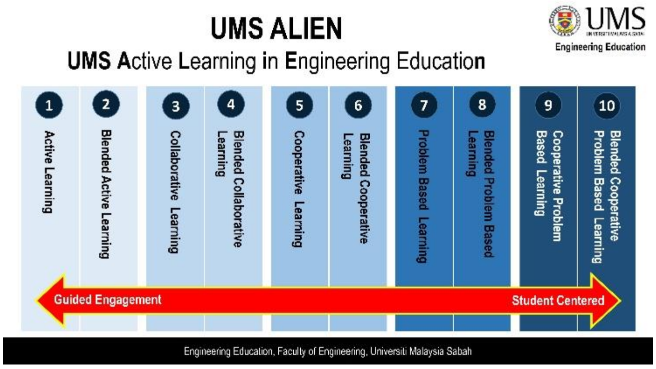

Figure 1. UMS Active Learning in Engineering Education (UMS-ALIEN)

Since its implementation, UMS-ALIEN has been successfully adopted in multiple engineering courses, showcasing significant improvements in student engagement, critical thinking, and learning outcomes. These outcomes are bolstered by the initiative's ability to blend digital tools with participatory teaching methodologies, creating dynamic learning environments. The hierarchical structure of UMS-ALIEN ensures educators are equipped to implement increasingly complex and impactful pedagogies, transforming the teaching and learning experience in engineering education (Prince, 2004).

Furthermore, UMS-ALIEN has gained international recognition for its innovative approach, particularly in areas such as micro-credentialing and blended learning. These achievements underscore the framework's potential as a model for modern engineering education, demonstrating its capacity to prepare students for real-world challenges in a rapidly evolving global landscape.

Figure 2. UMS Future Ready Engineering Educators (UMS-Future)

Conceptual Framework of UMS-ALIEN

The UMS-ALIEN framework presents a structured, hierarchical approach designed to enhance teaching and learning in engineering education. This framework comprises ten progressive competency levels, each building upon the previous to systematically transition educators from traditional teaching roles to facilitators of student-centered, active learning. The framework emphasizes the integration of active, blended, collaborative, and cooperative learning strategies, supported by both in-person and digital tools tailored to various engineering disciplines (Graham, 2013).

Hierarchical Learning Levels and Differentiated Approaches

The UMS-ALIEN framework organizes its learning levels to foster comprehensive skill development among educators and students. Initial levels introduce foundational active learning techniques, such as discussions and hands-on tasks, while maintaining educator guidance to ensure structured engagement. As competency levels increase, students are exposed to blended and collaborative learning methods that encourage teamwork, accountability, and communication.

Higher levels emphasize cooperative learning and problem-based learning (PBL), culminating in blended cooperative problem-solving, where students address complex, real-world engineering challenges (Freeman et al., 2014). This progression aligns with the demands of modern engineering education, preparing students to think critically and collaborate effectively in diverse, industry-relevant scenarios (Strobel, & van Barneveld, 2009).

Integration of Digital Tools Across Disciplines

A key strength of UMS-ALIEN is its adaptability across engineering disciplines, supported by the integration of digital tools. For example, LMS such as Moodle provide a platform for managing course content, facilitating discussions, and tracking progress. Discipline-Specific Tools such as Aspen HYSYS (chemical engineering), CAD software (mechanical engineering), MATLAB or Python (computational tasks), and Proteus (electrical engineering) ensure relevance to industry practices. These tools enable educators to tailor their teaching strategies to align with course objectives while providing students with hands-on experience in tools commonly used in their respective fields. This multidisciplinary adaptability ensures that UMS-ALIEN remains relevant and inclusive, catering to the diverse needs of engineering education while maintaining a unified, systematic approach (Johnson, et al., 2015).

Transition from Instructor to Facilitator

One of the most transformative aspects of the UMS-ALIEN framework is the transition it facilitates for educators, guiding them from traditional teaching roles to facilitators of active learning. As educators progress through the framework, their role evolves to empower students in self-directed learning, fostering independence and collaborative skills essential for lifelong learning. This shift aligns with the demands of the engineering industry, where graduates are expected to navigate complex challenges autonomously and collaboratively (Weimer, 2013).

Impact and Flexibility of UMS-ALIEN

UMS-ALIEN has been successfully implemented across multiple engineering courses, resulting in significant improvements in student engagement, problem-solving skills, and collaborative abilities. Its hierarchical structure provides a flexible model that can be adapted to different engineering disciplines and course requirements. Additionally, the framework's integration of active and blended learning methodologies ensures that it remains at the forefront of innovative teaching practices.

By bridging the gap between theoretical knowledge and practical application, UMS-ALIEN equips students with the skills needed to excel in the engineering industry. This systematic approach not only enhances teaching effectiveness but also prepares students for real-world challenges, illustrating the transformative potential of active and blended learning in engineering education.

Goals and Anticipated Outcomes

The UMS-ALIEN framework ultimately aims to prepare educators and students alike to embrace active and blended learning models. By systematically advancing through the competency levels, UMS-ALIEN fosters an engaging, participatory learning culture that enhances students' critical thinking, technical skills, and adaptability to real-world engineering challenges (Spady, 1994). This structured approach not only transforms the teaching and learning experience but also establishes UMS-ALIEN as a model for innovative engineering education that prepares future-ready graduates for a dynamic world.

Levels of Learning in the UMS-ALIEN Framework

The Levels of Learning in the UMS-ALIEN framework offer a sequential, structured pathway to progressively enhance both teaching effectiveness and student learning outcomes. This hierarchical design begins with foundational skills and advances to complex, collaborative methodologies, ultimately preparing students for real-world engineering challenges and enabling educators to facilitate deeper, student-centered learning.

1. Active Learning

At the foundational level, active learning engages students directly in the learning process through discussions, problem-solving activities, and hands-on tasks. Here, students begin developing basic analytical and application skills in a supportive, structured environment. Educators play an active role, guiding students and ensuring a robust understanding of key concepts.

2. Blended Active Learning

Building on active learning, blended active learning introduces a combination of face-to-face and online interactions to reinforce the material. This approach enables students to engage with learning materials at their own pace outside of the classroom, enhancing retention and encouraging independent study.

3. Collaborative Learning

In this level, students engage in group-based activities that promote teamwork and communication. Collaborative learning is designed to foster interdependence, as students work together to achieve common goals. Educators begin to take on a more supportive, facilitative role, encouraging students to take ownership of the learning process while still providing necessary guidance.

4. Blended Collaborative Learning

Blended collaborative learning incorporates digital tools and resources to support group-based activities in and out of the classroom. Students work together on shared projects or discussions via online platforms, which fosters continuous interaction and enables flexibility in collaborative engagement. This level builds communication skills and accountability among team members.

5. Cooperative Learning

Cooperative learning introduces structured team-based tasks, where each member is responsible for a specific role or task within the project. This approach not only emphasizes individual accountability but also enhances teamwork, as success depends on each member's contribution. Educators further transition into a facilitative role, supporting team dynamics and encouraging problem-solving within groups.

6. Blended Cooperative Learning

Here, cooperative learning is integrated with online components, allowing students to coordinate tasks and responsibilities digitally. Platforms like Moodle enable team members to communicate and track each other's progress, supporting an environment where teamwork and accountability are reinforced in both physical and virtual spaces.

7. Problem-Based Learning

Problem-based learning (PBL) challenges students with open-ended, real-world problems that require critical thinking, analysis, and solution-oriented approaches. In PBL, students actively engage with complex scenarios, applying theoretical knowledge to develop viable solutions. Educators guide this process by acting as facilitators, providing support without directly intervening in problem-solving.

8. Blended Problem-Based Learning

At this level, problem-based learning incorporates online tools to enhance flexibility and depth in addressing complex problems. Digital resources and simulations allow students to explore different problem-solving approaches and test solutions. This blended approach enables students to access resources, collaborate remotely, and delve deeper into analytical tasks.

9. Cooperative Problem-Based Learning

Combining elements of cooperative and problem-based learning, this level requires students to work in structured teams to tackle challenging, real-world engineering problems. Each team member takes on specific roles within the problem-solving process, promoting interdependence and critical thinking within the group. Educators function as mentors, encouraging independent inquiry and peer learning.

10. Blended Cooperative Problem-Based Learning

At the most advanced level, blended cooperative problem-based learning fully integrates online resources and digital platforms to support comprehensive, team-based problem-solving. Students work collaboratively on real-world engineering challenges, leveraging both in-person and virtual interactions to coordinate roles, discuss solutions, and apply technical skills in an immersive setting. This level cultivates high-level competencies in teamwork, critical thinking, and practical problem-solving.

Educator's Role and Student Autonomy

A core principle of the UMS-ALIEN framework is its emphasis on transforming the educator's role from a traditional instructor to a facilitator of active learning. This transformation aligns with the framework's hierarchical progression, guiding educators to adopt teaching practices that empower students to take ownership of their learning journey. As educators advance through the competency levels, their role evolves to support and nurture student autonomy, fostering an environment that encourages active participation, critical thinking, and collaboration.

Transitioning from Instructors to Facilitators

At the foundational levels, educators play a more directive role, introducing students to active learning techniques such as structured discussions, guided problem-solving, and hands-on tasks. These activities, while student-centered, are initiated and closely monitored by the educator to ensure proper engagement and understanding. As the levels progress, educators begin to adopt a facilitative approach, gradually transferring responsibility to students.

In the intermediate levels, the educator's role shifts to designing collaborative and cooperative learning activities, where students work in teams to tackle structured tasks. At this stage, educators serve as mentors, providing guidance and support while encouraging students to manage their team dynamics, contribute equitably, and make collective decisions.

At the advanced levels, particularly in problem-based and blended cooperative problem-solving contexts, educators fully transition into facilitators. Here, they provide minimal direct instruction, instead fostering a learning environment where students independently analyze complex problems, explore solutions, and apply technical skills collaboratively. This approach mirrors real-world engineering scenarios, preparing students for industry challenges by encouraging self-reliance and adaptability.

Promoting Student Autonomy

The UMS-ALIEN framework is designed to cultivate student autonomy by progressively reducing reliance on educator-led instruction. Through active and blended learning strategies, students are encouraged to take initiative in their education by engaging in self-directed learning activities, collaborating effectively with peers to solve open-ended problems and reflecting on their learning processes to identify strengths and areas for improvement.

This autonomy is further reinforced through the use of digital tools, such as Learning Management Systems and discipline-specific simulators, which enable students to access resources, revisit concepts, and practice skills independently.

UMS-ALIEN Implementation in Chemical Engineering Courses

The UMS-ALIEN framework has been effectively implemented across several chemical engineering courses at UMS, including Process Simulation, Programming, and Process Design. These courses, each with distinct learning objectives and challenges, were chosen for their relevance to UMS-ALIEN's active and blended learning methodologies, which help bridge the gap between theoretical concepts and practical applications in engineering education. The structured, progressive approach of UMS-ALIEN supports students in mastering essential engineering skills through real-world challenges and industry-aligned projects.

It should be noted that the UMS-ALIEN framework is designed around the individual engineering educator's competencies in implementing the ten hierarchical levels of the framework. The examples provided in this manuscript, which apply the blended-cooperative learning method, reflect the specific competency and expertise of the author in this approach. However, it is important to note that there are several ongoing implementations of UMS-ALIEN across different competency levels, representing diverse strategies and methodologies. These implementations, which further showcase the flexibility and adaptability of the framework, are not included in this manuscript but remain areas of active development and exploration.

1. Chemical Engineering Process Simulation

In Process Simulation, UMS-ALIEN incorporates a blended-cooperative learning framework designed to help students apply theoretical knowledge through simulation tools. Leveraging the TPACK (Technological, Pedagogical, and Content Knowledge) framework (Koehler et al., 2013), this course integrates UMS ITEL (Moodle), a self-paced process simulation MOOC, and the Aspen HYSYS Process Simulator (refer Figure 3). UMS ITEL is an e-learning platform based on Moodle version 4. These resources provide students with practical experience in simulating complex chemical processes, aligning with industry standards. The blended approach combines online modules with in-person support, allowing students to develop their skills in an interactive, self-directed environment that mirrors real-world engineering scenarios.

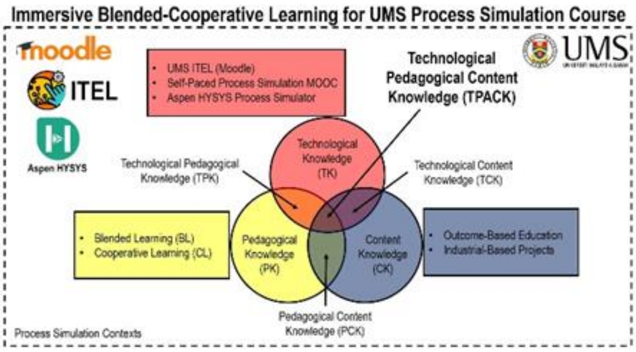

Figure 3. Immersive Blended-Cooperative Learning for UMS Process Simulation Course

2. Chemical Engineering Programming

For Programming, UMS-ALIEN utilizes a blended-cooperative learning model to build foundational technical skills and foster collaboration. The TPACK framework is applied here through UMS SmartV3 e-Learning (Moodle), MathWorks Online, and MATLAB Programming, as shown in Figure 4, which support both individual and team-based learning. UMS SmartV3 is an e-learning platform based on Moodle version 3. This setup enables students to gain proficiency in MATLAB while developing problem-solving skills critical for programming applications in engineering. The course's outcome-based design focuses on achieving measurable competencies in coding, troubleshooting, and team collaboration, which are reinforced through practical projects that reflect industry needs.

It should be noted that the pedagogical knowledge applied in the TPACK framework varies based on the delivery context of each course. For the Engineering Programming course, offered during the COVID-19 pandemic, the pedagogical approach emphasized online learning, leveraging fully virtual platforms to support remote instruction. In contrast, the Process Simulation course, conducted post-pandemic when students returned to campus, adopted a blended learning approach. This method combines face-to-face instruction with digital tools, providing a hybrid learning experience that integrates the flexibility of online resources with the benefits of in-person interactions.

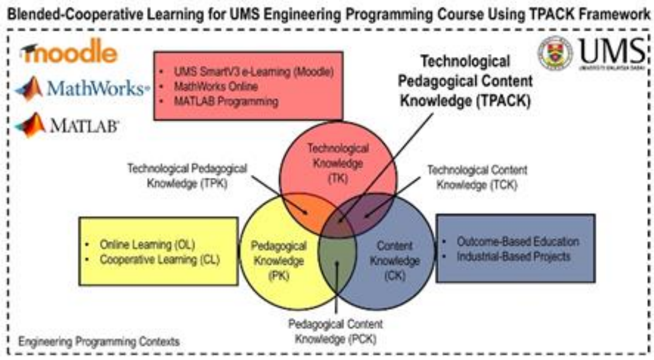

Figure 4. Blended-Cooperative Learning for UMS Engineering Programming Course

3. Chemical Engineering Process Design

The Process Design course integrates the blended-cooperative learning framework, using UMS ITEL (Moodle), UMS MOOC, and Aspen HYSYS Process Simulator (refer to Figure 5). This combination of digital and in-person resources enables students to work through complex design projects in teams, aligning closely with engineering design processes used in industry. Through outcome-based education (OBE) and industry-based projects, the course encourages students to tackle real-world challenges, from initial problem analysis to solution development. This hands-on approach enhances their technical expertise in process design and prepares them for engineering roles that require collaborative and innovative thinking.

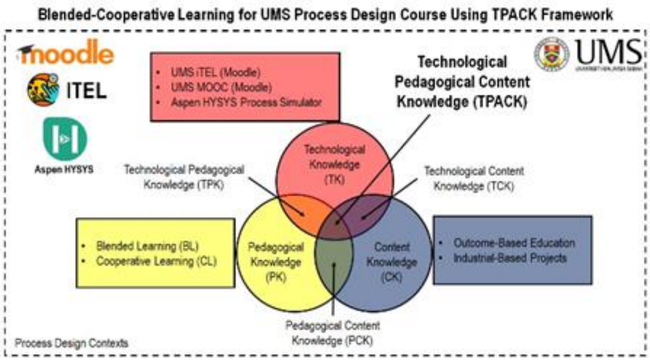

Figure 5. Blended-Cooperative Learning for UMS Process Design Course

Role of Digital Tools and TPACK Framework

The UMS-ALIEN framework integrates the TPACK framework to effectively combine digital tools with active and blended learning methodologies. This integration supports the hierarchical progression of teaching and learning levels by aligning technological resources with course objectives, pedagogical strategies, and discipline-specific content knowledge. By leveraging appropriate digital tools, UMS-ALIEN facilitates a flexible and inclusive approach to engineering education, accommodating diverse instructional needs and enhancing both teaching effectiveness and student engagement.

Strategic Integration of Digital Tools

Digital tools play a pivotal role in UMS-ALIEN, enabling educators to create dynamic learning environments that bridge theoretical concepts and practical applications. The framework incorporates tools tailored to specific engineering disciplines, ensuring relevance and effectiveness in achieving learning outcomes. Examples include:

- **Learning Management Systems (e.g., Moodle)**: Used as a platform for content delivery, assignment submission, and collaborative discussions across disciplines.
- **Discipline-Specific Tools**:
  - *Aspen HYSYS*: Supports process simulation in chemical engineering.
  - *MATLAB and Python*: Facilitate computational tasks and programming across multiple fields.
  - *CAD Software*: Enhances mechanical engineering design projects.
  - *Proteus*: Assists in circuit design for electrical engineering.

These tools not only provide practical, hands-on experience but also promote independent and collaborative learning by allowing students to engage with complex simulations, designs, and computations at their own pace.

Application of the TPACK Framework

The TPACK framework ensures a cohesive integration of technology, pedagogy, and content to optimize teaching and learning in UMS-ALIEN. For instance:

- **Technological Knowledge**: Digital tools like Aspen HYSYS and MATLAB are selected based on their alignment with course content and their ability to simulate real-world scenarios.
- **Pedagogical Knowledge**: Active, collaborative, and problem-based learning strategies are applied to create engaging and participatory learning experiences.
- **Content Knowledge**: Each tool is used to deepen students' understanding of engineering concepts, aligning with specific course objectives and industry requirements.

This alignment enables educators to tailor their teaching strategies to the unique needs of their courses while maintaining a consistent focus on student-centered learning.

Outcome-Based Education and Industry Alignment

A key component of UMS-ALIEN's implementation is its alignment with outcome-based education and industry standards. Each course incorporates industry-based projects, which provide students with realistic challenges that mirror professional engineering practices. Through these projects, students develop essential skills such as teamwork, technical proficiency, and adherence to industry standards. This alignment ensures that students are not only meeting academic goals but also acquiring competencies highly valued in the engineering field.

Student Benefits and Measurable Outcomes

The implementation of UMS-ALIEN in these courses has demonstrated positive outcomes, including increased student engagement, improved teamwork, and enhanced technical skills. Feedback from students has highlighted the value of interactive simulations and group projects in solidifying their understanding of complex engineering concepts. Additionally, UMS-ALIEN's success has been recognized through awards, further validating its impact on student learning and engagement in engineering education.

Future Applications and Scalability

Given the success of UMS-ALIEN in these courses, its methodology presents opportunities for expansion into other engineering disciplines at UMS. The framework's adaptability to different course structures and objectives positions it as a scalable model for engineering education, capable of preparing future-ready graduates across multiple fields (Halverson, & Graham, 2019).

UMS-ALIEN Impact Towards Teaching and Learning

The UMS-ALIEN framework has significantly advanced teaching and learning in engineering education at UMS. Its impact is reflected not only in international recognitions but also in tangible improvements in student engagement, knowledge retention, and critical thinking skills. By transforming educators into facilitators and employing innovative active and blended learning methods, UMS-ALIEN cultivates an interactive, skills-oriented learning environment that aligns with modern industry expectations.

Recognition of Micro-Credentialing Innovation

UMS-ALIEN's commitment to modular, flexible learning pathways has been widely recognized, especially for its pioneering use of micro-credentials. These focused learning units allow students to gain verified skills in specialized areas, adding value to their educational experience and enhancing their readiness for specific industry roles (Oliver, 2019). Key accolades include:

- **The Best Micro-Credential in e-CONDEV 2022**: This award highlights UMS-ALIEN's innovative approach to micro-credentialing, underscoring its role in promoting specialized, adaptable learning opportunities within engineering education.
- **Gold Medal in the MOOC Competition at e-CONDEV 2023**: This award for UMS-ALIEN's Massive Open Online Course (MOOC) demonstrates the framework's commitment to creating accessible, high-quality educational content, further extending UMS-ALIEN's reach and influence.

Achievements in Creative and Blended Learning Integration

UMS-ALIEN's excellence in integrating e-learning and active learning strategies has garnered significant recognition, emphasizing its creative and effective approach to modern education:

- **Gold Medal at i-PICTL 2022**: This award, received at the International Putra InnoCreative in Teaching and Learning, recognizes UMS-ALIEN's unique ability to engage students through active and immersive learning techniques. The accolade highlights the framework's creative contributions to enhancing the learning experience.
- **Gold Medal at IUCEL 2022**: Presented at the International University Carnival on E-Learning, this award underscores UMS-ALIEN's success in blending technology with pedagogy, making learning more interactive and accessible. It reflects the framework's versatility in adapting to diverse learning styles and environments.
- **Gold Medal at i-PICTL 2023**: Awarded again at the International Putra InnoCreative Expo, this recognition reaffirms UMS-ALIEN's impact on student engagement and cooperative learning in engineering education.

Direct Impact on Teaching and Learning Outcomes

The impact of UMS-ALIEN is also evident in measurable improvements in student learning outcomes and teaching effectiveness. By focusing on real-world applications and collaborative learning, the framework has increased student engagement, fostered higher-order thinking, and strengthened essential skills like teamwork and problem-solving.

Figure 6 presents the results of a thematic analysis of students' learning reflection journals from the KC32603 Process Simulation & Integration course. The analysis identifies the top 10 skills that students developed through their participation in the course, with the skills ranked according to their normalized scores.

Analysis of the Top Four Skills from Thematic Analysis:

1. **Teamworking (Highest Score):** Teamworking being the highest-scoring skill indicates that the KC32603 Process Simulation & Integration course strongly promotes collaboration among students. This is crucial in engineering, where projects often require multidisciplinary teamwork to solve complex problems. The high score suggests that students are not only engaging in teamwork but also mastering the ability to work effectively in teams, sharing responsibilities, and learning from each other.

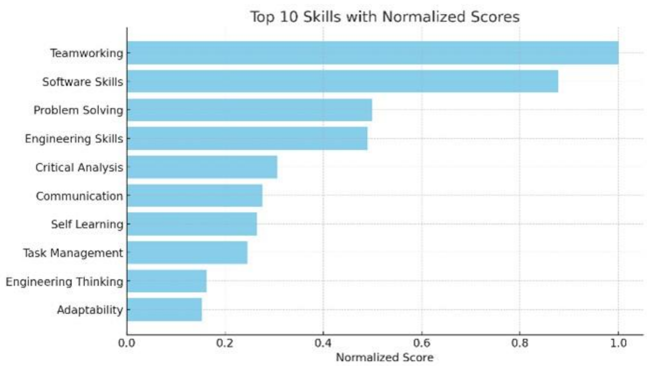

Figure 3: Top 10 Skills Developed by Students under IBCL Implementation

2. **Software Skills:** The significant emphasis on software skills highlights the course's focus on ensuring students are proficient with the technical tools required in the engineering industry. This likely includes simulation software such as Aspen HYSYS, which is central to process engineering. The high score in software skills indicates that students are gaining practical,

hands-on experience with these tools, which is essential for their future roles in the industry where digital competency is increasingly important.

3. **Problem Solving:** Problem-solving is a critical skill in engineering, and its high ranking reflects the course's success in developing students' abilities to approach and resolve complex challenges. The course likely uses PBL techniques to engage students in real-world scenarios, requiring them to apply their knowledge and critical thinking skills to find effective solutions. This skill is particularly vital in process simulation, where students must navigate and resolve intricate system behaviors and design issues.
4. **Engineering Skills:** The high score in engineering skills underscores the course's effectiveness in teaching core engineering principles and practices. Students are likely engaging in activities that require the application of theoretical concepts to practical situations, bridging the gap between classroom learning and real-world engineering. This suggests that the course successfully equips students with the fundamental engineering skills needed for their professional careers, ensuring they can translate academic knowledge into practical applications.

Feedback and Future Influence

Feedback from students and educators highlights the value of UMS-ALIEN's practical and interactive learning approach. Students appreciate the hands-on projects and simulations that enhance their understanding of complex engineering concepts, while educators find the framework beneficial for fostering an active learning culture. The continuous recognition and success of UMS-ALIEN emphasize its potential to influence engineering education broadly, offering a scalable model adaptable across various disciplines and institutions.

Conclusion

The UMS-ALIEN framework has proven to be a transformative approach in engineering education, significantly advancing teaching practices and student learning outcomes at UMS. By integrating active and blended learning models with digital tools, UMS-ALIEN equips students with essential skills, such as critical thinking, collaboration, and problem-solving, that are crucial for thriving in today's complex, fast-paced engineering environments. Through its structured, progressive learning levels, the framework not only engages students but also enables educators to transition from traditional instructional roles to facilitators of interactive, student-centered learning.

UMS-ALIEN's success is evidenced by measurable improvements in student engagement, higher-order thinking, and teamwork across multiple courses. For instance, the implementation of cooperative problem-based learning, supported by digital tools like Aspen HYSYS, has allowed students to work collaboratively on realistic engineering challenges, resulting in improved technical competencies and industry-aligned skills. Furthermore, the international recognition of UMS-ALIEN's innovative approach, including awards such as the Best Micro-Credential in e-CONDEV 2022, highlights its impact on e-learning and micro-credentialing, underscoring the framework's role as a benchmark in modern engineering education.

Looking ahead, UMS-ALIEN offers substantial potential for scalability, presenting a versatile model adaptable across other engineering disciplines and institutions. By expanding its application, UMS-ALIEN could serve as a foundational approach to education reform, promoting active and blended learning in diverse academic contexts. As the framework continues to evolve, it can inspire educational institutions worldwide to adopt modular, adaptable learning pathways that prepare students for real-world challenges.

In summary, UMS-ALIEN has established itself as a pioneering framework that aligns with industry expectations and prepares future-ready graduates. Its achievements serve as a call to action for educators and institutions to explore similar innovative pedagogies, positioning UMS-ALIEN as a model for driving impactful, student-centered learning in engineering education and beyond.

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Conflict of Interest

The author declares no conflict of interest.

References

Felder, R.M., Brent, R., (2007). Cooperative learning. Active Learning: Models from the Analytical Sciences, vol. 970. ACS Symposium Series. 34–53.

Freeman, S., Eddy, S. L., McDonough, M., Smith, M. K., Okoroafor, N., Jordt, H., & Wenderoth, M. P., (2014). Active learning increases student performance in science, engineering, and mathematics. Proceedings of the National Academy of Sciences, 111(23), 8410–8415.

Graham, C. R. (2013). Emerging practice and research in blended learning. Handbook of Distance Education, 333–350.

Halverson, L. R., & Graham, C. R. (2019). Learner engagement in blended learning environments: A conceptual framework. Online Learning, 23(2), 145–178.

Johnson, L., Adams Becker, S., Estrada, V., & Freeman, A. (2015). Horizon report: 2015 higher education edition. New Media Consortium.

Oliver, B. (2019). Making micro-credentials work for learners, employers, and providers. EdTech Journal, 45(3), 127–134.

Prince, M. (2004). Does active learning work? A review of the research. Journal of Engineering Education, 93(3), 223–231.

Spady, W. G. (1994). Outcome-based education: Critical issues and answers. American Association of School Administrators.

Strobel, J., & van Barneveld, A. (2009). When is PBL more effective? A meta-synthesis of meta-analyses comparing PBL to conventional classrooms. Interdisciplinary Journal of Problem-Based Learning, 3(1), 44–58.

Koehler, M. J., Mishra, P., & Cain, W. (2013). What is Technological Pedagogical Content Knowledge (TPACK)?, 193 (3), 13-20.

Weimer, M. (2013). Learner-centered teaching: Five key changes to practice. John Wiley & Sons.