

INTEGRATION OF KNOWLEDGE AT THE KULLIYAH OF ENGINEERING

NASSERELDEEN AHMED KABBASHI^{1*}, SANY IZAN IHSAN²,
AISHA HASSAN HASHIM³

^{1*}*Chemical Engineering & Sustainability Dept. Kulliyah of Engineering, International Islamic University Malaysia (IIUM), Gombak, Malaysia*

²*Mechanical and Aerospace Engineering Dept. Kulliyah of Engineering, International Islamic University Malaysia (IIUM), Gombak, Malaysia*

³*Electrical and Computer Engineering Dept. Kulliyah of Engineering, International Islamic University Malaysia (IIUM), Gombak, Malaysia*

**Corresponding author: nasreldin@iium.edu.my*

(Received: 3 January 2023; Accepted: 20 March 2023)

ABSTRACT: The Kulliyah of Engineering (KOE) at the International Islamic University Malaysia (IIUM) has been one of the leading institutions in the country since 1994, offering engineering education to students from all over the world. With its wealth of experience, the KOE has established different strategic plans over the years to improve its academic standards. The faculty provides undergraduate and postgraduate programs in various fields of engineering, such as chemical, civil, electrical, mechanical, manufacturing, mechatronics, and computer engineering. Despite having an excellent academic curriculum, there is still a significant gap in the integration of knowledge across different courses, which could hinder the overall learning experience of the students.

To bridge this gap and provide a more comprehensive approach to education, there is a need to integrate knowledge from various courses and disciplines. This approach will enable students to understand the relationships between different areas of study and better equip them to solve complex problems in the real world. Integrating knowledge from various courses will not only improve the overall quality of education but also increase the employability of graduates as they will possess a diverse set of skills that are highly sought after in today's job market.

ABSTRAK: Kulliyah Kejuruteraan (KOE) di Universiti Islam Antarabangsa Malaysia (IIUM) telah menjadi salah satu institusi terkemuka di negara sejak tahun 1994, menawarkan pendidikan kejuruteraan kepada pelajar dari seluruh dunia. Dengan pengalaman yang kaya, KOE telah menetapkan pelan strategik yang berbeza selama bertahun-tahun untuk meningkatkan standard akademiknya. Fakulti ini menyediakan program sarjana dan siswazah dalam pelbagai bidang kejuruteraan, seperti kejuruteraan kimia, awam, elektrik, mekanikal, pembuatan, mekatronik, dan kejuruteraan komputer. Walaupun mempunyai kurikulum akademik yang cemerlang, terdapat jurang yang besar dalam pengintegrasian pengetahuan di antara kursus yang berbeza, yang boleh menghalang pengalaman pembelajaran keseluruhan pelajar.

Untuk menyelesaikan jurang ini dan memberikan pendekatan pendidikan yang lebih komprehensif, terdapat keperluan untuk mengintegrasikan pengetahuan dari pelbagai kursus

dan disiplin. Pendekatan ini akan membolehkan pelajar memahami hubungan di antara bidang pengajian yang berbeza dan mempersiapkan mereka dengan lebih baik untuk menyelesaikan masalah kompleks dalam dunia sebenar. Mengintegrasikan pengetahuan dari pelbagai kursus tidak hanya akan meningkatkan kualiti pendidikan secara keseluruhan tetapi juga meningkatkan kebolehpasaran graduan kerana mereka akan mempunyai set kemahiran yang pelbagai yang sangat dicari dalam pasaran kerja hari ini..

KEYWORDS: *Integration of knowledge, KOE, ethical responsibility*

1. KOE IIUM

In March 1994, the Kulliyah of Engineering (KOE) was established with a few departments. The Kulliyah's vision is to become a global center for innovative engineering education and research with values and professional ethics. Its mission is to be a top-tier center for engineering education and research that upholds moral principles. The goal is to advance society by providing top-notch academic and professional services that are innovative and competitive. The objectives are to create graduates with high professional ethics who are globally recognized, to deliver homegrown research products such as publications, patents, intellectual properties, and commercialization, and to provide first-rate services such as consulting, training, and continuous education that exceed customers' expectations.

The engineering programs offer an integrated and comprehensive education that transcends the boundaries of various fields. This is in line with the Kulliyah's philosophy, which is founded on a systems approach. The approach is based on the Islamic idea of tawhid, which harmonizes the spiritual and material aspects of life. The graduates will develop spiritual, intellectual, moral, and ethical qualities to establish an integral and harmonious relationship with Allah (the Creator), other people, and the environment, in addition to being professionally trained and competent. The multidisciplinary approach to engineering education will enable the graduates to manage changes in accordance with the worldview based on the principles of Islam and help them solve industrial and human problems. Engineers are concerned with time, economy, and values that characterize the application of scientific concepts, in addition to knowing them. In light of this, the Kulliyah cultivates close ties with businesses, governments, the IIUM community, and the general public. The Kulliyah has an obligation to carry out effective research programs that expand knowledge, in addition to its role as a teacher.

2. COLLABORATIVE LEARNING IN ENGINEERING EDUCATION

The initial revelation to the Prophet (PBUH) asserts that Islam is a religion founded on knowledge and education. Islam perceives education and learning as a divine command from Allah Subhanahu Wa-Ta'ala ([1], [2], [3], [4], and [5]). In essence, Islam divides knowledge into two categories: revealed knowledge and acquired knowledge (non-revealed knowledge) ([6], [7]). Revealed knowledge, which every Muslim must learn, includes an understanding of hijjah, zakat, and salah (prayer) [7]. Acquired knowledge, which is not mandatory in Islam, is the knowledge that one may obtain but is not required to. However, it may be essential for individuals to acquire this knowledge to thrive in their environment. Acquired knowledge may encompass practical and behavioral sciences, technology, medicine, biological sciences, and the arts, according to prominent Muslim intellectuals like Al-Attas. Knowledge gained through

these means helps individuals achieve practical goals in society ([8], [9], [10], and [11]). Both types of knowledge are required for the appropriate growth of society and individuals in the socioeconomic system. While acquired knowledge helps people manage society, revealed knowledge helps individuals manage themselves (self-management) ([12] and [13]).

In cognitive reorganization, knowledge integration emphasizes the growth of increasingly interconnected networks of concepts instead of a collection of disjointed ones [14]. Integrated knowledge ties together, relates, and unites ideas across a variety of contexts. Students integrate their knowledge by investigating, identifying, organizing, and synthesizing ideas and information to evaluate their experiences and find solutions to challenges.

2.1 What does education's integration of knowledge mean?

Knowledge integration is the process of combining previously unrelated knowledge structures into a cohesive whole. Developing a deep understanding of a concept requires pupils to create connected knowledge structures based on its primary notion.

To create a coherent explanation of scientific facts, it is essential to integrate new concepts and identify connections. This process is known as knowledge integration. The research compared student performance on knowledge-integration-focused inquiry exams to their performance on multiple-choice tests. Integrating revealed and acquired knowledge promotes the full development of a student's body, soul, and spirit. By using integrated curricula, students can gain a deeper understanding of course material and learn to apply what they have learned in real-world scenarios. Ultimately, this prepares them for future coursework, careers, and life.

Integrating knowledge involves combining fields of knowledge, ideas, and skills to create a more comprehensive and holistic understanding of a topic. This requires synthesizing information from various disciplines, experiences, and perspectives to create a more complete picture of a given subject.

Breaking down barriers between different disciplines and promoting interdisciplinary thinking are essential components of knowledge integration. This encourages the application of knowledge and skills from multiple fields to address complex problems. Understanding how different fields are interconnected and leveraging this understanding to generate innovative solutions is a critical aspect of knowledge integration.

In essence, the integration of knowledge encourages a more nuanced and sophisticated approach to learning and problem-solving by drawing on the best practices and insights from various fields and perspectives. This can lead to more creative and effective solutions that take into account a broader range of factors and considerations.

2.2 Environmental knowledge integration

Research on Knowledge Integration Environments has shown that constructing new knowledge is more challenging than simply learning new ideas. In order to gain new knowledge, Knowledge Integration Environments typically require us to challenge and modify our preexisting information and ideas. This upheaval can arise from a variety of sources, such as a colleague's feedback, a passage in a book, or an observation in a classroom that raises doubts about our current assumptions.

Each word associated with the Knowledge Integration process indicates a supporting action. For example, making predictions prompts critical thinking; connecting with coworkers or materials adds new ideas; comparing ideas enables us to identify key characteristics, and explaining helps us reflect on our ideas so that they form a cohesive whole. By helping your team to consider the types of activities that will enable you to elicit, add, distinguish, and reflect on essential concepts related to content and instruction, the Knowledge Integration Environment can provide a useful perspective for lesson study.

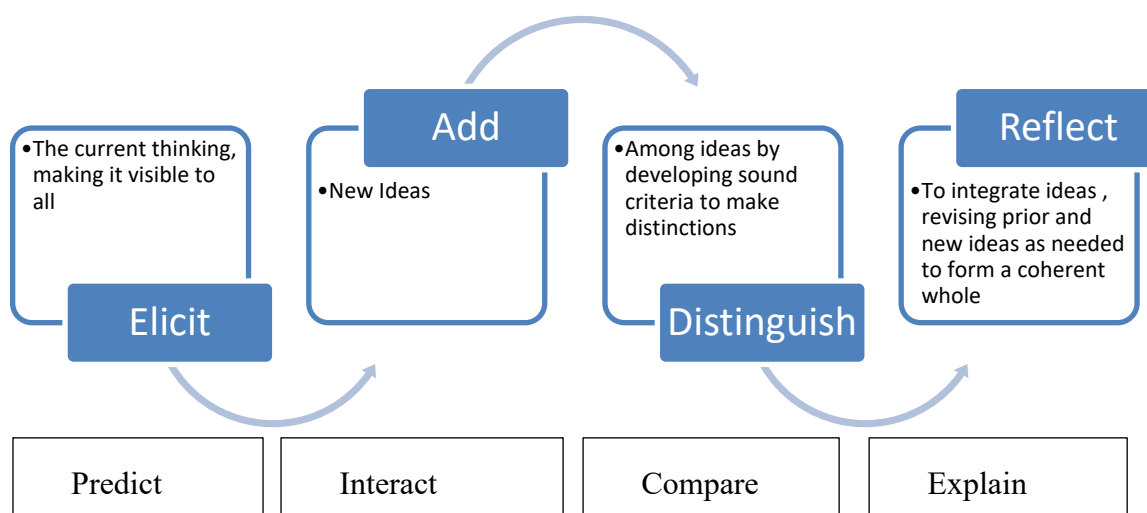


Fig 1: Knowledge Integration Framework, based on [15]

3. INTEGRATED OF KNOWLEDGE AT THE KOE

Since its establishment in 1994, the Knowledge Integration Environment (KOE) has been undergoing continuous development to align with international players in engineering education. The KOE periodically revises its strategic plan to ensure its relevance to international syllabi, societal needs, and Islamic values and ethics, in accordance with its vision and mission as well as those of the International Islamic University Malaysia (IIUM). The KOE has taken several steps to integrate knowledge to attain premier status, both locally and internationally.

In 2022, the KOE revisited its strategic plan and established a timeline for strategic measurement. Engagement with various members of the Kulliyah was conducted through performance reviews at each office and departmental level. The findings were then presented and deliberated in a strategic planning workshop, which included the Kulliyah Board members, executive members, selected senior members, and other members of the Kulliyah. Designing a strategic plan and integrating data and tools for the benefit of the KOE requires expertise from a variety of heterogeneous data sources and technologies. These days, integrating tools and data is a time-consuming and error-prone operation due to the variety of engineering data. Manual means or point-to-point integration are not advantageous to achieve

such goals, as they may be feasible for a small number of KOE communities and data sources but quickly become highly difficult. The likelihood of errors and the amount of work required for integration both increase as the number of parts grows. The suggested strategic plan has been tested and will guide the KOE for the coming years, as shown in Figure 2.

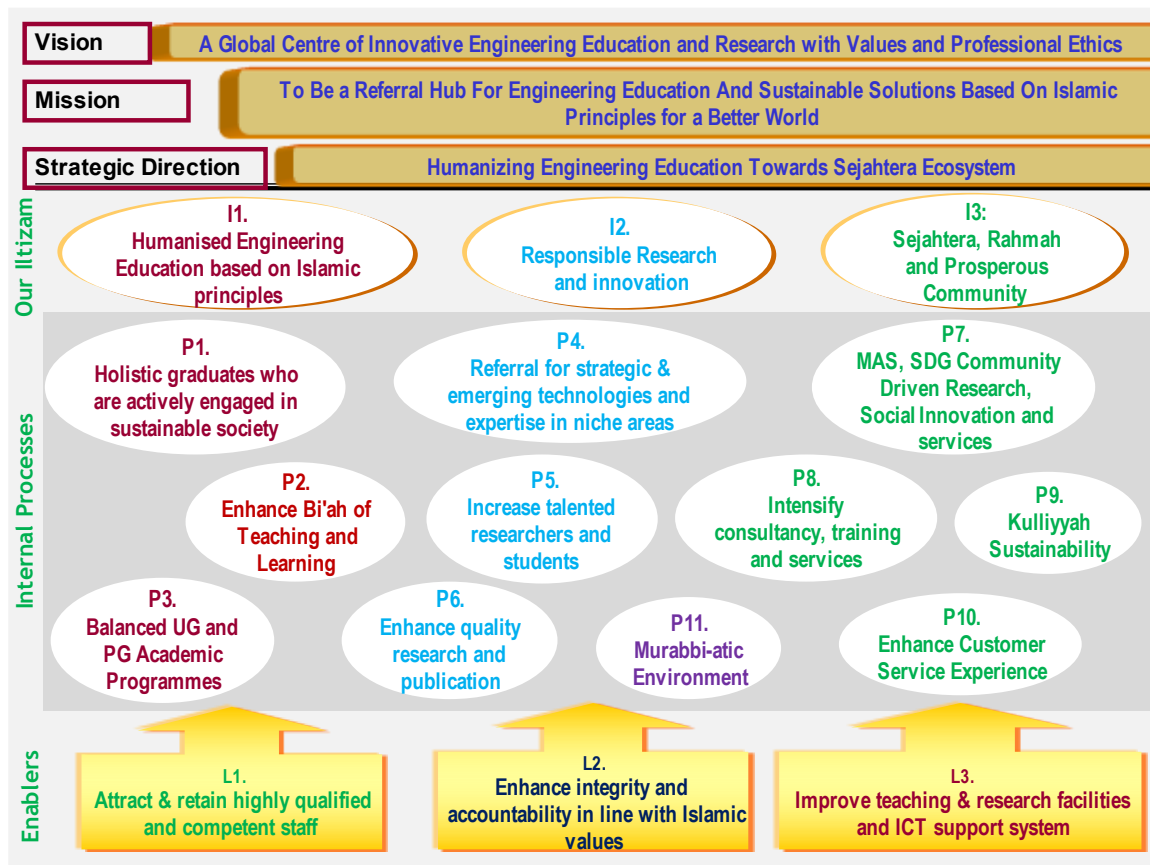


Fig. 2: KOE Strategic Planning and roadmap 2022-2024.

The ability to effectively participate in a learning process at a behavioral and motivational level is referred to as learning engagement. Students who are engaged in learning take ownership of their choices, use feedback, evaluate their personal conduct, and actively work towards continuous improvement, while accepting accountability and responsibility for their actions. The KOE aims to foster continuous and lifelong learning by setting learning goals, using feedback to develop effective strategies for improvement, and monitoring and adapting to changing learning needs and behaviors when faced with new settings or interactions with others.

3.1 Tangible Evidence of Integrating of Knowledge

Here are some examples of tangible evidence that demonstrate the integration of knowledge at the Kulliyah of Engineering, IIUM:

1. Interdisciplinary research collaborations: Faculty members and students from different engineering disciplines collaborate on research projects that tackle

- complex, multidisciplinary problems. For example, a team of mechanical, electrical, and civil engineering students could work together to design an energy-efficient and sustainable building.
2. Cross-disciplinary courses and programs: The Faculty of Engineering offers courses and programs that are designed to integrate knowledge from multiple disciplines. For instance, students may take a course on "Engineering and Society," which explores the social, ethical, and cultural dimensions of engineering.
 3. Industry partnerships: The Faculty of Engineering partners with industry to provide students with hands-on experience in applying their knowledge to real-world problems. For example, a team of Chemical engineering collaborated with IWK and succeeded in production of enzymes for large scale, as well as producing compost for the IIUM, Gombak campus. For instance, the faculty collaborated with a leading Malaysian engineering firm to provide students with internships and practical training in the design and implementation of sustainable infrastructure.
 4. International collaborations: The Faculty of Engineering has partnerships with universities and research institutions around the world. These collaborations provide opportunities for students and faculty members to work with people from different cultures and backgrounds and to learn from their perspectives and experiences.
 5. Innovative teaching methods: The Faculty of Engineering uses innovative teaching methods, such as project-based learning, flipped classrooms, and experiential learning, to promote integration of knowledge. These methods help students to connect theory with practice and to apply their knowledge in creative ways.
 6. Student clubs and organizations: The Faculty of Engineering has several student clubs and organizations that provide opportunities for students to work on projects and participate in competitions that require integration of knowledge from multiple disciplines. For example, the Robotics Club brings together students from electrical, mechanical, and computer engineering to design and build robots for various applications.
 7. Student Projects: The faculty encourages students to work on interdisciplinary projects that integrate knowledge from multiple fields. For example, students from different departments collaborated to design and build a solar-powered electric car, which required knowledge from electrical engineering as well as mechanical engineering.
 8. Islamic Perspectives: The faculty integrates Islamic perspectives into the engineering curriculum, providing students with a unique perspective on engineering that incorporates ethical and moral considerations. For instance, the course "Islamic Environmental Ethics and Engineering" explores the intersection of Islamic ethics and environmental science, helping students understand the broader implications of their work.

Overall, these examples demonstrate the commitment of the Kulliyah of Engineering, IIUM, to promoting integration of knowledge and to providing students with the skills and knowledge they need to tackle complex problems in a rapidly changing world.

3.1.1. Lower and Upper-level integrated knowledge

Lower-level integrated knowledge involves several important skills, including the ability to gather, review, analyze, organize, and interpret information relevant to solving problems. It

also involves synthesizing new knowledge with prior experiences and determining whether tried-and-true methods are appropriate for solving various problems. In addition, individuals with lower-level integrated knowledge demonstrate an understanding of how different pieces of knowledge are related and connected across different contexts.

Upper-level integrated knowledge, on the other hand, is characterized by the ability to interpret relevant information and make connections between different contexts in order to solve complex problems. Individuals with this level of knowledge also possess the ability to synthesize, integrate, and apply knowledge in creative and innovative ways, often resulting in the development of new perspectives and solutions to problems.

3.2 IIUM Integration of Knowledge Road Map

IIUM is one of the higher education institutions that offer an international model of Islamic education by efficiently integrating revealed and human knowledge. The International Islamic University Malaysia (IIUM) is a renowned institution of higher learning that has developed a unique roadmap called the Integration of Knowledge Road Map (IOK). The IOK is a distinctive approach to education that emphasizes the integration of various fields of knowledge to provide a holistic understanding of the world.

The IOK was first introduced in 1983 and has since been integrated into the university's curriculum. The IOK model emphasizes the integration of Islamic knowledge with other areas of knowledge such as science, technology, humanities, social sciences, and management. The purpose of this integration is to create a comprehensive understanding of the world that combines traditional Islamic knowledge with modern disciplines.

The IOK model also emphasizes the importance of critical thinking, creativity, and problem-solving skills. Students are encouraged to think critically and analytically to solve complex problems in various fields.

The IOK model has been widely recognized as a unique and effective approach to education. It has produced graduates who are well-rounded, knowledgeable, and equipped with the skills needed to succeed in a rapidly changing world.

In conclusion, the Integration of Knowledge Road Map is a unique approach to education that emphasizes the integration of various fields of knowledge to provide a holistic understanding of the world. The IOK model has been widely recognized as a distinctive and effective approach to education that produces well-rounded and knowledgeable graduates.

The Islamic way of life is the foundation for the staff, students, curriculum, syllabus, research, and community service, as shown in Figure 1.

3.2.1 Evidence of learning engagement

To ensure the learning engagement at the KOE here are some evidence points.

- Attendance: High attendance rates in lectures, tutorials, and other learning activities could indicate high learning engagement.
- Participation: Active participation in class discussions, group work, and other learning activities could indicate that students are engaged in the learning process.

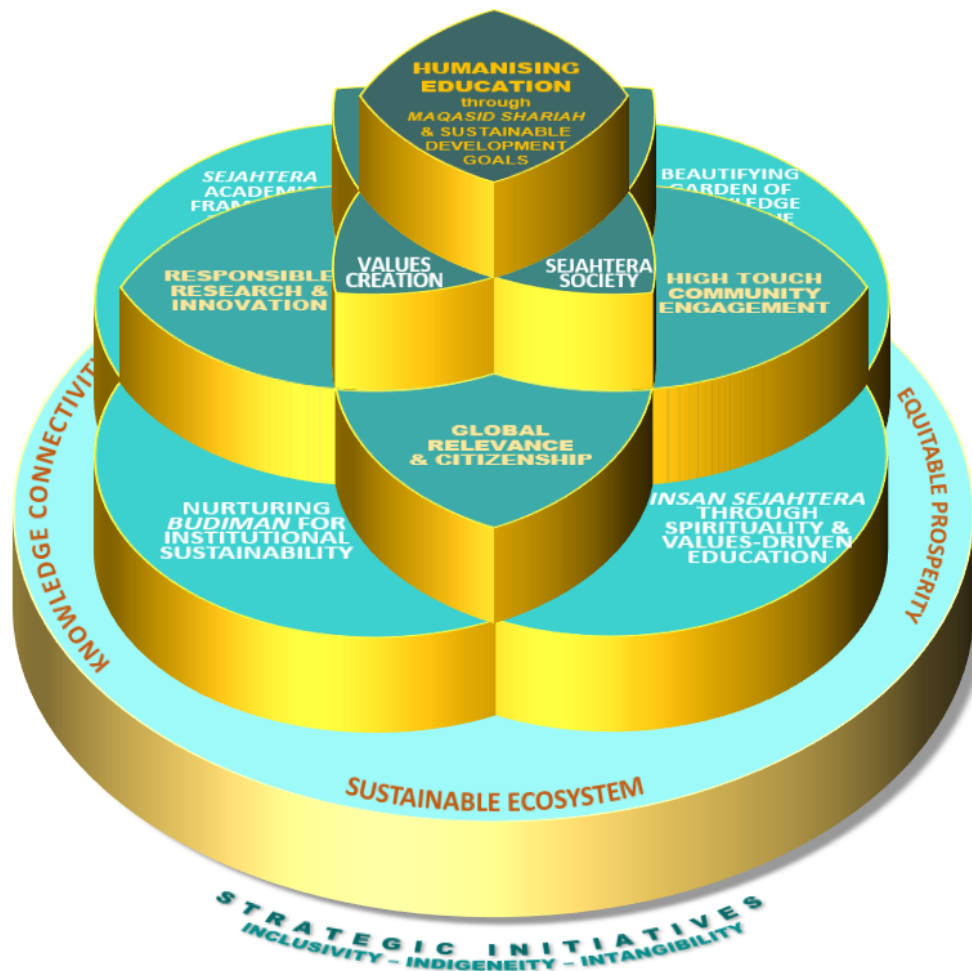


Fig. 1: IIUM roadmap 2021-2022.

- Assignments and projects: The quality and quantity of work produced by students could be an indicator of their level of engagement with the course material.
- Feedback: Students providing feedback on the course and their learning experience could indicate their engagement and interest in the course material.
- Collaboration: Students collaborating with their peers and faculty members on research, projects, and community outreach programs could indicate high levels of engagement and interest in their field of study.
- Involvement in extracurricular activities related to engineering: Students participating in engineering-related clubs, events, and competitions could demonstrate their engagement and passion for their field of study.
- Learning communities and social networking
- Performance reviews and plans for employees
- Ibadah camp

- ePortfolios
- Personal development talk
- Usrah programme
- Monthly spiritual talk.
- Annual reports and audits.

It is important to note that these factors may not be conclusive evidence of learning engagement on their own, but rather could be considered as part of a broader picture of students' engagement in their learning.

3.2.2 Lower and Upper-level learning engagement

Less sophisticated learning engagement involves setting learning objectives and working towards achieving them, using feedback to inform learning objectives and strategies for improvement, completing tasks and learning objectives independently, actively engaging in and taking responsibility for one's own learning and work, identifying and assessing knowledge, abilities, and skill gaps, and implementing improvement tactics.

On the other hand, a higher level of learning engagement entails identifying and evaluating one's own knowledge, skill, and ability gaps, and understanding how these gaps may impact one's perspectives, analyses, and interpretations. Actively engaging in learning and work with the aim of continuous improvement, accepting accountability and responsibility for both, building on learning goals to engage in continuous and lifelong learning, and using feedback to construct effective strategies for improvement.

4. INTEGRATING ETHICS AND SOCIAL RESPONSIBILITY IN ENGINEERING EDUCATION

Integrating ethics and social responsibility in engineering education is an important aspect of preparing future engineers to be responsible, ethical, and socially conscious professionals. The International Islamic University Malaysia (IIUM) can adopt several strategies to integrate ethics and social responsibility into engineering education.

Incorporate ethics and social responsibility courses: IIUM can incorporate ethics and social responsibility courses into the engineering curriculum. These courses can be standalone courses or integrated into existing courses. The courses can cover topics such as ethical decision-making, sustainability, social justice, and cultural awareness.

Encourage service-learning projects: IIUM can encourage engineering students to participate in service-learning projects that address social and ethical issues. These projects can be community-based, and students can work with community organizations or non-governmental organizations (NGOs) to solve real-world problems. These projects will provide students with hands-on experience in applying their engineering skills to solve problems while also addressing social and ethical concerns.

Establish industry partnerships: IIUM can establish partnerships with industry leaders to provide students with opportunities to learn from industry experts. Industry leaders can provide insights into ethical and social responsibilities in the workplace and share real-life experiences with students.

Promote research in ethics and social responsibility: IIUM can encourage research in ethics and social responsibility within the engineering faculty. Faculty members can conduct research on topics such as sustainable engineering, social justice, and cultural awareness. This research can provide valuable insights into ethical and social responsibilities in the engineering profession.

Create an ethics and social responsibility committee: IIUM can create a committee that focuses on ethics and social responsibility in engineering education. The committee can be comprised of faculty members, industry experts, and students. The committee can organize events, workshops, and seminars that address ethical and social responsibilities in engineering education.

5. INTEGRATING SUSTAINABILITY PRINCIPLES IN ENGINEERING CURRICULUM

Integrating sustainability principles in engineering curriculum at the International Islamic University Malaysia (IIUM) is an important step towards creating a more sustainable and environmentally conscious engineering profession. Here are some ways in which this integration can be achieved:

Incorporating sustainability topics in engineering courses: Engineering courses should include topics related to sustainability, such as renewable energy, green engineering, and sustainable design principles. This will provide students with a solid foundation in sustainable engineering practices and enable them to incorporate these principles into their future projects and work.

Providing hands-on experience with sustainable technologies: Students should have the opportunity to work with sustainable technologies and participate in hands-on projects that promote sustainable practices. This could include projects related to renewable energy systems, sustainable construction, and waste reduction.

Encouraging interdisciplinary collaboration: Encouraging collaboration between engineering and other disciplines such as architecture, business, and environmental science can lead to the development of more sustainable solutions. By working together, students can gain a deeper understanding of the interconnected nature of sustainability issues and develop solutions that address a range of environmental and social challenges.

Providing access to sustainable resources: Providing students with access to sustainable resources, such as textbooks, case studies, and research articles, can help them stay up-to-date with the latest sustainability practices and innovations. This can also help students develop a deeper understanding of the complexities of sustainable engineering and the challenges associated with implementing sustainable solutions.

Incorporating sustainability principles into assessment criteria: Finally, assessment criteria should include sustainability principles to ensure that students are evaluated on their ability to incorporate these principles into their projects and work. This will help ensure that sustainability remains a central focus of the engineering curriculum at IIUM.

6. CONCLUSION REMARKS

The integration of knowledge is a crucial aspect of engineering education, and the Kulliyah of Engineering, IIUM, recognizes this importance. By breaking down disciplinary boundaries and promoting collaboration and innovation, the Kulliyah of Engineering encourages students and faculty members to work together to tackle complex, multidisciplinary problems.

Through interdisciplinary research collaborations, cross-disciplinary courses and programs, industry partnerships, international collaborations, innovative teaching methods, and student clubs and organizations, the Kulliyah of Engineering provides tangible evidence of its commitment to integrating knowledge.

Overall, the integration of knowledge at the Kulliyah of Engineering, IIUM, prepares students to become skilled and knowledgeable engineers who are equipped to address the challenges of the 21st century. By embracing interdisciplinary thinking and encouraging the application of knowledge from multiple fields, the Kulliyah of Engineering fosters a culture of innovation, creativity, and excellence that benefits students, faculty members, and society as a whole.

ACKNOWLEDGEMENT

The authors acknowledge the scientific assistants from all the KOE members for sharing knowledge, advising each other's and working as one team during and after the strategic plan set up.

REFERENCES

- [1] Aminuddin, H., Asmawati, S., Norhasni, Z. A., Habsah, I., & Haziyah, H. (2010). The Role of Islamic Philosophy of Education in Aspiring Holistic Learning. *Procedia Social and Behavioral Sciences*, 5, 2113–2118.
- [2] Halstead, M. J. (2004). An Islamic Concept of Education. *Comparative Education*, 40(4) special issue 29, 517-529. <http://dx.doi.org/10.1080/0305006042000284510>.
- [3] Najwan, S., & Zehavit, G. (2017). Islamic Education and the Challenge of Democratic Citizenship: A Critical Perspective. *Discourse: Studies in the Cultural Politics of Education*, 38(6), 807-822.
- [4] Islam, M. (2016) Importance of Girls' Education as Right: A Legal Study from Islamic Approach. *Beijing Law Review*, 7, 1-11. <http://dx.doi.org/10.4236/blr.2016.71001..>
- [5] Maali, M., & Jassim, A. (2019). Religious Tolerance in Secondary Islamic Education Textbooks in Kuwait. *British Journal of Religious Education*, 41(4), 422-434.
- [6] Miftachul, H., Jibril, Y., Kamarul, A. J., & Gamal, A. N. Z. (2016). Al-Zarnuji's Concept of Knowledge ('Ilm). *Sage Open*, 3,1-13. <http://dx.doi.org/10.1177/2158244016666885>.
- [7] Azam, M., & Amin, M. (2011). The Concept of Acquired Knowledge: Its Reformation in the Discourse of Muslim Scholars. *Revelation and Science*, 1(3), 50-61. <https://pdfs.semanticscholar.org/79f9/bdd7bdb61be9c924be8db0b52caeed9fd014.pdf>.
- [8]] Mohammad, K. A. (2014). Perspectives on the Discourse of Islamization of Education. *American Journal of Humanities and Social Sciences*, 2(1), 43-53. <http://dx.doi.org/10.11634/232907811402449>.
- [9] Sarfaro, N., & Nadeem, M. (2011). Islamic Education and Islamization: Evolution of Themes, Continuities and New Directions. *Journal of Muslim Minority Affairs*, 31(1), 5-30. <http://dx.doi.org/10.1080/13602004.2011.556886>.

- [10] Paya, A. (2015) A Critical Assessment of the Programmes of Producing Islamic Science and Islamisation of Science/Knowledge. *International Studies in the Philosophy of Science*, 29(3), 311-335. <http://dx.doi.org/10.1080/02698595.2015.1179043>.
- [11] Yasmineen, M. F. (2006). Contributions of Islamic Scholars to the Scientific Enterprise. *International Education Journal*, 7(4), 391-399. <https://files.eric.ed.gov/fulltext/EJ854295.pdf>.
- [12] Sidek, B., & Tareq, M. Z. (2015). Knowledge of Shariah and Knowledge to Manage ‘Self’ and ‘System’: Integration of Islamic Epistemology with the Knowledge and Education. *Journal of Islam, Law and Judiciary*, 1(1), 45 – 62.
- [13] Sidek, B., Mohamad, J. S., Tareq, M. Z., & Ridwan, H. (2018). Historical Development of Islamic Integrated Education in Malaysia Since 15th Century: Current Needs for The Globalized World. *History of Education & Children’s Literature*, 8(2), 9-30.
- [14] Linn, M. C. (2006). The Knowledge Integration Perspective on Learning and Instruction. In R. K. Sawyer (Ed.), *The Cambridge handbook of: The learning sciences* (pp. 243–264). Cambridge University Press.
- [15] Linn, M. C., & Eylon, B.-S. (2011). *Science learning and instruction: Taking advantage of technology to promote knowledge integration*. New York: Routledge.