

Educating Construction Engineering Students for a Sustainable Ethical, Global Practice

Muge Mukaddes Darwish

Texas Tech University, Lubbock, Texas, USA, mukaddes.darwish@ttu.edu

Mary Frances Agnello

Texas Tech University, Lubbock, Texas, USA, maryfrances.agnello@ttu.edu

Bolanle Olaniran

Texas Tech University, Lubbock, Texas, USA, b.olaniran@ttu.edu

Abstract

The new millennium was accompanied by a dramatic technological revolution and challenges in many realms including the energy crisis, environmental degradation, over-population, over-consumption, public health, and education. Construction engineering education is closely affected by these forces, and in turn effects all of these complex and encompassing environmental, economical, ethical and social issues. Solutions to these challenges are increasingly interdisciplinary and international.

It is imperative that global aspects of construction, including global literacy, ethical and cultural characteristics, are incorporated into the education and training process of construction engineers so that they are better prepared for their practice and are globally competent. This paper will discuss existing Current Global Construction Programs and courses and also will provide a hypothetical and specific framework for incorporating global course content in construction engineering education that will empower students in a global market. In doing so, future engineers will have utilized proper educational resources in order to better serve the field of construction on a global level, allowing students to become a more valuable commodity to future employers.

Keywords: Globalization, Construction, Engineering, Ethics, Education

1. Introduction

1.1 Globalization:

The term “globalization” was popularized in the second half of the 1980’s and it refers to an increasing global connectivity, integration and interdependence in the economic, social, technological, cultural, political, and ecological sectors (Felder, 2004). Globalization can be perceived as a unitary process inclusive of many sub-processes including enhanced economic interdependence, increased cultural influence, rapid advances of information technology, and novel governance and geopolitical challenges. All of these phenomena increasingly bind people and the biosphere more tightly into one global system (Bartel, 2003) so that they work as a single cohesive unit or parallel to one another.

Lubbers and Koorevaar (2000) put it this way in their article “Globalization and Sustainable Development”, “the phenomenon [of globalization works so] that the degree of global human interaction increases to such an extent that both its primary effects and the reactions it provokes, give rise to numerous new developments”. Stated another way, globalization is the interaction between economies, technologies and politics highlighting the emphatic manner in which it unites international efforts. To better understand the process of globalization, one

can employ a *Tower of Babel* metaphor. The construction of a global economy requires a substantial amount of volunteers, so to speak. Some maintain a belief in the system while others work from the outside, but both are curious as to the nature of the system. Confusion arises in that many different factors are at work in the construction of a global economy. The builder starts with a concept at the micro level of private venture, or in a business setting a standard that is later adapted or develops on a global level as the standard becomes popularized. Of course, the communication between sectors, such as the privatized market influencing the global market, standard, can become convoluted. If the businesses are directing a standardized system, their ideologies or plans then travel up towards other relative sectors, or coworkers; the engineers, the scientists, etc. must then interpret their ideas. The lack of emphasis on a standardized concept of a global market affects young workers and as they enter into an evolving market becoming more and more globalized. Often they lack the skills to communicate effectively and thus their potential is minimized.

This current obstacle in communication amongst differing sectors creates the need for cross cultural communication training, global literacy and technology education (Alli et al., 2007). The process of globalization is reinforced by the evolution of technology, which allows people to work simultaneously in the realm of past, present and future. Of course, this technology exists and continues to expand as a result of education. The benefits of globalization, or side-effects in some cases, can only be understood through the process of learned insight, (Alli et al., 2007). Since at least five specific areas of international forces are affected by globalization including the economy, communication technology, politics, businesses, and education (Banks, 2003), implications are even greater for cross cultural communication, global literacy, and technology education.

Currently, the manner in which globalization is impacting the way nations of the world conduct business, is visible in this example. It is nothing short of impressive when a US owned Construction Company employs workers in Iraq and uses a GPS to track a truck rented in Istanbul, Turkey. The scheduling is done in Dallas, Texas and reinforced at the hands of a cellphone conversation. According to a recent report by the Fails Management Institute (FMI), “the global spread of business is expanding productive capacity, changing the cost of labor and materials, speeding inventory turnover, and upending traditional supply chains” (FMI, 2006). The same report goes on to state, “The playing field is full of pluralism: multicultural, multi-ethnic, and multi-religious. Skills to work in this environment are essential in a global market place” (FMI, 2006). Because globalization is resulting in higher productivity for nation-states and has become a standard for many business practices, proper education for a youthful workforce who wishes to enter the ever-changing current global market is requisite.

If future construction engineers wish to be successful in the global construction marketplace, they will need to acquire those skills and the knowledge that will not only provide a deeper understanding and appreciation for different cultures, but also how to effectively and efficiently work with individuals in different countries. These future construction engineers will become reliant upon education and experience to further maximize their potential. While both fields are equally essential, they must become a part of every engineer’s personal and professional development. The acquisition thereof can be attained through such means as attending university degree programs, participating in continuing education programs, as well as traveling to other countries to further gain experience working overseas. It is critical in our dynamic world that more structured opportunities are provided to emerging construction engineers to learn about different cultures and how construction is performed in other countries through formal education and experience in their training programs.

1.2 Globalization and Sustainability

Today the world is beleaguered by increasingly intense, frequent storms and by a rising sea levels. Environmental change threatens peoples' health, physical security, material needs and social structure. The recent tsunami in Japan not only claimed the lives of hundreds, if not thousands, but also has possibly created a nuclear threat to the rest of the world. Some people experience extensive flooding, while others endure intense droughts. Species extinction occurs at rates never before witnessed. Safe water is increasingly limited, hindering economic activity. Land degradation endangers the lives of millions of people. As time progresses the world seemingly begins to unravel due to the deliberate negligence of an ignorant populous. This neglect is leading to an environment in which change can be vital to securing mankind's existence.

It is well documented that building construction and operations have extensive direct and indirect impacts on the environment (Darwish et al., 2010). Buildings use resources such as land, energy, water, raw materials, generative waste (construction and demolitions) and emit potentially harmful emissions. See Figure 1 for the environmental effects of buildings. Yet, as the World Commission on Environment and Development (Brundtland Commission) concluded 24 years ago "humanity has the ability to make development sustainable" (Brundtland, 1987). The fourth *Global Environment Outlook* highlights imperative steps needed to achieve this vision.

Over the last three decades, global attention has focused on the concept of sustainability, and sustainable development has been introduced to address and overcome the causes and effects of human activities' increasing negative impacts on the environment (Kibert, 2008). Parallel to the global trend in the United States, there is an increasing demand, in both the public and private sectors, to understand sustainable design and construction practices. This demand is driven by the realization of the need for sustainable practices that not only help the environment but that can also improve economic profitability and improve relationships among many stakeholder groups (Darwish, et al., 2009).

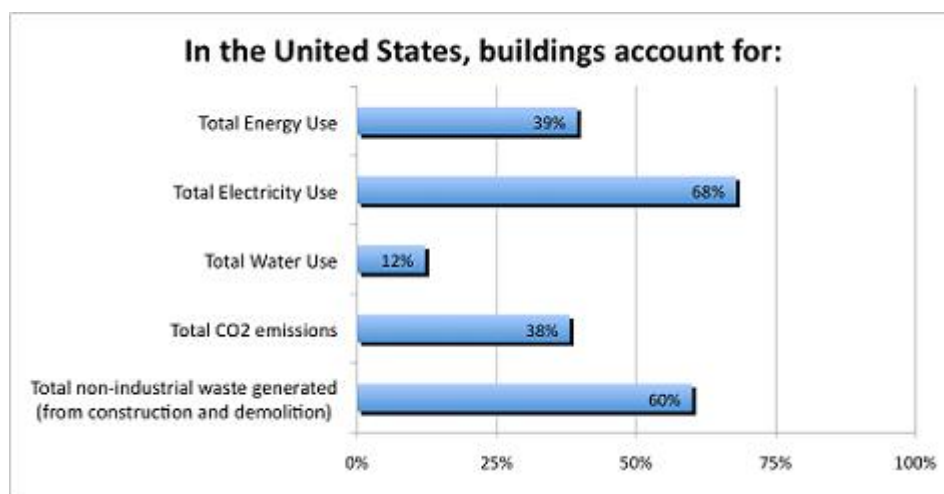


Figure 1. Environmental effects of buildings. (Source EPA 2004 Building data base.)

Moreover, rising public awareness of environmental deterioration has created a shift of focus in the built environment from passive waste cleanup and pollution control to proactive pollution prevention and ecological sustainability that requires a shift in the ways in which we do business (Painter, 2003). The construction industry is complex and there are myriad professions such as architects, engineers, and construction managers etc., who are involved in the procedure of decision-making. Therefore, the design and building of sustainable buildings requires working closely with interdisciplinary teams. As it is argued in Jucker (2002), we need to overcome the disciplinary confinement of current education that makes implementing sustainability in the built education

difficult, and that which prevents each educator from looking beyond one's own narrow field of vision. Teaching sustainability fosters civic responsibility and develops informed citizens who are responsible to their professions, communities, posterity and the world. It is an ethical imperative that we educate construction engineering students in the six fundamental concepts of sustainable design and construction of buildings.

1.3 Global Literacy and Aspects of Cross Cultural Communication

A 1994 joint report published by the Engineering Deans Council (EDC) and ASEE stated, "Today, engineering colleges ... must educate their students to work as teams, communicate well, and understand the economic, social, environmental and the international context of their professional activities (Dowell et al., 2006). In the 21st century, global competency is essential for engineers including construction engineers from any country who now compete in an international market. Cultural sensitivity has become a necessity in most aspects of business, including building and design markets. Increasingly, successful entry into the engineering profession requires significant intercultural skills in order to join efficient and productive collaborations with diverse engineering colleagues. Those colleagues may be encountered "virtually" at a distance, in person at an international site, or next door in the office of a multinational corporation. Diversity has become foundational in the engineering profession and students must understand that it is not a matter of if they encounter it, but when. Outsourcing is increasing as well, not only for products but also for processes, including highly technical engineering work. Projects are distributed across sites and effective collaboration requires professionals who can work productively with colleagues who are very different from themselves (Allert et al., 2007).

1.4 Global Competency

Carol Conway, director of the Southern Global Strategies Council, defined global competency as "the ability to be fluent in at least one other language, such as Spanish or Mandarin; fluency with e-commerce and the Internet; a well-versed knowledge of geography; and, maybe most important, some knowledge of the political and cultural history of one or two countries or regions outside of Western Europe.(Fails Management Institute, 2006). This ideological stance is reiterated by Ron Moffatt, director of the San Diego State University International Student Center, "a global-ready graduate [is] a person with a grasp of global systems, global issues, the dynamics of how things are interrelated and interconnected in the world, and how society can best address global issues" (Teather, 2004). Globally competent construction engineering students must be equipped with specific skills such as, language and communication skills, initiative, self-reliance, an open mind, an adoptive appreciation of diversity, creativity, and an interest in lifelong learning, etc. In a global setting, different cultures perceive some parameters with unique perspective(s):

- Perception of Time: In some countries, punctuality is considered important and being late can be construed as an insult. The opposite is true in other countries, however, where a sense of urgency is less heightened.
- Perception of Space: The concept of "personal space" also varies from country to country. In certain countries it is considered respectful to maintain a distance while interacting. Again, as a result of differing cultures, this issue does not hold as much weight in some countries.
- Non-verbal Communication: Some cultures give value to the written word rather than oral statements. Other cultures infer information from message context, rather than from content. They rely heavily on nonverbal signs and prefer indirectness, politeness & ambiguity.

1.5 Ethical Aspects

Engineering graduates must be capable of understanding the values of different cultures and be able to effectively grapple with important ethical considerations (Herkert, 1991). These students must be articulate in discerning the values of their culture and engage in dialogue on other values. Moreover, they have the advantage of a (developing) familiarity with cutting edge construction techniques and materials. Ethical conduct on an international stage clearly requires more than blind acceptance of all locally held standards of conduct. Future engineers must have a strong ethical foundation as to better serve the scientific community and society on a whole. However, ethics must be taken into account and held with respect when applying foreign values so as not to appear imperialistic, arrogant, or worse. Thus, a delicate balancing act is required. The globalization movement and trend necessitates addressing ethics often embedded in local cultural value beliefs and societal constructs and regarded critically as such (Olaniran and Rodriguez, 2010; Olaniran and Agnello, 2008)).

1.6 Programmatic models for Educating Global construction Engineers

In Europe, an organization called FEANI, representing an approximate 3.5 million engineers in 31 countries, grants the EUR-ING title to qualified engineers so that they can more easily practice across national boundaries. APEC economies and ASEAN countries are also granting the APEC Engineer and ASEAN Engineer titles, respectively, for the same reason. In effect, the number of registered engineers on an international scope) has risen. In United States several universities have adopted different methods of how to approach the globalization of engineering education (Chang et al., 2009). Double or dual degree programs, minors or certificates, international internship or projects, study abroad and academic exchange, collaborative research projects, service-learning projects, graduate level international program are a few of the many options available to the modernity of engineering as it becomes a global field of interest. Many universities send their students for a short term to study abroad. There are a limited number of programs offered for a year or even prolonged abroad studies.

The majority of programs for engineers is in English and do not aid or promote the idea of bilingualism (Dowell, 2006). This is a conflicting ideal in rendering new engineers for a global scope, as several other respective fields either promote or enforce bilingualism. For instance, a history major studying modern or classical French history must ascertain a strong grasp on the French language to better understand the culture whose history they interpret or to assess source documents more accurately. Global engineering is similar in this regard, as the aforementioned statistics become vital in cross-cultural productivity. Cultural exposure is also very limited. Many of these programs, including the Texas Tech summer experience, are not integrated across the curriculum. This could very well hinder a future engineer's understanding of international work efforts.

2. Recommendations:

In order to promote global sustainable ethical construction education, universities must invest in long-term programs. The curriculum must be restructured to teach global literacy, sustainability, and environmental and cultural ethics as well as encourage at least a full semester in international experience for a substantial number of students. See Figure 2 for a suggested model by the authors.

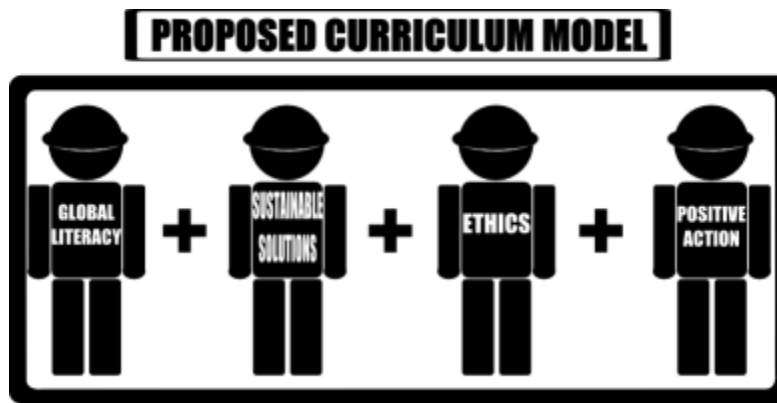


Figure 2 Efficient global curriculum model

3. Conclusion:

With the rapid development of technology and societal evolution, on top of the ever present challenges such as energy crisis, environmental degradation, over-population, over-consumption, public health, and education; building construction and operations have extensive direct and indirect impacts on the environment. Therefore it is essential that construction engineers be educated in sustainable development and green construction practices. It is imperative that global aspects of construction, including global literacy, ethical and cultural characteristics, are incorporated in the education and training process of construction engineers so that they are better prepared to globally competent for their future practice. This also better prepares the student for international commerce and thus makes them a more viable candidate for businesses. This benefits the world, and the student, respectively as the two are correlated, especially during times of economic disparity where financial success and job dependency become risky issues.

It is also imperative that the global construction engineering model includes global literacy, sustainable development, cross cultural communications, ethics and positive actions in the engineering curriculum so that engineering educators and education can better adopt contemporary global teaching methodologies and better environments for better teaching and learning their craft. If educators wish for their graduates to be successful in the global construction marketplace, they will need to attain those skills and knowledge that will not only provide a deeper understanding and appreciation for different cultures but also how to effectively and efficiently work with individuals in different countries. The achievements of the needed skills and knowledge must be fostered in construction engineering curricula. Educators must instill in their students a true sense of global perspective which requires better self-assessment of their applicable trade beyond the realm of the classroom or their environmental conditioning. In order to be worthwhile, practices applied worldwide every day must expand their scope to include universal concerns.

References:

- Allert. B.I., Atkinson.D.L., Groll.E.A., Hirleman. E.D, Making the Case for Global Engineering: Building Foreign Language Collaborations for Designing, Implementing, and Assessing Programs. *Online Journal for Global Engineering Education*, 2007
- Alli M. Ali., Winter S.Gregory., May, David L., 2007.Globilizations:Its Effects. *International Business & Economics Research Journal – January 2007 Volume 6, Number 1*
- Banks, James A. (2003). "Teaching for Multicultural Literacy, Global Citizenship, and Social Justice" Retrieved 3/1/2011 from <http://www.lib.umd.edu/PAL/SCPA/fowlercolloq2003bankspaper.html>
- Bartel, M. (2003). Internationalization of universities: A university culture-based framework. *Higher Education*, 45(1), 44, 48, 49
- Brundtland, G. H. _1987_. *Our common future*, Oxford University Press,Oxford, U.K
- Chang, Yating; Atkinson, Dianne; and Hirleman, E. Dan (2009) "International Research and Engineering Education: Impacts and Best Practices," *Online Journal for Global Engineering Education*: Vol. 4: Iss. 2, Article 1.
- Darwish, M.M., Agnello M.F Burgess, R., (2010) Incorporating Sustainable Development And Environmental Ethics Into Construction Engineering Education. Eighth LACCEI Latin American and Caribbean Conference for Engineering and Technology (LACCEI'2010)“Innovation and Development for the Americas”, June 1-4, 2010, Arequipa, Peru
- Darwish, M., and Agnello, M.F. (b) Sustainability Green: Challenges and Changes for Education, Construction in the Twenty-First Century, Istanbul, Turkey, May 21-24, 2009.
- Dowell, E., E. Baum, and J. McTague, 2006 Green Report: Engineering Education for a Changing World. American Soc. for Engineering Education, <http://www.tradeslive.com/2010/11/11/engineering-accreditation-global/> Engineering accreditation goes Global retrieved 3/11/2011
- Fails Management Institute, (2006), *The 2007 U.S. Markets Construction Overview*, Raleigh, NC, USA
- Felder, R.M. and R. Brent, (2004) “The intellectual development of science and engineering students. Part 2:Teaching to promote growth”, *Journal of Engineering Education*, Vol. 93(4) (2004b), pp 269-277.
- Hein, M. F., & Liu, J. (2007). Digital graphics literacy for 21st century constructors. *Proceedings of Fourth International Conference on Construction in the 21st Century (CITC-IV)*, Gold Coast, Australia
- Herkert, J.R., and Viscome, V. (1991). “Introducing Professionalism and Ethics in Engineering Curriculum.”*Journal of Professional Issues in Engineering Curriculum.” Journal of Professional Issues in Engineering Education and Practice*, ASCE, Vol. 117 (4), pp 319-329.
- Jucker, R. (2002) *Our Common Illiteracy. Education as if the Earth and People Mattered*. Frankfurt, M., Oxford, New York: Lang 2002 Environmental Education, Communication and Sustainability; Vol. 10.
- Kibert, Charles (2008). *Sustainable construction: Green Building Design and Delivery*, John Wiley & Sons, Inc
- Langford, P.(2004) “Engineering to Shape a Better World,” *Engineering Sustainability* 57, no. ES2, 69-78.
- Lubbers. R., and Koorevaar .J.2000. Primary Globalisation, Secondary Globalisation, and the Sustainable DevelopmentParadigm - Opposing Forces in the 21st Century Conference on 21st Century Social Dynamics: Towards the Creative Society 07-04-2000/15.02
- Olaniran, B. and Agnello, M.F(2008) Globalization, educational hegemony, and higher education Multicultural Education Journal, 2(2), 68-86.
- Olaniran, B. A. & Rodriguez, N. B. (2010). The role of computer-mediated Communication: A look at methods for delivering and facilitating Training in Academic and organizational settings. *International Journal of Information and Communication Technology Education*. 6(4), 61-71.
- Painter, D. J. _2003_. “Forty-nine shades of green: Ecology and sustainability in the academic formation of engineers.” *Ecol. Eng.*, 20_4_,267–273
- Teather, D. (2004). The networking alliance: A mechanism for the internationalisation of higher education? *Managing Education Matters*, 7(2), 3

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