

**Trend of engineering education research among ASEAN engineering faculty members**

Fatin Aliah Phang*, Nor Farahwahidah Abd Rahman

*Centre for Engineering Education, Universiti Teknologi Malaysia***ABSTRACT**

There is a wide range of understanding of engineering education research among engineering educators worldwide. Some engineering educators perceive that as long as they are involved in designing and then assessing engineering programs or teaching and learning, they are conducting engineering education research. However, under the Rigorous Research in Engineering Education (RREE), research in engineering education must be scientific, and at least follow the principles of scientific research in any discipline. In the context of ASEAN countries that are emerging in the scientific community, it is important to investigate the trend and understand the involvement of the engineering education community in engineering education research. Therefore, this research investigates to understand the trend of engineering education research through publications by authors from ASEAN countries. The publications in Web of Science Core Collections were included in this research as these are the rigorous and scientific publications in this field. This research employed a systematic literature review by scoping engineering education research publications from the Web of Science Core Collections that have been written by ASEAN countries' affiliated authors within the last five years. From the eight journals, twenty-eight papers fulfilled the criteria of this research. Most of the papers were published in the International Journal of Mechanical Engineering Education. Only five ASEAN countries have published in these journals recently, Malaysia topped the list with Universiti Teknologi Malaysia (UTM) as the leading university. Most of the topics published are related to the sharing of teaching and learning. From 2,419 papers published in those eight engineering education research journals, only twenty-eight papers were written by authors from the ASEAN countries. The trend of engineering education research in ASEAN centers around sharing best practices in teaching and learning using technology and project-based learning.

Keywords: engineering education research, ASEAN countries, rigorous research, high-impact publications

1. Introduction

Researchers in engineering education have actively participated in the well-being of engineering programs. The obvious question, then, is how engineering education researchers in ASEAN countries approach this field of research. The existing literature is silent on this question, although there is a growing literature from ASEAN countries in engineering education. The technical engineering curriculum that is taught in universities at the undergraduate or graduate levels is the exclusive definition of engineering education, according to numerous engineering academics from the 20th century and other groups or institutions in Southeast and East Asia [1]. Therefore, when research on engineering education is discussed, some might refer to it as engineering research rather than employing educational research methodologies. Early engineering education conferences and seminars, wherein only technically sound papers from a range of engineering disciplines were submitted and occasionally approved for presentation, were a manifestation of this uncertainty.

Although the trend was reported in 2015, some engineering educators still submit papers in the engineering field to engineering education journals such as the ASEAN Journal of Engineering Education (AJEE). Since the inception of AJEE 2012, manuscripts have been received from engineering educators ranging from educational research to practice sharing, and there were more

manuscripts in engineering research more than a decade ago compared to recently. The growing awareness and understanding of engineering education research have elevated the quality of research in engineering education in ASEAN. Therefore, it is timely to look at the trend of engineering education publication of ASEAN engineering educators especially in top-tier journals in engineering education to understand the direction of engineering education in ASEAN.

Research in engineering education must be scientific, which at least follows the principles of scientific research in any discipline, such as engineering [2]. These principles include a) presenting significant question that can be investigated empirically, b) linking research to relevant theory, c) utilizing methods that permit direct investigation of the question, d) providing coherent and explicit chain of reasoning, e) replicating and generalizing across studies, and f) disseminating research to encourage professional scrutiny and critique.

There have been efforts to bring the RREE framework to engineering educators in ASEAN countries such as through the bi-annual conference named Regional Conference of Engineering Education (RCEE) hosted by Universiti Teknologi Malaysia (UTM). UTM also introduced a virtuous cycle of research in engineering education to help engineering educators bridge engineering research and engineering education research to follow similar principles of scientific research [3]. At the same time, UTM published a training module engineering education research [4] and provides training for engineering educators who wish to learn the basics of designing and conducting research in engineering education.

*Corresponding author

Email address: p-fatin@utm.my

UTM is the first university in ASEAN to offer PhD in Engineering Education in 2008 [5]. Recently, UKM and UiTM have offered similar research studies at the faculty of engineering as a generic research program where the name of the program is not directly awarded as Ph.D. in Engineering Education. At UTM, the PhD in Engineering Education received students from around the world such as India, Pakistan, Qatar, Iran, Philippines, Sudan, and Nigeria. There are more than twenty graduates from this program until today.

There are more than fifty reputable journals that publish specifically on research in engineering education. Some of the top-tier journals are indexed in the Core Collections of Web of Science. They are: Journal of Engineering Education, IEEE Transactions on Education, International Journal of Engineering Education, European Journal of Engineering Education, International Journal of Continuing Engineering Education and Life Long Learning, International Journal of Mechanical Engineering Education, International Journal of Electrical Engineering & Education, and Journal of Civil Engineering Education.

Therefore, in the context of ASEAN countries that are emerging in the scientific community, it is important to investigate the trend and understand the involvement of the engineering education community in engineering education research, especially in the top-tier publications.

2. Materials and methods

The papers included in this study met the following criteria: a) published in recent five years, i.e. between January 2019 and October 2023 (when this paper was written), b) published in the top-tier journals as listed in the previous section, and c) authored by ASEAN countries members.

The countries (ASEAN) affiliation were determined by using the search function on the websites of the journals selected for this study. The authors and abstracts were analyzed to identify any trends.

3. Results and discussion

A summary of the papers published in the eight journals during the period is presented in Table 1. The total number of papers across all journals was 2,419.

Table 1. Review protocol and number of hits.

Journal title	No. of papers published in 2019-2023
Journal of Engineering Education (JEE)	252
IEEE Transactions on Education (IEEE)	279
International Journal of Engineering Education (IJEE)	696
European Journal of Engineering Education (EJEE)	340
International Journal of Continuing Engineering Education and Life Long Learning (IJCEE)	180
International Journal of Mechanical Engineering Education (IJMEE)	131
International Journal of Electrical Engineering & Education (IJEED)	456
Journal of Civil Engineering Education (JCEE)	85

The affiliation search results in Table 2 indicate the number of publications by authors from ASEAN countries. Out of the twenty-eight publications, the majority were in the International Journal of Mechanical Engineering Education (10), while only two publications appeared in the top-tier journals, namely Journal of Engineering Education and IEEE Transactions on Education.

Table 2. The number of publication records by authors from ASEAN countries identified and analyzed in this study.

No.	Title	Authors	Affiliation	Journal	Year
1	Evaluating the influence and modification for environment and sustainability learning outcome in environmental engineering course during COVID-19 pandemic	Bolong, N, Saad, I	UMS	IJEE	2022
2	The role of makerspaces in enhancing the student learning experience	Namasivayam, S, Fouladi, MH, Sivanesan, S, Noum, SYE	Taylors	IJEE	2020
3	Investigating the reliability and usefulness of self- and peer assessments of a capstone design project	Foong, CC, Liew, PY	UM, UTM	IJEE	2020
4	A hazard identification digital simulation game developed based on the extended authentic learning framework	Sufiana Safiena, Yang Miang Goh	NUS	JEE	2022
5	Engineering ethics education from the cultural and religious perspectives: a study among Malaysian undergraduates	Balamuralithara Balakrishnan, Fumihiko Tochinai, Hidekazu Kanemitsu, Ali Altalbe	UPSI	EJEE	2021

Table 2. Continued

No.	Title	Authors	Affiliation	Journal	Year
6	Review of engineering programme outcome assessment models	Chia Pao Liew, Marlia Puteh, Shahrin Mohammad, Abdul Aziz Omar, Peck Loo Kiew	Xiamen, UTM, Sunway, UCSI	EJEE	2020
7	Effectiveness of technology-integrated project-based approach for self-regulated learning of engineering students	T. T. Hang Bui, Amrita Kaur, Minh Trang Vu	Hanoi University of Science & Technology, Vietnam National University	EJEE	2021
8	Active and project-based learning implementation in a constructively aligned digital systems design course	Ismahani Ismail, Muhammad Mun'im Ahmad Zabidi, Norlina Paraman; Khairiyah Mohd-Yusof, Nor Farahwahidah Abd Rahman	UTM	IEEE	2023
9	Research on timeliness evaluation model of online teaching based on intelligent learning	Wenwen Lv, Xiuzhen Ding, Zarina Abdul Salam	UTM	IJCEE	2021
10	Design for blended synchronous learning: the instructor's perspective	Qiyun Wang	NTU	IJCEE	2021
11	Satisfaction ranking of employers towards graduates from higher education institutions: an application of hybrid multiple criteria decision-making approach	Mongkol Kittiyankajon	Udon Thani Rajabhat University, Thailand	IJCEE	2020
12	Study on the design of interactive distance multimedia teaching system based on VR technology	Tian Ge, Otto Darcy	Assumption University, Thailand	IJCEE	2022
13	Execution of the C-D-I-O framework at postgraduate level in mechanical engineering	Namasivayam S, Hosseini Fouladi M, Al-Obaidi AShM, Luke Laimon A, Syafiq Mohd, Eftekhari S.	Taylors	IJMEE	2021
14	Utilisation of the conceive-design-implement-operate framework in a mechanical engineering capstone project	Yong Ze Siin M, Namasivayam SN, Fouladi MH, Mohd Zali MA, Quen LC, Hang MC	Taylors	IJMEE	2020
15	Implementation of process safety assessment through case study presentations in a private university in Malaysia	David Hassell	Taylors	IJMEE	2021
16	Enhancing user experience and usability in engineering education: A comparative analysis of multiple functions and tangible user interfaces	Manjit Singh Sidhu	UNITEN	IJMEE	2023

Table 2. Continued

No.	Title	Authors	Affiliation	Journal	Year
17	The hybrid project-based learning–flipped classroom: A design project module redesigned to foster learning and engagement	KJ Chua, MR Islam	NUS	IJMEE	2021
18	An exact deflection solution to a type of cantilever with partially built-in end using strong boundary conditions	Teik-Cheng Lim	Singapore University of Social Sciences	IJMEE	2021
19	Artificial intelligence-enabled evaluating for computer-aided drawings (AMCAD)	Jianwu LW, Yew LS, On LK, et al.	ITE College Central, Singapore	IJMEE	2023
20	Redesigning a commercial combined cycle in an undergraduate thermodynamics course: Connecting theory to practical cycle design	Tohru Suwa, Tetuko Kurniawan	President University, Bekasi, Indonesia	IJMEE	2021
21	Evaluating the learning performances for CNC machine practice in mechanical engineering degree courses based on students' mental workload	Hoang S, Tran CC, Pham VT, et al.	Vietnam National University of Forestry	IJMEE	2023
22	The real value of experiential learning project through contest in engineering design course: A descriptive study of students' perspective	Nguyen Van Hanh	Hung Yen University of Technology and Education	IJMEE	2020
23	Formative assessment practices in undergraduate microwave engineering education	Kok Yeow You	UTM	IJEEE	2019
24	Surfacing learner intuitions about electrical circuit design using an open-source virtual environment 'chart-a-path'	Lim KY, Chua D, Yuen MD, Hazyl Hilmy A.	NIE	IJEEE	2019
25	A multipurpose problem-based learning platform for education and research under smart grid umbrella	Ahmed MA Haidar, Vic Smith, Sean Elphick	UNIMAS	IJEEE	2021
26	Mastery of fundamental concepts based on students' learning approach in flipped classrooms	Florence Yean Yng, Mark Joo Seng Gan	NUS	JCEE	2020
27	A grounded-theory study of civil engineering design practice in Malaysia	Sharifah Osman, Shahrin Mohammad, Mohd Salleh Abu, Mahani Mokhtar	UTM	JCEE	2019
28	Prevention through design (PtD) education for future civil engineers in Malaysia: Current state, challenges, and way forward	Che Khairil Izam Che Ibrahim, Sheila Belayutham, Mazlina Zaira Mohammad	UiTM	JCEE	2020

The recent publications in these journals are dominated by five ASEAN countries including Malaysia, Singapore, Thailand, Vietnam, and Indonesia. The top three universities are Universiti Teknologi Malaysia (UTM), Taylor's University, and the National University of Singapore (NUS). UTM has a long history of excellence in engineering education research, dating back to 2008 when it launched the first Ph.D. in Engineering Education Program in Asia [5] and the establishment of the Centre for Engineering Education (CEE) in 2010 [1]. Malaysia also has an active professional society dedicated to engineering education since 2007, the Society for Engineering Education Malaysia (SEEM) [1]. Other ASEAN countries are catching up, such as the Philippines with its Philippines Society for Engineering Education (PSEE) and Indonesia with its Royal Academy of Engineering Project led by the UTM, both of which started in 2021.

The papers published cover various topics related to the use of technology in teaching and learning, such as simulation, blended learning, online learning, virtual reality, and artificial intelligence. The papers also discuss different teaching and learning methods, such as project-based learning, problem-based learning, flipped classrooms, capstone projects, and CDIO. Some papers explore engineering practices and safety issues in the workplace.

This paper has revealed some important implications for engineering education in ASEAN countries but also pointed out some gaps that require further research. Some possible directions for future research are as follows.

Investigate the level of preparedness and interest of engineering educators in ASEAN countries to engage in scholarship of teaching and learning, and explore new ways of conducting research practices among them. This may involve more cross-country research collaboration and training opportunities to enhance the professional learning of engineering educators.

Develop and articulate a framework or model that addresses the specific challenges in engineering fields that are relevant for advancing innovation and new knowledge in this domain. This may lead to more fundamental research in engineering education that reflects the cultural and normative practices of faculty members that can be shared and adopted by other ASEAN countries.

Adopt outcome-based education (OBE) as a reference point that incorporates educational theories to ensure that project based/technology integration approaches can produce evidence-based practice for engineering educators. This may draw more attention to the development of professional competencies needed for engineering educators in designing instruction for teaching and learning.

4. Conclusions

This paper has outlined the trend of engineering education research among ASEAN countries. It has also served to situate the trends within the realm of teaching and learning for engineering programs. To continue this scholarly discussion among ASEAN countries is highly needed regarding the nature and scope of engineering education. Some notable considerations were shown by these literatures for the values of teaching and learning. The debates and

dialogue from these papers help to preserve the significance of looking into engineering education among engineering faculty members. The implication from this review is to move ASEAN countries to further invest in looking at specific core engineering education research practices that are key for all instructional activities at any level of engineering program. This builds upon the concept of building a common framework for engineering education practices among faculty members in ASEAN countries.

The following implication and suggestion have been drawn from literature reviewed in this study, and from experience in this field. Engineering education researchers in ASEAN lack the rigorous research in engineering education as promoted by RREE [2] as the papers published are still centred around assessing the effectiveness of certain teaching and learning practices, at a scholarly level. Low number of papers accepted into top journals in engineering education made by ASEAN engineering education researchers. ASEAN engineering educators focus more on assessment research by evaluating project-based learning/ service learning, or technology integration in their teaching or engineering programs.

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