Editorial Note

STEM Enculturation in Agricultural Engineering: The Needs for Government, Academia, Industry and Community Collaborations

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Main Text

Science, Technology, Engineering, Mathematics and Education (STEM) is life-long learning which integrates knowledge of STEM either in formal or informal teaching and learning paradigm. The Ministry of Education Malaysia has developed the STEM education initiative in Malaysia Blueprint 2013–2025 which aims to strengthen the quality of STEM education through an improved curriculum, training of teachers, and use of blended learning approaches (Ministry of Education Malaysia, 2013; Ng & Adnan, 2018). It is vital to increase interest and awareness in STEM to all students across all ages from early childhood, primary, secondary, and tertiary education levels, and at industrial or community linkages through campaigns and partnerships (Ministry of Education Malaysia, 2013, 2017). The challenge remains on creating interest and awareness in STEM across various stakeholders.

The STEM transformation in Malaysia aims to produce a STEM literate society and sufficient professionals and qualified STEM workforce that can contribute towards new innovations (Hafizan *et al.*, 2017). Active involvement of stakeholders such as academia, government, industry and community will ensure successful STEM enculturation. Empowering the next generation through STEM could be attained by human capital development, programme development, facilities, research, visibility, promotion and partnerships (Academy of Sciences Malaysia, 2018a). The statistics provided by the Ministry of Science, Technology and Innovation showed that only 44% of secondary and vocational school students studied STEM subjects in 2018; a decrease from 48% in 2012 (The Star, 2019). The current number of students engaged in STEM subjects (334, 742) is low compared to the government's target which is 60:40 ratio of students pursuing science and arts stream

(570,858) (Ramli & Talib, 2017; Zulkifli, 2020). A major cause of this low ratio may be due to the slowing demand of STEM knowledge-based workforce in industries and perception of subject difficulties held by students discouraging them from undertaking STEM courses (Cuff, 2017; Lau, 2019).

Collaborative networking between the government and academia is essential to improve the quality of education training and delivery system. The collaboration may allow for better facilities and wealth of resources in learning experiences of science and mathematics. The Ministry of Education Malaysia has been organising STEM workshops and conferences for academicians to share the best practices in teaching and learning STEM, such as applying gamification and theory inventive problem-solving. Industrial Revolution 4.0 is the impetus of the transformation of education in Malaysia as new technology is made available for enhanced teaching and learning experiences. Much effort to review and develop the science and mathematics curriculum at school has been made to meet future needs (Academy of Sciences Malaysia, 2012). Research on the development of STEM education could strengthen the planning and execution of STEM enculturation. Facilities at STEM centres need to be maintained or upgraded in line with the current emerging technologies.

Synergies between industry and academia will promote demand-driven research and development (Academy of Sciences Malaysia, 2018b). The industry through the corporate social responsibility arrangement, together with the academia could organise events or programmes related to STEM. A joint programme between academia and industry to educate the community in regard to agricultural engineering subjects such as vertical farming, waste treatment, hydroponics, green wall and many more could be conducted (Islamic Relief Malaysia, 2019; Juferi, 2020; Mustafah, 2019). The industry could provide a platform for promising talents in the STEM fields to enhance their skills and contribute to the community. Ultimately, Malaysia could produce future-proof graduates who meet the needs of jobs with their cognitive, psychomotor and skills.

The Department of Biological and Agricultural Engineering (DBAE), Faculty of Engineering, Universiti Putra Malaysia (UPM) was established in 1996, and currently offers a 4-year course of Bachelor of Agricultural and Biosystems Engineering. Four specialised areas offered by the department are mechanisation and automation, agricultural informatics, soil and water resources, as well as postharvest and environment. As one of the leading research universities where agriculture is the research niche, UPM through the DBAE has actively organised STEM programmes for students, indigenous people and other communities with the aim to contribute towards wealth creation and nation-building. The aim was achieved through the exploration and dissemination of knowledge. Such a programme enhanced the visibility of UPM in pursuit of the 3rd university's goal which is to boost industry and community network services.

For instance, Urban Agrischool module which aims at educating students on agriculture focuses on the appealing side of urban agriculture through the greenhouse concept (Mustafah *et al.*, 2019). Collaboration between academia, industries and communities have led to the success of the programme. The module was developed by the DBAE, UPM. The module was successfully conducted by the DBAE, UPM in collaboration with Kulim (M) Berhad, Agri Space Tech Sdn. Bhd., Malaysian Society of Agricultural and Food Engineers — Student Chapters, SK Sedenak, Johor and Parent-Teacher Association, SK Sedenak, Johor. Kulim (M) Berhad and Faculty of Engineering, UPM provided the fund while Agri Space Tech Sdn. Bhd. provided a temporary mini greenhouse for the programme. The community at school was proactive in helping with the planning and execution of the programme. According to

the pre and post survey conducted during the programme, Urban AgriSchool: Greenhouse module has increased the interest in agriculture of about 30% amongst the students. In future, this programme will be continued to reach as many young people as possible to introduce the concept of urban agriculture and transform the perception of agricultural sectors.

Success is the sum of small efforts, repeated day in and day out. More effort and time are needed in order to integrate STEM into the mind and habits of the community (Academy of Sciences Malaysia, 2018a). As demonstrated through the success story of Urban Agrischool programme at SK Sedenak, Johor, STEM enculturation requires support from the government, academia, industry and community. Planning and developing strategic directions and action plans of STEM programmes in terms of how to adapt, adopt and apply the STEM concepts are essential. Let us foster and strengthen the collaborations across the government, academia, industry and community to instil interests of the young generations in science, technology, engineering and mathematics so that they may become enablers of technological innovations and advancements in future.

References

Academy of Sciences Malaysia. (2012). *Teaching and learning of Science and Mathematics in schools — Towards a more creative and innovative Malaysia: ASM advisory report 2/2011*. Kuala Lumpur.

Academy of Sciences Malaysia. (2018a). *Science outlook 2017: Converging towards progressive Malaysia 2050*. Kuala Lumpur.

Academy of Sciences Malaysia. (2018b). Thought leader. In *2018 Annual Report*. https://doi.org/10.12681/sas.500

Cuff, B. M. P. (2017). *Perceptions of subject difficulty and subject choices: Are the two linked, and if so, how?* Retrieved from https://www.gov.uk/government/publications/students-subject-choices-at-gcse-and-a-level

Hafizan, E., Shahali, M., Ismail, I., & Halim, L. (2017). STEM education in Malaysia: Policy, trajectories and initiatives. *Asian Research Policy*, *8*(2), 122–133.

Islamic Relief Malaysia. (2019). STEM cultivate interests in Science, Mathematics & Engineering for indigenous people. Retrieved April 23, 2020, from Islamic Relief Malaysia website: https://islamic-relief.org.my/ms/stem-pupuk-minat-ilmu-sains-matematik-kejuruteraan-kepada-orang-asli/

Juferi, N. E. (2020). Orang asli student community outreach programme. *E-Putra Newsletter*, (53), 1–5.

Lau, R. (2019, April 7). Tough love for STEM threatens labour market. *Borneo Post*.

Ministry of Education Malaysia. (2013). Malaysia Education Blueprint 2013–2025 (Preschool to Post-Secondary Education). In *Ministry of Education Malaysia*. https://doi.org/10.1016/j.tate.2010.08.007

Ministry of Education Malaysia. (2017). *Malaysia Education Blueprint 2013–2025: 2016 Annual Report*. Putrajaya.

Mustafah, A. M. (2019). Reaching out urban agrischool: Urban agriculture education through greenhouse concept. *Synthesis*, (02), 1–28.

Mustafah, A. M., Jamaludin, D., Jahari, M., Hamzah, M. H., & Khairudin, N. (2019). Urban AgriSchool: Urban Agriculture Education through the Greenhouse Module. In M. A. M. Jedi, M. H. Johari, Z. M. Nopiah, H. M. Affandi, N. Razali, H. Othman, … M. H. Osman (Eds.), *National innovation and invention in engineering and built environment* (pp. 24–29). Bangi: Universiti Kebangsaan Malaysia.

Ng, C. H., & Adnan, M. (2018). Integrating STEM education through Project-Based Inquiry Learning (PIL) in topic space among year one pupils. *IOP Conference Series: Materials Science and Engineering*, *296*(1). https://doi.org/10.1088/1757-899X/296/1/012020

Ramli, N. F., & Talib, O. (2017). Can education institution implement STEM? From Malaysian teachers' view. *International Journal of Academic Research in Business and Social Sciences*, *7*(3), 2222–6990. https://doi.org/10.6007/IJARBSS/v7-i3/2772

The Star. (2019, September 28). Govt worried over dwindling number of STEM students. *The Star*, pp. 9–10.

Zulkifli, N. (2020, February 10). Girls need to see women in science. *New Straits Times*.