Revisiting Engineering Education: A Prerequisite for Internationalization

Emerging societies may require a transformative revision, consider it a paradigm shift, in their method of teaching and learning engineering, in order to indigenize technology and make it genuinely relevant to their own prospects. Such transformation is not in contrast to the internationalization of engineering education. On the contrary, as paradoxical as it may sound, *domestication* of engineering education to contextualize the field is indeed a crucial prerequisite to the internationalization process. (The term "domestication" is primarily used for "processes by which plants and animals are *tamed* and made at home." I would extend the terminology in here, implying that education is indeed an organic mechanism.) Let me briefly elaborate on this stand, before discussing the proposed change:

The fact of the matter is that internationalization of higher education, in a broad sense, has turned into a ubiquitous buzzword in the last two decades, with a widespread consensus on its potential benefits. The rewards that internationalization, if founded on a solid ground, can offer to a society's higher education are indisputable. The promoters of the notion have done a good job in highlighting its promises, and portraying internationalization of higher education as a pressing response to the inevitable globalization trend (see [1] as an example.) A growing number of universities, primarily in the Western Hemisphere, but also recently in Latin America [2], Africa [3] and South [4] and East Asia [5], have aggressively implemented one or more forms of internationalization, and consequently reported impressive outcomes, such as climbing up the global academic ranking as well as enhancing their sources of revenue. There are, nevertheless, two major shortcomings with the current trends of internationalization, in both theory and practice:

- First, as pointed out by several critiques (e.g., [6], [7]), it appears that the prevalent approaches to the conception of internationalization within the mainstream literature on higher education focus on a narrow spectrum, most suited to Western societies, with a reluctance to discuss the unsettling challenges that such paradigms may cause in their enactment in other societies. A content analysis of all the articles published between 1996 and 2016 in the Journal of Studies in International Education (JSIE), one of the handful of prominent outlets of higher education studies, shows that "research in the field has so far been largely Anglo-Saxon and Western European driven, in content as well as in disseminating a certain understanding of internationalization" [8]. More than 67% of the publications in the journal during the mentioned period (out of 406 papers) originate from the United States, Australia, the United Kingdom, Canada and the Netherlands. These results are consistent with a broader, but older, study performing both content and bibliometric analyses of 2302 records from more than three thousand scholars around the globe between 2002 and 2011 [9]. The study shows that within a decade the number of publications in the subject has increased 7 times, with nearly 30% of them originating only from the United Stated and Australia. The concern here is that failure in critically examining the less celebratory constituents of the Western interpretation and overlooking alternative, diverse interpretations of internationalization of higher education may result in the recurrence of harmful patterns of epistemological, economic and social colonialism on a global scale. Unlike many other scientific subjects, one must constantly be reminded that research and development on notions such as internationalization (and globalization) are driven by a dynamic mixture of political, economic, socio-cultural and academic rationales and stakeholders. (To acknowledge this reminder, one does not need to go any farther than listening to Tony Blair's passionate speech on internationalization of higher education [10].)
- Secondly, there is a tendency to narrow the objectives of internationalization down to mere economic interests in enhancing institutional marketability and capturing more student consumers from other countries. In other words, internationalization has turned into yet another source of tapping revenue

for universities in developed countries [11]. In Australia, the United Kingdom and the United States, trade-in education services, mainly as the higher education export, are now considered as a vital "industry." The commodification of international higher education services has reached a point where, for example, the Australian government not only describes higher education in trade terms as an "export," but also places it into equivalence with other extractive resources, such as gold, iron and coal [12]. Many international firms have emerged specializing in student placement services with a profitable track record. As an example, the IDP Education Ltd., head-quartered in Australia, reported a 71.4% annual increase in 2016 in the company's student placement volumes in the United Kingdom, the United States, Canada and New Zealand, resulting in a 32.9% annual increase in its revenue from student placement services [13]. More than one million international students are currently enrolled in the United States, a nearly 100% increase within two decades, which contributed more than $35.8 billion to the country's economy in 2015 [14]. The shift from education and research perspectives to "academia, Inc." [15], in the internationalization process may have come out of the necessity for the lead developed countries to fiercely compete in attracting talented workforce as prospective "brain immigrants."

The bottom line is that the mainstream notion of internationalization of higher education, both conception and implementation, may have been customized to the needs of certain developed societies, based on their own system of values. The key concern here is to prescribe what has been predominantly done with the notion so far as a universal framework for all societies. In building a framework for internationalization of higher education, engineering and otherwise, each society must meticulously answer the three fundamental questions of what, why and how, in order to avoid the "tailor and king's new dress" syndrome, i.e., when everybody appreciates the same (abstract) thing, but only a few know what it is, why it looks good, and how it works. This is indeed the process of *glocalization* [16], which some higher education experts advocate as a safe pathway toward an international and intercultural discourse [17]. In fact, the (Western) creators of the notion of internationalization of higher education have started by trying to answer the three fundamental questions within the context of their own societies [18]. Only recently can one notice in the relevant literature some works toward diversification of the notion based on the societal contexts, a movement clearly against hegemonic tendencies and chiefly sourced by some smart developing countries. One notable example is the creation of the Universidade Federal da Integração Latino-Americana (UNILA), an inter-regional university set up in 2007 by the Brazilian federal government at the tri-border of Argentina, Brazil and Paraguay to promote international cooperation within the regional context of Latin America. The initiative embodies, as declared by Morosini [2], a "Latin American model of university," different from both Napoleonic (Enlightenment-based, elitist professional education) and Humboldtian (focusing on personal development and academic freedom) ideals. Some other attempts in Africa [3] and East Asia [5] are also worth studying. A recently published book on the "globalization of Internationalization" has tried to gather and discuss some of the diverse, emerging voices and perspectives vis-à-vis internationalization of higher education [19].

Let me briefly examine each of the three fundamental questions: In regards to the "what" question, there have been multiple attempts to create (and promote) a universal working definition for internationalization of higher education. One of the latest, which indeed comes with an augmentation to the original Jane Knight's definition [20], is given by Hans de Wit [21]:

"*The intentional process of integrating an international, intercultural or global dimension into the purpose, functions and delivery of post-secondary education, in order to enhance the quality of education and research for all students and staff, and to make a meaningful contribution to society.*"

The above definition appears to specify the nature of internationalization as a conscious and systemic integration of a pluralistic worldview in the planning, execution and deployment of higher education. Note that despite using the connective "or" in the definition, the originators explicitly argue in their works that "[t]hese three terms complement each other and together depict the richness in the breadth and depth of internationalization [20]." The definition also articulates the ultimate goal of such integration as to enhance the quality and serve the society, albeit vague in what system of values is meant to measure the quality and which society it refers to: global or local (or both). The point here is that definitions, in general, are created to delineate a notion and map the landscape of its articulations, in the hope of making it relevant to and useful for a certain purpose. Therefore, a proper definition must fundamentally rely on the sense of identity and system of values of the society which internationalization of higher education is meant to primarily serve. In forming such a (customized) definition, it is important to avoid generic terms, such as "integration," "global dimension," "quality" and "contribution," and try to specify these terms within the context of the society and its system of values. Further, there must be an emphasis in the definition on striking a balance between importing a global view into higher education and embracing the root traditions as a sustainable, forward- looking paradigm for meaningfully serving the society.

As for the "why" question, first and foremost, one needs to beware of the myths [22] and misconceptions [23] that may be misconceived as relevant incentives for internationalizing higher education. In this respect, some crucial points to make include:

- Internationalization is not an end, but merely a means of enhancing the quality of higher education and its service to the society.
- Global branding and international marketing campaigns are not synonymous with the internationalization process.
- The quantity of international students, accreditations or joint agreements between institutions does not necessarily correlate with the better accomplishment of internationalization.
- Strong international reputation does not necessarily lead to a higher quality in education (and research).
- Internationalization does not necessitate sending students abroad, receiving a countable number of international students, or teaching in the English language.

Secondly, four broad categories can be identified as the prime incentives (and rationales) for internationalization of higher education, namely political, economic, sociocultural and academic (see [24] for a review.) However, many critiques have raised concerns about the prevalence of political and economic motivations in the current trends, specifically focusing on the recruitment, retention and eventually assimilation of global talents as well as corporatization of international education (e.g., [11]). Some adverse effects of such trends include lack of attention to the quality of learning, teaching and research, disrespect to the indigenous knowledge and language, and disregard of reciprocal exchange of cultural wealth. Once again, it is imperative for each society to carefully outline the specific purpose of internationalization of higher education for each of the four major incentives, in order to make higher education (and research) genuinely relevant to the society and enrich its own identity, culture and system of values through interactions with other societies. As a simple example, it should be asked whether the intention is to jump on the bandwagon heading towards unifying the language of (engineering) teaching and learning in English or to strengthen the mother tongue as a global alternative, to say the least, in scientific and technological communications. And, so on and so forth.

The question of "how" indeed has a make-or-break role in the establishment of a sustaining framework for internationalization of higher education. A detailed answer to the question is, of course, beyond this note, and it must be delegated to an assembly of academic, political and social strategists who are not only

knowledgeable in the breadth and depth of the subject but also profoundly devoted to the society's system of values. Nevertheless, within the context of engineering education I would like to take the question as a gateway to a proposal for a transformative change in the way that engineering subjects are taught and practiced in the universities of developing societies. The ultimate goal of such a proposal is to customize engineering knowledge and expertise to the indigenous culture and social fabric. The outcome of such domestication is two-fold, to say the least: a) it will help training engineers who are able to utilize science and technology to address the immediate needs of their own society; and b) it will pave the way for generating "new knowledge" that can be shared with the global community, to transform the internationalization process into a truly reciprocal discourse, instead of a one-way channel of receiving and implementing a prescribed framework.

The premise of the proposed transformation lies in the foundations of pedagogy. The traditional model of teaching and learning engineering is based on *behaviorism* [25], which conceives learning as a process of changing or conditioning observable behavior as a result of selective reinforcement of learner's response to various stimuli. The mind is seen as a *tabula rasa* to be filled by, or as a mirror to reflect, the objective reality [26]. Learning is considered as dissemination of knowledge via abstract representation of reality. Thus, the goal of learning, behaviorism posits, is to understand reality and modify behavior accordingly, and the purpose of teaching is to transfer knowledge, in a broad sense, from teacher to student. The behaviorist model is widely adopted for the instructional design of teaching factual or procedural knowledge of engineering. Instructors transfer the abstract or generalized representations of the reality to students through a well-planned, linear and gradual procedure in a "tamed" environment, be it a classroom or laboratory. The students' performance is assessed by measuring the proximity of their behavior (answering questions, writing reports and essays, performing laboratory experiments, etc.) to the expected outcome. Characterizing knowledge as a "transferrable commodity," the way that behaviorism postulates, will normally enforce students to mimic their teachers' knowledge, as their teachers similarly followed suit up in the education chain. Therefore, a natural consequence of behaviorist pedagogy is the formation of "knowledge imitation," with little or no room for "creativity" and "critical thinking." Imitating knowledge can hardly occur without bringing in the context that the knowledge was initially originated within, which practically means transferring the original culture, ideology and system of values. This mechanism may explain why the contemporary modernization movements, led by Western societies, so heavily rely on science and engineering education.

There is an alternative learning model based on *constructivism* [27], which views knowledge not merely as the awareness of objects that exist independent of any subject, but also as a subjective and dynamic product of knower's experiential world constructed through the senses and through social interactions. Hence, the premise of such a learning model is that knowledge is created by learners, rather than just transmitted to them. In von Glasersfeld's words [28]: "*knowledge is not a transferable commodity and communication not a conveyance*." Students learn by experiencing the real world and challenging real problems. Thus, the role of teacher is not to dispense knowledge, but to serve as a creative mediator and facilitator to provide students with opportunities and incentives to construct their own perception of reality. Consequently, the instructional design based on a constructivist model needs to be more concerned with the design of learning environments and less concerned with the selection and sequencing of instructional events. It requires that the teacher develop a product that is facilitative in nature rather than prescriptive. The learning content is not pre-specified; learning direction is determined by the learner, and assessment relies less on specific quantitative outcomes and more on the process and learner's reflection and self-evaluation. As a result, the two notable features intrinsic to the constructivist doctrine of learning are creativity and critical thinking; the former is indeed inherent in the creation of "personal" knowledge, and the latter is a by-product of the necessity of critically examining other

people's artefact, as their knowledge, in order to "customize" the personal knowledge to be viable. The constructivist model of learning can, therefore, be considered as a promising vehicle for transforming a society's knowledge and skills of engineering from an imitated package to a customized and indigenized one, which flows smoothly through the fabrics of society, and is compatible with societal needs and priorities.

Application of the constructivist model to engineering education is particularly appealing, because of the close interaction between engineering subjects, across various disciplines, and the growing dependence of people's daily life on technological advancement. This is a key reason why in the past decade there has been an emergence of project-based courses in the engineering curricula, as one form of constructivist learning, introducing contextual open-ended problems to the student's learning experience. The extent of such design-oriented courses has gone beyond the traditional senior *capstone* courses, which conclude and encapsulate the learning of junior years, to *cornerstone* courses that consider tackling real-life problems as a means of learning engineering, not a result of it. (See [29] as an example.) It is important, nevertheless, to note that one should not undermine the role of the behaviorist model in engineering education, nor consider it as a trivial task to develop and deliver a course, let alone the entire curriculum, based on the constructivist model. Pedagogical research has shown the value of both learning models in the learning sequence, and attempted to establish hybrid models for engineering education [29]. Furthermore, developing student-centered, project-based, design-oriented courses demands enormous resources as well as strong determination and devotion to the ultimate goal of indigenizing technology for the society's well-being.

In summary, internationalization of engineering education can evidently offer potential benefits to the society and its academic institutions. But, to guarantee such benefits it is imperative to first make a paradigm shift in the engineering curricula, in order to domesticate the field and enable students to construct "customized" knowledge that is contextualized within their own society. The constructivist model of learning can be an appropriate mechanism for this purpose. Without a new knowledge, as an alternative way of thinking engineering and implementing technology, following the Western prescription of internationalization may lead to yet another (more complex) phase of westernization. It is possible that, through the journey of constructing customized knowledge, some societies will indeed rediscover themselves and come to the realization that they have long possessed the "precious gem" which they have been desperately seeking from strangers.

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