Engineering Education Management for Sustainable Development through Globalization, Diversity and Inclusion – A Curriculum Perspective

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***Abstract*— In this paper, the conceptual framework is presented for Engineering Education Management based on Sustainable Development through Globalization, Diversity, and Inclusion. The framework will be helpful to revise and improve the existing curriculum for engineering students. Nowadays, globalization, diversity, and inclusion have had a significant impact on teaching and learning in the engineering curriculum. Their impact stimulates a broad perspective, cultural competence, and collaborative problem-solving skills that are vital for engineers working in an increasingly interconnected and diverse world. The paper discussed the various aspects of how Globalization, Diversity and Inclusion can be helpful to improve teaching and learning in the engineering curriculum. Our main contribution for this work is that we have proposed a methodology to bring Globalization, Diversity, and Inclusion in engineering education.**

Keywords*—*Diversity and Inclusion, Engineering Education, Globalization and Sustainable Development Goals

I. INTRODUCTION

The engineering education is one of the catalyst that emerges the global trends and had a great impact on creating a skilled workforce, and the education and training of the workforce. The Future engineers will be anticipated to function differently as of today, as they may face new work environment that have influence due to globalization, diversity and inclusion, emerging technologies, and outsourcing. The raises several questions but fundamental research question that need to be address are:

- What will be the impact of Globalization, Diversity and Inclusion in the Engineering Education?
- Importance of Globalization, diversity and inclusion for engineers in current scenarios

These are some fundamental questions that are exploring the new dimension among individuals, especially for those particularly who never thought about the relation between Globalization, diversity and inclusion for engineering education. In the engineering code of ethics, the engineers in their related professions matters shall treat and consider all workforce as equitable without any discrimination based on either age, gender, race or ethnicity, faith, ill health or by any other mean [1]. Engineering is a powerful action, which is important to meet all economic development and the delivery of services to society by meeting the needs of people. It includes the determined solicitation of mathematics and natural sciences that includes the body of engineering knowledge, technology and techniques. Engineering pursues to yield clarifications about the effects that are predicted to engineering degree possible, in often uncertain contexts. While bringing benefits, engineering activity has potential adverse consequences []. Engineering therefore must be carried out responsibly and ethically, use available resources efficiently, be economic, safeguard health and safety, be environmentally sound and sustainable and generally manage risks throughout the entire lifecycle of a system. The United Nations Sustainable Development Goals present targets for 2030. Engineers are vital contributors for making progress towards these goals [22]-[25]. The present challenges for the International Professional Forums like International Engineering Alliance (IEA) are the global imperatives of poverty, inequality, climate, and environmental degradation, which are borne so heavily and inequitably across the world,

and the role we can play as engineers in addressing these challenges [26]-[30]. Working is underway by the IEA, UNESCO and the World Federation of Engineering Organizations (WFEO) to align the IEA Graduate Attributes and Professional Competency Benchmark Standards and practices to facilitate the UN Sustainable Development Goals. The global imperatives present a significant challenge for engineering academics and engineering institutions. While past engineering has brought great progress (for some), it has done so without the burden of finite resources, active society engagement and safety constraints. For the future, the capacity of engineers to deal with complexity, environmental fragility and global interdependence will be crucial in determining what future we have. Educating engineers for the future requires re-thinking engineering capability and new educational models. Consequently, accreditation systems for the future must balance quality and rigour with the imperative to accommodate educational innovation generated by our engineering academics and institutions.

II. Globalization in Engineering Education

Globalization is a relatively new idea in research, having first gained popularity in the 1980s in public, intellectual, an d pedagogical discourse. Many renowned globalisation resea rchers have debated the major causes or shapers of the pheno menon, specifically the movement and mixing of materials b eyond the local or national level, which has been going on fo r centuries.

From a historical standpoint, globalisation and education are inextricably linked. During the late modern colonial and imp erialist centuries, historical forces that may be identified as k ey antecedents to political

conomic globalisation influenced the formation and rise of m ass education.Globalization of education refers to the integrat ion and application of similar educational systemand informa tion beyond national borders, with the goal of enhancing edu cation quality and deployment globaly. Globalization is a co mplex process with far-reaching consequences.

In recent decades, India's foreign trade has shown rapid growth. Most workers in India are said to have had multiple types of employment over a period of time. It clearly contributes to the integration of the labour market, which closes the wage gap between workers in various types of countries, especially in developed and developing countries, especially through the dissemination of technology. For developing countries, globalization will bring about the decline of inefficient capital-intensive industries that are tightly protected by tariffs and the growth of labour-intensive and export-oriented industries that reflect the country's comparative advantage. The relationship between Globalization in engineering education is depicted in Fig. 1.

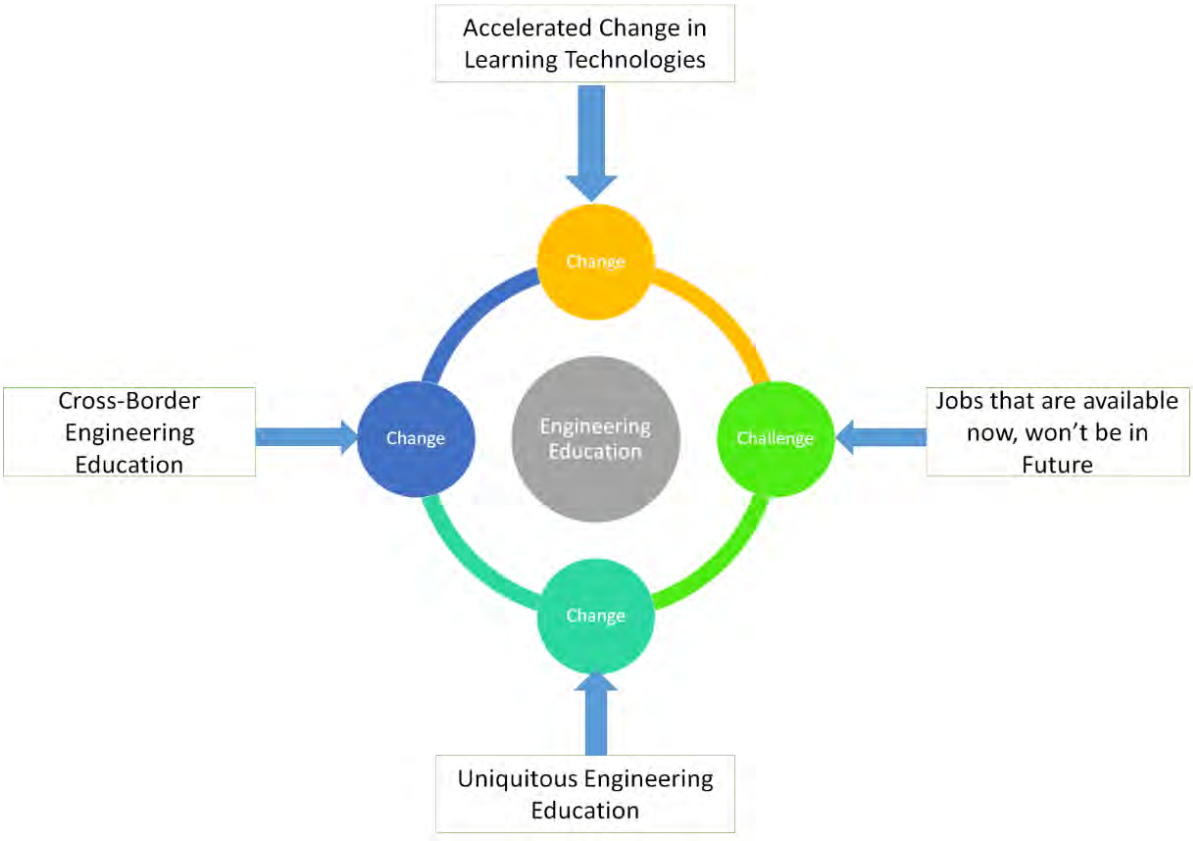

Figure 1: Relationship Globalization on Engineering Education

Another important aspect in Engineering Education is Diversity and Inclusion for Sustainable Development in the engineering Curriculum Perspective. The Diversity and Inclusion in the direction of Curriculum Perspective is discussed in detail.

III. Diversity and Inclusion in the Engineering Curriculum

The one of the important aspect about how diversity in the engineering curriculum leads to students' increased cultural understanding, stronger critical thinking skills and enhanced creativity, which all better prepare them for adulthood. This is possible by exploring the following

A. Exploring the Benefits of engineering curriculum Diversity and Inclusion

Diverse engineering curriculum feature differences in ethnicity, socioeconomic class, religion, reading level, athletic ability, background, gender, personality, and much more. Strong engineering curriculum programs teach engineers to value the unique aspects of what makes each student different, and helps them embrace those differences in the society.

An in-depth research review of dozens of other studies on diversity—conducted by The Century Foundation, a New York-based think tank—found that having different and divergent perspectives can create positive learning outcomes. Those outcomes, explored below, can have benefits that reflect well beyond students' graduation and can impact their lives going forward.

B. Diversity Improves Cognitive Skills and Critical Thinking

The presence of diversity in the engineering curriculum allows students to consider perspectives and opinions beyond those they've already formed or were shaped in early life by family and friends. By presenting engineering curriculum students with viewpoints far different from their own, it gives them the opportunity to think critically about their own beliefs and examine the world in fresh ways.

C. Exposure to Diversity Helps Students Enter Adulthood

When students enter the professional world, they join a vast and diverse workforce. Interacting with people of all different backgrounds and mindsets can present a challenge without prior exposure to diversity, especially at a younger age. Companies are taking note of their employees' ability to handle diversity with grace and maturity; 96 percent of major employers, according to the Century Foundation, say it is vital that employees are able to work with people from diverse backgrounds.

D. Diversity Prepares Students for Citizenship

As part of the Century Foundation's research study on diversity, the authors reviewed 27 different studies about the effects of diversity on people's willingness to interact with and improve their local community—a concept known as civic engagement.

E. Diversity Promotes Creativity

At its core, creativity is all about bringing together different ideas and transforming them to make something new, unique, and personal. The more ideas and experiences people are exposed to, the more creative they can be. Indeed, Scientific American cites a study conducted by several research professors who found that groups with racial diversity significantly outperformed groups without diversity in a problem-solving scenario. In professional and nonprofessional situations that call for creativity, it is a wise choice to bring together diverse perspectives. After discussing the both Globalization, Diversity and Inclusion in the engineering curriculum. It is important to discuss the engineering as Program and Profession. Engineering education and profession, in particular, is experiencing and confronting a difficult juncture. Globalization, the "new world order," worldwide crises (such as the global economic crisis that began in 2008 and is still ongoing), and other developments have resulted in several opportunities and difficulties. The quality and components of education that a country provides to its citizens have played and will continue to play a significant influence in a country's success and sustainability. Competition is now a vital idea in any business' existence, where quality, durability, pricing, and 'green-ness' of manufacturing and product are all critical. Thus, it is critical to make the engineering education and programs dynamic so that they are responsive to changing times and societal needs.

The engineering education must include solid preparation and mastery of mathematics and science. Math (calculus, analytical, numerical, and linear algebra), science (physics, chemistry, and/or biology), and computer and programming are all technical courses in engineering schools. Statistics, management, economics, cultural studies, and humanities are examples of other courses. Understanding and mastering technical courses, particularly mathematics and other disciplines, is essential for becoming a skilled engineer. An engineer must also be able to understand society's demands, prioritize society's problems, and optimally and offer intertemporal solutions, given the available resources.

As a result, a more holistic engineering program is required, one that includes a good mix of engineering, scientific, and technological knowledge, as well as managerial, innovation, economic, communication, and, most importantly, ethical and moral knowledge and skills. With Globalization, Diversity and Inclusion in the engineering curriculum are becoming increasingly important.

Engineers work to address problems. They are obliged and expected to make decisions that will have an economic or non-economic impact on their organization, themselves, and society. They must conduct themselves professionally, ethically, and with social responsibility in their work and decisions. Airport building, petroleum and natural gas exploration, mining, chemical and petrochemical plants, and waste facilities all have societal advantages and expenses. Communities living near these projects may be impacted (positively or badly) by the proposed engineering projects, necessitating a focus on globalization, diversity, and inclusion in the engineering curriculum. Engineers reach conclusions using a scientific method that includes data collection, analysis, interpretation, and conclusion.

IV. Problem Statement

This research will be carried out under the umbrella of Engineering Education Management which was rarely considered as an area worth focusing towards Sustainable Development in the context of Globalization, using Curriculum as a tool with ingredients of Diversity and Inclusion. The real dilemma faced by engineering education in the so-called developing or under-developed world is the persistence of the belief that the engineering curriculum seldom needs revival in the respective jurisdictions or economies. The minor rearrangement has always been considered as "curriculum revision" which could not serve the purpose to synchronize with the pace of development, especially in the developing countries. The regulatory

limitations also, to some extent, hamper bringing about the changes in curriculum in many countries.

V. Research Gap

The following difficulties, risks, and opportunities characterize the contemporary and quickly evolving workplace and environment in which young engineers will work:

• A global platform for obtaining, marketing, and exporting materials, products, and services.

• Competition for survival (business, self, flora, animals, etc) (business, self, flora, fauna, etc)

• 'Degradation' of the environment as a result of industrial and economic development.

• Promotion and education of sustainable development principles and practices.

• Access to knowledge and experience is simple and straightforward.

• Communication technology has virtually eliminated the distance between sender and recipient.

Present engineering programs do not adequately incorporate these current realities. The modus operandi of the twentieth century dealt with different 'issues' and priorities than those that we face today in the twenty-first century. As a result, the structure and components of engineering education must be adjusted [16-19].

The basic structure of engineering education was set in 1955 and hasn't changed much since. Rather than hands-on problem solving, classes emphasize theory, while a "pipeline mindset" perpetuates a system designed to keep people out rather than welcome them in. How can engineering schools connect their curricula to solving the broader social justice, equity, and environmental issues that motivate today's students? [24].

The need for engineering curriculum to properly contain, discuss, and prioritize ethical and moral topics in its program is urgent and overwhelming. This is the crucial missing piece in engineering education.

VI. Proposed Solution

For sustainability to be properly and practically practiced, its benefits to be comprehensively achieved, and to result in inter-temporal benefits for the globe and its inhabitants, it is absolutely crucial and necessary that we raise a generation that live by and believe in strong ethical and moral foundation. If every component of our society starting with leaders, decision makers, engineers, scientists, lawyers, bankers, politicians, and all other professionals and non-professionals alike lives on and is guided by strong and unwavering ethical and moral principles, then a major portion of SDGs will be achieved. The question is "How can we train engineers to fit into this type of a model having a combination of Globalization, Diversity and Inclusion in the engineering curriculum?"

This proposal address the combination of Globalization, Diversity and Inclusion in the engineering curriculum. The combination will have numerous positive benefits for students, but how can engineers ensure their pupils are getting the most out of interacting with their diverse peers? - Well-trained engineers with the tools to encourage the exchange of ideas and interpersonal understanding. No matter what level of education, elementary school teachers through college professors can all utilize the following strategies to benefit their engineering education. The proposed system is explained in Fig. 2.

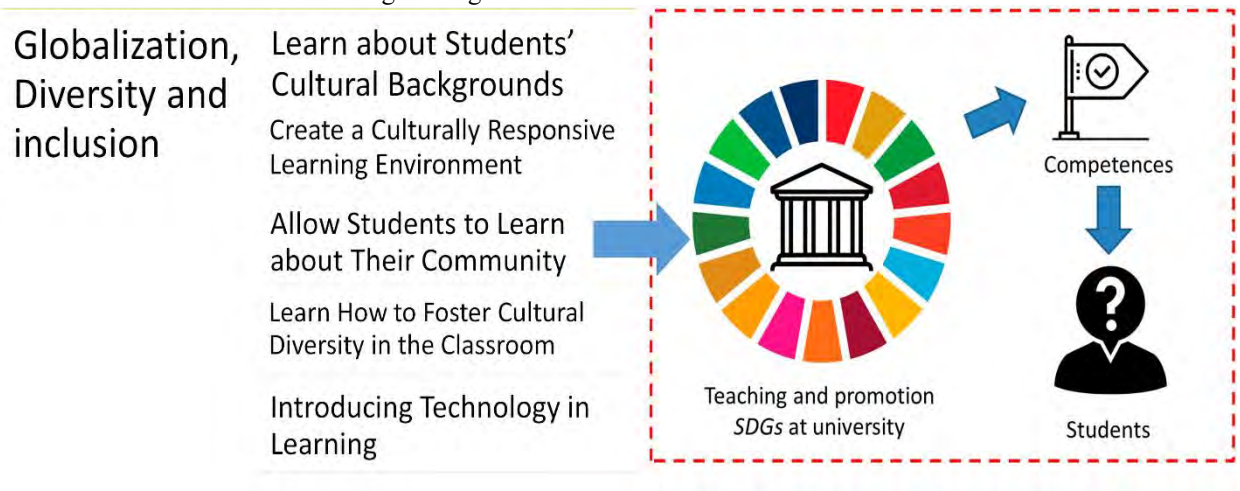

Figure 2: Proposed Methodology

A. Learn about Students' Cultural Backgrounds

Engineering students aren't the only ones who can benefit from learning about what makes them diverse. For an educator, understanding cultural diversity in the classroom is a crucial part of being able to anticipate where certain lessons might lead, or any issues that might arise between students of different backgrounds. Educators can establish a tone of inclusion, emphasizing that all perspectives are valuable.

B. Create a Culturally Responsive Learning Environment

An educator who properly creates a culturally responsive environment will have fostered a classroom where students become respectful and understanding of cultures different from their own. Those students are typically more willing to

listen respectfully to different viewpoints, rather than mock, scorn, or fear the unfamiliar.

C. Allow Students to Learn about Their Community

Learning about one's own culture is just as important as learning about others when it comes to developing cultural understanding among students. Educators with a strong teaching background such as an EdD can facilitate projects for their students that encourage them to get to know their own history.

D. Establish a Zero-Indifference Negative Behavior Policy

In recent years, schools have enacted zero-tolerance policies in an attempt to curb bullying, harassment, and intimidation. However, the tide is now shifting toward zero-indifference policies instead, according to GLSEN. Zero-indifference is an alternative that promotes safety in schools by consistently and firmly addressing disrespectful behavior. Unlike zero-tolerance, in which a first offense results in punishments as harsh as suspension or expulsion, zero-indifference allows the teacher to use culturally insensitive moments as opportunities for learning and understanding. The Tolerance.org project of the Southern Poverty Law Center recommends zero-indifference policies when it comes to addressing bullying and harassment, as does the Anti-Defamation League; the American Civil Liberties Union; the Respect for All Project; and the Gay, Lesbian, and Straight Education Network—according to research by Jacqueline Leung on the Oregon Commission on Black Affairs.

E. Learn How to Foster Cultural Diversity in the Classroom

Teachers who wish to be at the forefront of their profession should have a strong foundation in understanding diversity and how to create an environment of inclusion in the classroom. To accomplish this, educators would do well to explore an award-winning education program.

F. Introducing Technology in Learning

Technology provides students with easy-to-access information, accelerated learning, and fun opportunities to practice what they learn. It enables students to explore new subjects and deepen their understanding of difficult concepts, particularly in STEM.

VII. Expected Outcomes

Globalization, Diversity and Inclusion improve teaching and learning in the engineering curriculum. Engineer learn and enrich their abilities to think critically and creatively as they engage in conversations across difference, especially when all learners' abilities and attributes and embraced. Inclusive teaching strategies in the engineering curriculum are intended to ensure that all students feel supported such that they freely learn and explore new ideas, feel safe to express their views in a in the engineering, and respected as individuals and members of groups. Intentionally incorporating inclusive teaching strategies helps students view themselves as people who belong to the community of learners in a classroom and university via engineering curriculum.

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