

## **Reformulation of Critical Thinking in the Malaysian Tertiary Engineering Education: An Islamic Approach**

**Mohd Nuri Al-Amin Endut\*, Muhammad Ridhuan Tony Lim Abdullah and Raja Ahmad Iskandar Raja Yaacob**

*Universiti Teknologi PETRONAS, 32610 Seri Iskandar, Perak, Malaysia*

### **ABSTRACT**

The inculcation of critical thinking elements into the engineering undergraduate programme in Malaysia as one of the national Engineering Accreditation Council (EAC) priority has been included in nation's Vision 2020 to produce competent and innovative graduates with high ethical and professional standards. One of the major concerns raised in this inculcation model is the absence of Islamic critical thinking concept. The present concept of critical thinking taught in this country fails to connect with Islamic teaching and could lead to misunderstanding of the concept among Muslim engineering students. This paper aims to explore the elements of critical thinking embedded within the engineering curriculum in Malaysian higher learning institutions with particular interest to Muslim undergraduate students. The paper adopts the conceptual approach in stating the case for current implementation practices of critical thinking at higher learning and proposes a reformulation of how critical thinking based on Islamic teaching could be embedded into the formal learning institution elaborated through three main themes: a) the embedding of critical thinking in Malaysian faculties of engineering; b) the significance of elements of Islamic critical thinking to engineering education; and c) the accessibility of the main elements of Islamic critical thinking in engineering curriculum. Based on these themes, argument will be developed to illustrate the significance of Islamic critical thinking in

relation to engineering education before finally reaching the approachable context on how to incorporate the elements of Islamic critical thinking which are yet to be identified within the content of Malaysian universities' engineering curriculum.

### **ARTICLE INFO**

*Article history:*

Received: 14 March 2017

Accepted: 28 December 2017

*E-mail addresses:*

nureind@utp.edu.my (Mohd Nuri Al-Amin Endut)

ridhuan\_tony@utp.edu.my

(Muhammad Ridhuan Tony Lim Abdullah)

iskandar\_yaacob@utp.edu.my

(Raja Ahmad Iskandar Raja Yaacob)

\* Corresponding author

*Keywords:* Critical thinking, engineering education, Islamic education

## INTRODUCTION

The sustainability and development of engineering education in Malaysia is a great concern to many Malaysian authorities and organisations. One of the main bodies related to the issues of engineering is the Board of Engineers Malaysia (BEM) which primarily functions to register graduates and professional engineers under the Registration of Engineers Act 1967 (Revised 2015). In view of the fact that BEM (2017) will only accept for registration graduate engineers who graduate with a qualification in engineering recognised by the board, BEM thus, has the duty to set the minimum standard of engineering education to ensure the quality of its registered engineers reaches the level of global practice. Hence BEM has delegated a body to accredit engineering programmes conducted in the Malaysian higher education institutions known as Engineering Accreditation Council (EAC). EAC is embodied by both government and non-governmental organisations consisting of the representatives of the Board of Engineers Malaysia (BEM), The Institution of Engineers Malaysia (IEM), industry employers, Malaysian Qualification Agency (MQA) and the government's Public Services Department (PSD).

In general, EAC (2017) has the key responsibilities to set policy and conduct approval and accreditation evaluations which also require the body to maintain a list of accredited engineering programmes, oversee the development and operation of accreditation and mutual recognition of programmes with other countries,

as well as to foster the dissemination of developments and best practices in engineering education. Consequently, EAC has outlined some anticipated outcomes of the engineering programme where students, by the time of their graduation, are expected to attain a balanced set of skills, knowledge and behaviour that include all technical and non-technical competent attributes. According to Megat Mohd Noor (2010), the fact that critical thinking is not explicitly mentioned in any of these outcomes does not suggest that EAC has low expectations on the thinking skill to be instilled to the engineering students. In fact, the concept and skills of critical thinking, in the view of EAC, should be embedded and integrated, encompassing the whole aimed outcomes of engineering education as an effective domain of learning in addition to cognitive and psychomotor domains.

An ideal engineering academic curriculum, according to EAC, should allocate two-thirds of its components for engineering courses while utilising the remaining part for general education components that complement the technical contents of the curriculum with courses such as mathematics, computing, languages and communication as well as thinking skills. The curriculum should not just provide students with ample opportunities for analytical, critical, constructive, and creative thinking, and evidence-based decision making, but also include sufficient elements for training students in rational thinking and research methods. Nevertheless, emphasis on these non-technical components must be

placed on the understanding and acquisition of basic principles and skills of a discipline, rather than detailed memorisation of facts.

This Malaysian model of engineering education is designed to realise the nation's need for technically competent and well-respected professional engineers in ensuring the progress and sustainability of the country. Professional engineers must not only be well-versed in adapting to the rapidly expanding technological development, but also maintain a high level of ethical standard, leadership and management skills. Therefore, potential engineers must demonstrate good fundamental scientific knowledge with the development of general skills and qualities to ensure better chances to reach top management post in performing useful functions in the industry (Johari et al., 2002). More importantly, they must also be instilled with consciousness and understanding of the ethical, social, cultural, global and environmental responsibilities of professional engineers as part of the expected essential outcomes of the Malaysian engineering education with regard to the aspect of humanities. The idea of an exclusively technical and highly specialised engineering education in making an excellent engineer is being abandoned (Russo, 2007) and the need to integrate technical competencies with humanistic attributes has become clearer, particularly from the aspects of culture, values, thought and ethics.

However, the main question lies on what would be the central issue in embedding critical thinking among Malaysian

engineering students, how the elements of critical thinking based on Islamic teaching would differ from the common practice, and how these elements would be accessible in practice. In response to these questions, the author has adopted the conceptual approach in developing the case on the teaching practice of critical thinking through the lens of Islamic teaching at higher learning based on three main themes; a) the embedding of critical thinking in Malaysian faculties of engineering; b) the significance of elements of Islamic critical thinking to engineering education; and c) the accessibility of main element of Islamic critical thinking in engineering curriculum.

### **The Embedding of Critical Thinking in Malaysian Faculties of Engineering**

The inculcation of critical thinking element into the engineering undergraduate programme in Malaysia does not only concern EAC in particular, but has also attracted the interest of the Malaysian government to attain the nation's Vision 2020 in creating an excellent centre for knowledge that produces competent and innovative graduates with high ethical and professional standards. Thus, in fulfilling the vision, the Ministry of Higher Education (MOHE) has the obligation to principally formulate a conducive environment for intellectual, professional and ethical enhancement of education system that would guide Malaysian universities to complement the technical hard skills in their academic programmes with the perfect elements of soft skills (Huzili & Shukri, 2008).

Therefore, MOHE (2006) has introduced Soft Skills Development Modules as a guideline for all Malaysian higher education institutions in order to inculcate soft skills in their education curriculum. MOHE's modules confine the application of soft skills into seven essential elements which definitely include critical thinking skill. The element of critical thinking and problem solving skills (CTPS) in this module implies the ability to think critically, be creative, innovative, analytical, and the ability to apply understanding and knowledge to new and different problems. The module identifies seven levels of CTPS skills in which three of them are obligatory to be attained by students that cover: [1] the ability to identify and analyse problems in a complex and ambiguous situations, and to provide justified evaluation; [2] the ability to expand and improve thinking skills such as explaining, analysing and evaluating discussion; [3] and the ability to look for alternative ideas and solutions. The rest of the four upper levels of CTPS skills are additional and considered as added values to the students that include: [4] the ability to think out of the box; [5] the ability to make decisions based on sound evidence; [6] the ability to persevere and to fully focus on the responsibilities assigned; [7] and the ability to understand and adapt to a new community culture and working environment.

Basically the module's framework proposes a holistic approach in the planning and implementation of critical thinking development which focuses on the combination of various programmes

involving formal teaching and learning activities, university's supporting programmes and campus life of conducive environment setting. The formal teaching and learning model, as the core academia of the faculty, is essentially important in imparting the knowledge and skills of critical thinking to the undergraduate students by using two models: stand-alone subject model and embedded model.

The stand-alone subject model implies the offering of a thinking skills subject specifically aimed to inculcate CTPS skills in a formal and explicit mode without connecting it to other subjects. The subject is normally offered either as a university's requirement subject that obligates all students to take the subject, or as an elective subject under the humanities courses whereby students are free to opt for this subject should if they wish to. Generally, this credited subject is deliberately designed to fulfil the need of the faculty and is formally considered as part of the engineering curriculum. On the whole, this model would assist the students to consciously acquire the critical thinking skills although it requires some additional credited hours that may prolong the duration of study.

In the embedded model, on the other hand, the subject is applied across the curriculum where it is engaged with the process of teaching and learning of all subjects. This model does not have a specific subject as described in the stand-alone subject model. Instead, students are trained to learn and attain critical thinking skill through formal teaching and learning

process which applies critical thinking approach without amending the initial content and learning outcomes. In general, lecturers of all courses would implement the model by assimilating appropriate elements of critical thinking skills into the lesson plan according to its level in order to achieve the learning outcomes. The MOHE's embedded model proposes the attainment of critical thinking skill to be applied through many teaching and learning methods that include problem-based learning, student centred learning, case studies, viva, group work and others.

Obviously both models have their own strengths and weaknesses. In terms of the course design, planning, implementation and assessment, the stand alone subjects would definitely have more advantages since the subjects have been developed specifically to help students to master critical thinking skills. In fact, this model also offers the possibility for the faculty to include the conception of Islamic critical thinking as part of the subject content. However, the stand alone subjects would provide less opportunity for the students to integrate the critical thinking skills with the knowledge and skills in their specialised fields.

The embedded model, in contrast to the stand alone model, requires a more challenging preparation in its course planning, teaching skills, learning environment and implementation. It also requires the lecturers to firstly master certain skills of critical thinking before applying it in their teaching across the subjects. Nonetheless, with proper planning and

implementation, this model is claimed to be very effective in nurturing the students' critical thinking skill in integration with their specialised knowledge and skills in engineering. Thus, looking at these strengths and weaknesses, it is best to combine both models since they complement each other to arrive at the aimed result.

In response to MOHE's request, indeed many Malaysian engineering faculties follow the proposed soft skill modules particularly in its formal academic curriculum by allocating a specific and credited course for critical thinking skills. The engineering faculties in Universiti Malaya (UM), Universiti Sains Malaysia (USM), and Universiti Teknologi PETRONAS (UTP) for instance, are among the Malaysian engineering faculties that have made it compulsory for their students to take a particular course which covers, explicitly or implicitly, some aspects of critical thinking.

In UM's faculty of engineering (Abd Shukor, 2010), the course Thinking and Communication Skills is compulsory for all students whose partial aim is to explicitly introduce students to critical thinking particularly on how to explain and analyse ideas, analyse and evaluate arguments, determining source credibility and recognising fallacy. In USM, all engineering undergraduate students are required to take Thinking Technique course that elaborates the concept and definition of thinking techniques and styles which are closely related to critical thinking. The course also explains the thinking tools and techniques used in decision making based

on engineering perspectives. Meanwhile in UTP, engineering students have to take a critical thinking related course, namely Thinking Skills in their foundation or pre-university programme. The course basically discusses the principles for thinking and its tools and approaches for various decision making models (Sabdin, 2011).

Moreover, some of these thinking courses have been directly discussed within the aspect of Islamic perspective and religious sanctity. IIUM (Abdullah, 2010), for example, attempts to suit to its inspiration in upholding the worldview of tawhid and Islamic philosophy of the unity of knowledge, hence, is naturally obliged to constructively integrate this particular course with Islamic values and perspectives in decision making. USM in spite of the differences with IIUM's vision and philosophy, has made the related thinking course meaningful by imparting the dimension of religious sanctity into the thinking known as *ludur* thinking.

*Ludur* thinking is basically a sacred vision that associates thinking with the supernatural and divine belief that links faith with the Creator. This thinking distinguishes itself from the Western type of thinking because it does not only rely on logical and scientific methods, but also includes religious elements as inspired and guided by God's revealed principles (Abdullah & Hussin, 2006). Therefore, *ludur* thinking links all human behaviour to the principle of tawhid that serves as the ultimate bridging act between the worldly endeavours and the final judgement of the hereafter.

Apart from having the concept and skills of critical thinking imparted through a stand-alone subject, there are engineering faculties in Malaysia that combine this model with the embedded model which require all courses to be infused with the elements of critical thinking. The combination of both models could be observed from Universiti Malaya's engineering curriculum which does not only make critical thinking course compulsory for all students, but requires all courses to incorporate and transfer some levels of CTPS skills as recommended by MOHE soft skills module (Abd Shukor, 2010). This combination of methods represents an integrated approach of the module that would definitely help the faculty to implant skills and dispositions of critical thinking into their undergraduate engineering students.

Nevertheless, there are engineering faculties that are reluctant in allocating specific courses for critical thinking within their formal academic curriculum, and would rather focus more on the embedded model as is practised in Universiti Teknologi Malaysia (UTM). However, this does not imply that UTM has neglected critical thinking skills as well as other important soft skills. Instead of offering a particular credited course, UTM believes that these skills should be imbued in students through appropriate teaching and learning methods that is to be applied across all courses. As such, UTM has established a Centre for Teaching and Learning (CTL) that would provide frequent training sessions for its teaching staff in order to infuse and coach

students with practical aptitude in applying critical thinking and other generic skills via various teaching and learning techniques. In fact, these particular techniques could inculcate even higher level of critical thinking compared to the theoretical approach of the stand-alone subject (Mohd Yusof, 2011).

On the whole, it is quite clear that Malaysian engineering faculties are aware of the importance of critical thinking and skills in engineering education as almost all the faculties have included this thinking element into their curriculum. However, despite all the efforts that have been put into the inculcation and enhancement of the skill, there is still much room for improvement. One of the major weaknesses that can be observed in the faculty's implementation of the MOHE modules lies in its assessment method.

The fact that the embedding of critical thinking skills and concept is an ongoing process requires continuous assessment procedure that should be carried out throughout the learning period in the university. The continuous assessment is certainly an effective way to constantly monitor the development of students while allowing the authorities to take necessary remedial actions. All students' performances and levels of critical thinking must be continuously assessed from the beginning of the first semester by lecturers and the university staff during formal education and student activities. However, not many universities are willing to perform this demanding assessment method but are quite

satisfied with the assessment from the stand-alone model.

Another concern that could be raised in this inculcation model is the superficial integration of the conceptual and practical understanding of critical thinking from the Islamic perspective. Several engineering faculties such as USM and Universiti Malaysia Perlis (UniMAP) has made efforts to associate thinking courses with the Islamic perspective such as *luhur* thinking but are not structurally aligned with the elements of Islamic critical thinking with reference its spiritual, epistemological and axiological perspectives. Even the IIUM's Faculty of Engineering only covers the general concept of Islamic critical thinking within their curriculum, which is embedded in general Islamic courses that would obviously fall short to counter the dominant Western concept of critical thinking.

To think, in Islam, is actually to perform an act of worship (*'ibādah*) and it is the thinking that would strongly induce one's belief, faith and personality. Therefore, these thinking courses should also be exposed to the Islamic concept of thinking especially the engineering faculties which have a large fraction of the applied science students' population, who potentially play a very substantial role in the development of the *ummah*. Apparently, the present concept of critical thinking taught in this country is generally based on the Western perception due to lack of study done on the establishment of Islamic critical thinking. Thus, it is a timely important effort to establish and introduce a proper

concept of Islamic critical thinking and to associate its significance to engineering education. It is important for these students or potential leaders to be instilled with proper understanding of Islamic critical thinking in order to ensure the development of a balanced, virtuous and progressive society.

### **The Significance of Elements of Islamic Critical Thinking to Engineering Education**

Much has been written about integration of the Islamic philosophy and values into academic curricula which has advocated Muslim intellectuals to articulate the unity of knowledge and the interrelatedness of all observable phenomena. The main reason for this development would be the consciousness of the non-existent of value-free sciences or technological activities which require all decisions, particularly with regard to the development of a society, have to be carefully examined and weighed from the Islamic perspective.

Thinking is an essential part of Islamic religious duty. It is an important means through which knowledge is attained and signs are comprehended. As such, it is indeed inconceivable to refer to someone who cannot think correctly as a true Muslim. Moreover, Islam encourages men to engage in thinking in order to meet the divine expectation of human creation. While various materials and utilitarian benefits can be generated from the process of good thinking, the recognition of Allah as the sole creator of the universe and all creatures will

always remain the ultimate goal of thinking and contemplation in Islam. The impact of the recognition, however, does not only enhance one's spirituality but also improves one's social living. This explicitly explains the key function of the human mind in making sense of the realities of human and social wellbeing based on rationality in the light of revealed guidance. This recognition also reveals a sense of direction of the thinking process and activities as dictated by the mind giver in order to make thinking and life more meaningful (Al-Attas, 2001).

Even for a technological decision, Muslim engineers must critically engage their thinking to Islamic spirituality and morality factors as they believe that their judgment is directly accountable to Allah in the hereafter. This spirituality context of decision making which explains the relation between science (including engineering) and spirituality (*al-tafakkur*) must be perceived in a broader sense in which both aspects are harmoniously blended in a value system that leads towards the recognition of Allah as the sole creator. Any engineering or technological activities are ultimately related to the consequence of tawhid that stresses the Islamic worldview of the unity of creation, thus cannot be viewed in isolation of other universal factors and phenomena (Suhaimi, 1986).

The Islamic concept of spirituality is quite alien to some modern educators. Current technological judgements, instead inspired by spirituality, are widely based on the utilitarian perspective enthused by the Western ethical theory of maximising the

overall happiness of human beings that relies largely on material achievements. Science and technology have been mainly taught in our universities from the secular perspective which has dehumanised knowledge by depriving its Islamic moral and spiritual relationship. Although the matters of spirituality have been acknowledged by academics, its discussions are left on the margins and not brought to the centre of academia discourse (Shahjahan, 2005). Academics rarely express their spirituality consciousness; they may practise it outside academic confines, but fear that their spirituality expression will be ridiculed by the academe as an embodied practice or discourse.

This may result in an incident where students' attitudes towards nature seem to be less dependent and shift to a feeling that they can conquer the nature to their own advantage, and eventually to a sense of superiority of man over nature itself. Therefore, it is essential for engineering education to seek harmony with the principle of *al-tafakkur* and bring spirituality dimension to its endeavours through the correct approach and attitude because one cannot believe in tawhid and at the same time continue to pursue a secular attitude in science and technology. Moreover, it should be distinguishably rewarding to be able to reformulate these ideals based on our spiritual need in the process of becoming a part of the emerging cultural pattern for the nation (Shariffadeen, 1986).

However, the Qur'anic expression of spirituality does not only concern the *al-tafakkur* paradigm, but often articulates the structure of human cognitive consciousness together with other forms of thinking faculties of *al-'aql* (intellect-reason), *al-qalb* (heart) and *al-nafs* (soul). These faculties certainly mark the significance of Islamic epistemological elements of critical thinking in which Muslim engineers are obliged to deal with different classifications of senses and knowledge as well as different ways in deriving new information from them which lead to various levels of theory construction (Bakar, 1999). This is where the epistemological element of *al-yaqin* (certainty) plays its meaningful role in the process and concept of critical thinking. This certainty element emphasises the affirmation process of critical thinking to reach at the highest level of assertion and belief that is constructed from a certain data in searching for the truth. It would help engineers to be more decisive, determined and confident in making a sound reasoning with regard to engineering problem.

Unlike the Islamic epistemology of certainty, which engrosses knowledge with the belief in the spiritual realm and the ultimate truth, the Western discourse on the concept tend to concentrate more on the psychological aspect of epistemological development and beliefs. Thus, instead of looking for the various natures, classifications and sources of knowledge in defining the belief, the Western liberal epistemological

study in education shows more interest in generally exploring the manner of how individuals come to know, the theories and beliefs they hold about knowing and how epistemological beliefs affect cognitive processes of thinking and reasoning (Hofer & Pintrich, 1997). From this perspective, the epistemological element of certainty in engineering education is discussed within the dimension of the absolute of knowledge; whether the knowledge is fixed as a set of stone or continuously evolving as fluid relativism which makes no distinctions between evidence-based reasoning and mere opinion (King & Magun-Jackson, 2009).

This is obviously different from the Qur'anic epistemological approach which stresses more on the conceptual and methodological context of certainty in illustrating the cognitive proof structuring process as to attain the *yaqin* (firm) state. Engineering is the kind of knowledge that would bring Muslims closer to Allah as stated in the concept of tawhid. It is the area where Muslims scrutinise the beauty and benefits of natural resources as the signs of Allah's Supremacy. Thus Muslim engineers must be certain of this knowledge for it is basically a fundamental *yaqin* premise in the effort of reaching the *yaqin* state of faith.

On the other hand, it is also vital for today's engineering education to equip students with the ability to understand certainty and to handle ambiguity so that these potential engineers will be able to cope with tomorrow's complex engineering

challenges (Bordogna, 1997). In this context, not only Islamic critical thinking provides inclusive theories of knowledge and cognition, but it also decisively defines the state of certainty. The element of certainty should not be examined merely from one's perspective on the absolute of knowledge as it does not really reflect one's level of certainty. Certainty is not simply a matter of how and what one knows as discussed by Al-Farabi in his conditions of certainty. It also requires a firm self-awareness state of "knowing that one knows" as it significantly helps engineers to be thoughtful, certain and determined in justifying any technological decisions. Moreover, this Islamic concept of certainty would definitely boost Muslim engineers' self-confidence as well as firm up their belief and character in becoming well-rounded and respected engineers.

Another important aspect of Islamic critical thinking that would bring a lot of impact in Muslim engineering education is the element of *Al-'adl* (just balance). This Islamic axiological element is vital in technological decision making as it addresses the issues of religious values and ethics that are primarily set to fulfil the purpose of human life on earth. The nature of engineering, which basically deals with ways to exploit the human and material resources for the well-being of mankind, would certainly expose engineers with dilemmas and arguments that acquire critical evaluation in making righteous decisions. It is common for today's engineering practice

to confront several conflicting demands particularly with regards to social and environmental issues.

Current engineering education has exposed various methods and techniques of decision making to facilitate engineers in seeking the best functional balance between cost, reliability and performance of a product or a project. These expositions, however, will basically look into the influential constraint conditions of various contexts, mainly in the business and environmental contexts, which believe that the bigger concern lies in the economic consideration instead of religious values. Such perception obviously does not accord with Islamic education that witnesses the comprehensiveness of the problem from the basic maxims of the *sharia* encompassing sociological, political, legal, economic, philosophical and other issues.

Essentially, the content of the Qur'an includes broad and fundamental principles, and legally cognisable value judgments. Even in matters pertaining to the rationally perceptible natural rights of man, or the demand of social justice, its justification must be weighed from the God-conscious and revealed value system. This justification is indeed crucial as an all alleged 'pure rational' reasoning is easily swayed by inordinate desires, social distortions, vested interest and the corrupted authorities for natural reason and natural law have been invoked from unholy causes throughout

history (Husaini, 1980). The Islamic value judgment, therefore, provides guidance for engineering designers to comprehend and devote themselves to the virtuous personal and societal core values, and to be cautious with the misleading liberal rationalisation of base human instincts.

Therefore, it is critically important for future engineers to be ideally instilled with Islamic value systems in handling the multi criteria engineering problems. The permanent axiological cognition of certain Qur'anic verses is not only applicable to several situations in diverse frames of reference, but is also capable of multi interpretations as observed in *mutashabih* (allegorical) verses. This profound wisdom renders levels of meaning and generality of the values of the Qur'an that suits its adoption to real time-space situation. It also demands a form of axiological systemisation that distinguishes the terminal and intrinsic values from its instrumental values, and facilitates application of strategies in dealing with complex issues and ever-changing circumstances with the best solutions. Such system could be apparently perceived from various Islamic maxims of *maqasid al-syari'ah* (the objectives of Islamic law), the classification of values into the necessities (*daruriyyat*), convenience (*hajiyyat*) and embellishments (*tahsiniyyat*), as well as the classifications of knowledge into the personal (*'ayn*) and social (*kifayah*) obligation.

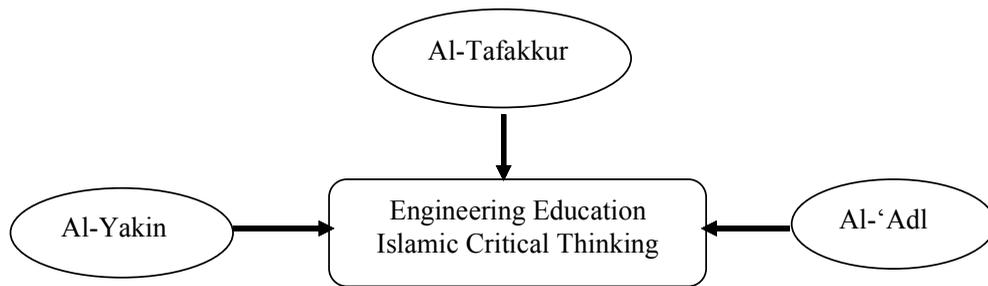


Figure 1. Engineering education Islamic critical thinking model. Adapted from Al-Amin (2013)

On the whole, the three unique elements of *al-tafakkur*, *al-yaqin* and *al-'adl* depict a distinct and appropriate perspective of critical thinking that significantly distinguish Islamic critical thinking from the current or modern critical thinking taught in engineering education. This could be summed up through the model in Figure 1. It certainly adds a more meaningful and God-consciousness insights into Muslim engineers' perception and attitude to carry out the responsibility of Allah's vicegerent on earth in creating a conducive and balanced development of humankind.

### **The Accessibility of the Main Elements of Islamic Critical Thinking in Engineering Curriculum**

The incorporation of Islamic critical thinking into the Malaysian engineering curriculum is necessary to expose and instil in students, particularly the Muslim students, the accurate concept of Islamic critical thinking through the stand-alone subject model and the embedded model. The inculcation of the concept using the stand-alone subject model would be less

demanding than the embedded model as it should be a straightforward teaching and training method on the specific subject as explained in the preceding section. The bigger challenge would definitely be on the embedded method that requires proper suggestion on how to link and assimilate the elements of Islamic critical thinking into the engineering curriculum.

One of the constraints in making the content of Islamic critical thinking accessible to the engineering curriculum is the wide range of engineering specialisations. Although engineering has its common core curriculum that emphasises fundamental engineering science and a few interdisciplinary connections between different areas of engineering, it is normally at the foundation level which is yet to reach to its engineering specialisation area. If there is a course that can naturally demonstrate the assimilation of Islamic critical thinking into the heart of engineering, it would be engineering design. In fact, design is one of the essential dimensions of engineering knowledge. Its practice is founded in holistic, contextual and integrated visions of the world, rather than on partial visions

which make it perfect to adopt the right perception of Islamic critical thinking.

Engineering design is actually a set of activities that lead to the manufacture of existing new products such as aircraft and automobiles as well as the construction of new facilities such as refineries and steel mills. Designing products with potential benefit for mankind is a high human achievement that always includes substantial engineering content. The subject of engineering design includes solving technical problems, finding suitable and preferably optimal solutions for the given task, accounting for organisational, economic, cultural, societal, environmental, sustainability, safety and other factors including belief and religion (Ernst & Hosnedl, 2010). As such the subject would not only touch on engineering sciences, but requires a wide range of information in the issues of culture, societal organisation, economics, aesthetics and other general awareness, not to forget religious conscience, at the macro and micro levels so as to achieve the anticipated product objectives.

Engineering design, apart from its technical matter, is fundamentally a human endeavour that involves the relationships between designers, clients and manufacturers, and the ways purchasers use the designed devices. Design affects the lives of people and societies in fulfilling their various needs and wants that appear in different levels of demand for satisfaction. Thus design touches so many facets of people's daily lives. As science, engineering and technology are not value-free, to

design means to accept responsibility for creating designs for people that open doors for designers to either influence or to be influenced by the society, in a positive or negative manner, and to consciously consider the ethical or religious implications of the designs created.

Therefore, engineering design is a complex process in developing the best solution to a given problem, not only in dealing with its technical functionality but more importantly its concern on the well-being of the people in various aspects. Such process would definitely require a lot of critical thinking capabilities in making judgment on the design because once a device or system is released for public use, it embodies and structures a particular way of life; it establishes social and political relationships, permissions and prohibitions, and it is bound by the distribution of power to control people. This scenario implies the importance of Islamic critical thinking to be instilled into Muslim engineering designers so as to imbue the Islamic vision into the society through their systems and devices.

## CONCLUSION

This paper has explored the significance and accessibility of Islamic critical thinking in Malaysian tertiary engineering education. Generally, the current engineering education has unanimously agreed on the need for the values of humanities in the curriculum, to complement the technical competencies, to impart proper perceptions and critical understanding of the real meaning of technological development, and to decisively

deal with the event. Thus, critical thinking is one of the essential aspects of humanities and has been largely embedded into the Malaysian faculties of engineering, either through the stand-alone subject model or the embedded model.

Nevertheless, the model of critical thinking delivered to the engineering students, Muslims particularly, seems to have fallen short in its association with the Islamic worldview and could have led to the misconception of thoughts among them. Indeed, the notions of Islamic critical thinking are very important to be established and integrated into the engineering curriculum. It certainly inculcates substantial God-consciousness factors into the Muslim engineer and develops firm, fair and noble attitude in performing the vision of Allah on earth in creating a conducive and balanced development of humankind.

As discussed in this paper, the three unique elements of *al-tafakkur*, *al-yaqin* and *al-'adl* confined within Islamic critical thinking distinguish differences with that of the current or modern critical thinking taught in engineering education, which also provide an inspiring and meaningful understanding of the discipline. The assimilation of Islamic critical thinking into the heart of engineering could be best demonstrated through the adaptation of these three elements into engineering design courses. A holistic and integrated vision of engineering design could open the path for Muslim engineers to critically appreciate, enlighten, clarify, ascertain, justify and value the design

endeavours from the context of Islamic worldview as an affirmative stand on the ultimate superiority of Allah.

## REFERENCES

- Abd Shukor, M. H. (2010, August 17). Interview by Mohd Nuri Al-Amin [Tape recording]. *Reformulation of Islamic critical thinking in the Malaysian tertiary engineering education project*. Universiti Teknologi Petronas, Malaysia.
- Abdullah, N. A. (2010, November 22). Interview by Mohd Nuri Al-Amin [Tape recording]. *Reformulation of Islamic critical thinking in the Malaysian tertiary engineering education project*. Universiti Teknologi Petronas, Malaysia.
- Abdullah, S., & Hussin, H. (2006). Pemikiran luhur menurut perspektif Islam dalam kursus kemahiran berfikir: Satu Tinjauan di Kolej Universiti Kejuruteraan Utara Malaysia. In *Seminar Kebangsaan Pengajian Umum Proceedings* (pp. 404-409). Skudai: Universiti Teknologi Malaysia.
- Al-Amin, M. N. (2013). Islamic critical thinking: A study on the perception of Muslim engineering students in Malaysian higher learning institutions (Unpublished doctoral dissertation). Retrieved from <http://www.diglib.um.edu.my/umtheses/search.asp>, p. 243
- Al-Atas, S. M. N. (2001). *Risalah untuk kaum muslimin*. Kuala Lumpur: ISTAC.
- Bakar, O. (1999). *The history and philosophy of Islamic science*. Cambridge: Islamic Texts Society.
- Board of Engineers Malaysia. (2017). *Registration of Engineers Act 1967*. Retrieved from <http://www.bem.org.my/web/guest/home>.
- Bordogna, J. (1997). Making connections: The role of engineers and engineering education. *BRIDGE-WASHINGTON-*, 27, 11-16.

- Centre for Teaching and Learning Universiti Teknologi Malaysia. (2011). *Online Evaluation*. Retrieved from [http://ctl.utm.my/online/index.php?option=com\\_content&view=article&id=48&Itemid=299](http://ctl.utm.my/online/index.php?option=com_content&view=article&id=48&Itemid=299).
- Engineering Accreditation Council (EAC). (2017). *Engineering Accreditation Council, Engineering programme accreditation manual*. Retrieved from <http://www.eac.org.my/web>.
- Ernst, W. E., & Hosnedl, S. (2010). *Introduction to design engineering*. Leiden: CRC Press/Balkema.
- Hofer, B. K., & Pintrich, P. R. (1997). The development of epistemological theories: Beliefs about knowledge and knowing and their relation to learning. *Review of Educational Research*, 67(1), 88-140.
- Husaini, S. W. A. (1980). *Islamic environmental systems engineering*. London: Macmillan Press Limited.
- Huzili, H., & Muhammad Shukri, S. (2008). Memperkasakan mahasiswa kejuruteraan menerusi penerapan kemahiran insaniah (Soft Skills). *International Conference on the Roles of the Humanities and Social Sciences in Engineering 2008 (ICOHSE08) Proceedings* (pp. 583-596). Kuala Lumpur: Universiti Malaysia Perlis.
- Johari, M. M. N. M., Abdullah, A. A., Osman, M. R., Sapuan, M. S., Mariun, N., Jaafar, M. S., ... & Rosnah, M. Y. (2002). A new engineering education model for Malaysia. *International Journal of Engineering Education*, 18(1), 8-16.
- Kementerian Pengajian Tinggi Malaysia. (2006). *Modul pembangunan kemahiran insaniah (soft skills) untuk institusi pengajian tinggi Malaysia*. Serdang: Universiti Putra Malaysia.
- King, B. A., & Magun-Jackson, S. (2009). Epistemological beliefs of engineering students. *The Journal of Technology Studies*, 35(2), 56-64.
- Megat Mohd Noor, M. J. (2010, October, 6). Interview by Mohd Nuri Al-Amin [Tape recording]. *Reformulation of Islamic critical thinking in the Malaysian tertiary engineering education project*. Universiti Teknologi Petronas, Malaysia.
- Mohd Yusof, K. (2011, January 26). Interview by Mohd Nuri Al-Amin [Tape recording]. *Reformulation of Islamic critical thinking in the Malaysian tertiary engineering education project*. Universiti Teknologi Petronas, Malaysia.
- Russo, M. T. (2007). The newcomers: Humanities in engineering education. *International Conference on Engineering and Education (ICEE-2007)*. Portugal: International Network for Engineering Education and Research (iNEER).
- Sabdin, M. (2011, January 15). Interview by Mohd Nuri Al-Amin [Tape recording]. *Reformulation of Islamic critical thinking in the Malaysian tertiary engineering education project*. Universiti Teknologi Petronas, Malaysia.
- School of Electrical and Electronic Engineering, Universiti Sains Malaysia. (2011). *Onset of E-Tech*. Retrieved from <http://ee.eng.usm.my/v3/index.php/related-link/download/category/1-academic.html>
- Shahjahan, R. A. (2005). Spirituality in the academy: Reclaiming from the margins and evoking a transformative way of knowing the world. *International Journal of Qualitative Studies in Education*, 18(6), 685-711.
- Shariffadeen, T. M. A. (1986). Critical issues in engineering curriculum development. *The National Seminar on Engineering Education Proceedings* (pp. 26-32). Kuala Lumpur: University of Malaya.
- Suhaimi, A. (1986). Engineering education: Islamic perspective. *National Seminar on Engineering Education Proceedings* (pp. 50-56). Kuala Lumpur: University of Malaya.

