

## ICE-T: Internationalising the curriculum in engineering and technology

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**ABSTRACT:** The need for the engineering professional to be global in outlook and practice is more relevant than ever [1-4]. Engineering is one of the very few professions that is portable in terms of recognition and acceptance. A reputable engineering degree earned from a university in one region of the world is accepted without reservation by peers in other parts of the world. Also, the workforce needs of multinationals are becoming global and diverse. There is a high expectation that a graduating engineer would be informed about global issues, and it is also expected that an employee working for a multinational company essentially will need to deal regularly with global issues [3]. This has created a need for the engineering curriculum to have international content. Discussed in this paper is a recent initiative undertaken by the College of Engineering and Engineering Technology (CEET) at Northern Illinois University (NIU) to internationalise its engineering curriculum.

### INTRODUCTION

The College of Engineering and Engineering Technology is one of the seven colleges at Northern Illinois University in DeKalb, Illinois. The faculty (academic staff) in the College is very diverse, offering the varied experiences and cultural heritage from several countries. Some of the countries represented are Europe, the Middle East, India, China, Taiwan and Latin America. Many of them have experience of working in industry before coming to academia. While most of the faculty staff have terminal (or higher) degrees earned in the United States of America, their undergraduate degrees were often earned in their country of birth.

A typical engineering curriculum does not include exposure to global issues unless specialised courses are developed to address that proficiency. Especially, the undergraduate engineering programmes are technical in nature and do not have scope or the mission of addressing international issues. Several schools do have exchange programmes for students to study abroad, but the number of students participating in those programmes is below 100 per cent. When it is obvious that almost every engineering student must understand the concept of globalisation as it relates to their work environment, the curriculum should have some scope to embed international experiences into its content.

Also, the student body in the graduate programmes offered by the College is largely international, which brings great international diversity to the engineering programmes. In the past, due to the strict nature of the curriculum desired by the Accreditation Board for Engineering and Technology (ABET) and the lack of global issues in the curriculum, the students were only being prepared for the American market. In the past decade, the expectations of ABET have also evolved, addressing globalisation as part of the learning outcomes. Furthermore, with the economy being global, there is a critical need for students to understand global challenges and be prepared to handle those challenges.

### PROJECT DESCRIPTION

The globalisation phenomenon often is wrongfully perceived as posing a serious threat to the US economy, when in reality the globalisation phenomenon has opened doors to tremendous opportunities. The opportunities have included, but are not limited to, open markets and global consumers, international trade, technical partnerships, innovation and economic development activities. Several schools have used different techniques to introduce globalisation into their programmes but CEET-NIU has used a unique approach to engage in curricular innovation, to embed global issues into an existing curriculum.

The project *ICE-T: Internationalizing Curriculum in Engineering and Technology* is a unique attempt to globalise an engineering curriculum using the global knowledge and experience of faculty staff teaching engineering courses. The motivation for the project came from the strategic planning at the University, in which curricular innovation was one of

the priorities. While at the University, the focus was on general education reform during the initial phase of the project, the technical courses at the College were updated to internationalise them. The ICE-T project is in line with the University's strategic planning.

The College allocated resources to start the programme and solicited proposals from all faculty members through a RFP (Request for Proposal). Proposals were sought from the College faculty to identify a course and incorporate international content into those courses.

The RFP emphasised that the College considered globalisation to be an important and critical aspect of student learning at CEET-NIU and that every student graduating from CEET must have an understanding of global issues and some of what was happening in other countries. The rationale provided to the faculty was, that since the US is a major trade partner with several upcoming economies of the world, it is obvious to expect that many of the students would have to face issues dealing with cultural diversity, diverse trade practices, logistics and supply chain issues. The students will have to deal with international issues and global partners as part of their employment and career trajectory.

The faculty staff were assured that this project was an NIU commitment to promote global education as part of the NIU experience. The faculty staff were empowered through recognition of their understanding of global issues and in their ability to bring tremendous knowledge about international issues to the table. It was emphasised that the purpose of the project was to enrich the curriculum with international content, without changing the technical outcomes of the course(s). Since the programmes were accredited, the basic content of the course was to be preserved. The faculty staff were encouraged to use case studies, discussions, global competitiveness issues, global economic implications, special projects/papers, design for global success, etc, in their attempt to internationalise their course(s).

The faculty staff were provided with token compensation for their effort and they were asked to submit formal proposals with clear deliverables and outlines. The expectations were that the faculty staff teaching the course would assume ownership of change. Documenting the change was encouraged to ensure the longevity of the project. Since the departments maintain ABET course files for every course, it would be very easy for departments to preserve the proposed integration through formal documentation. One of the binding factors was that the change be permanent and not limited to a one-off process. However, it was explained that the proposed activities and studies may have to change subject to emerging trends and possible obsolescence. Also, the faculty staff was asked to address ABET learning outcomes in the proposal to make sure that the proposed change was consistent with the ABET outcomes.

In some cases, additional learning outcomes were addressed to ensure increased compliance with ABET, especially in the category of globalisation and the understanding of contemporary issues. Depending upon the nature of activities proposed, the faculty staff could address more than one of the learning outcomes expected by ABET. Internationalising the curriculum could have short-term, as well as long-term, effects. While the short-term effect could be on the learning outcomes associated with ABET, there could well be a long-term effect on learning objectives. As an accreditation process, every programme has to address learning outcomes and objectives. Internationalising the curriculum often results in giving engineers, during their mid-careers, a clear competitive edge. A student graduating with an internationalised curriculum will have a competitive edge in the global economy, as compared with someone who was educated through a traditional curriculum.

Finally, the RFP was sent to the faculty staff and funding was secured to sustain the project. A total of nine proposals were submitted by the faculty staff, and all were funded to maximise impact. The nine proposals received were in the following areas and were submitted by nine different faculty members. The projects were:

- Warehousing and Distribution Systems;
- Mechanical Vibrations;
- Globalisation of Digital Design with FPGAs (field-programmable gate array) Using Remote Access;
- Supervision in Industry;
- Introducing Global Issues into Supply Chain Management;
- Engineering Project Management;
- Industrial Project Management;
- Computer Integrated Manufacturing;
- Utilisation, Production and Distribution of Energy.

#### OTHER SYNERGISTIC ACTIVITIES

The CEET at NIU has also signed a major contract with the University of Malaysia to develop a joint programme in engineering technology to prepare 60% of the country's technical workforce as engineering technologists. The proposal was discussed at a regular visit of the NIU faculty to Universiti Malaysia Pahang. The engineering technology programmes offered by CEET are fully accredited by ABET and, therefore, enjoy a high reputation and recognition by peers and industrial partners. The project involves faculty staff from two institutions working together to develop a

curriculum, which has technological synergy but also considers regional and cultural sensitivities based upon consumers, customer expectations, student preparation, trade practices and regional/national policies.

The ongoing project is in the second phase and the faculty staff are working together to develop the curriculum. There are more than ten faculty members and three administrators engaged in the process. The collaborative project will not only result in an accreditable programme in engineering technology for the students in Malaysia, but will focus also on developing some technical electives, which are suitable for the technical, business and social environment in Malaysia. The interaction will educate faculty staff in the United States on pertinent issues in Malaysia and will make them more knowledgeable in identifying opportunities for course transformation.

The long-term goals of the project are to develop dual degree programmes and engage multinational companies with operations in both countries (USA and Malaysia). The working arrangements will enable faculty staff from both countries to develop culturally enriched programmes to include content that is relevant to global practices and the global competitiveness of engineering graduates. Use of technology to enable faculty members to work together in a convenient manner is an asset to the programme. Also, collaboration amongst faculty staff will not only enhance other opportunities for joint research, innovation and intellectual property, but will allow them to engage in continuously improving the curriculum. This also could be a marketing point for both the programmes, and provide a competitive edge to its students.

The CEET also has been engaged in hosting students, from international partners, for a summer programme. The partnership was with a university in South Korea, where the Government sponsored a group of 15-20 students for a three-week summer programme at NIU-CEET. The students were engineering students and were enrolled in Kyungnam University in South Korea. The students were given several modules of instruction in engineering courses by American professors. The students were exposed not only to a different style of teaching but also to a tour of industrial plants, businesses and social places to enrich their knowledge of the cultural differences between the two countries.

Several students were able to compare the similarities and differences between the two countries, and to gain additional insight into preparatory techniques needed to become more globally competent. The students were given enough experience to become a product of a dual-culture environment. It is fascinating to report that many students later decided to come to the US to pursue their studies and become part of the engineering workforce in the US. It is obvious that these students will have an edge when they are ready to enter the job market. Hence, these students will be able to function successfully in a globalised environment.

## JOINT RESEARCH

One of the benefits of internationalising the curriculum and of disseminating the results to the College is that the faculty staff would have a great understanding of challenges and opportunities in a global context. Therefore, their ability to conceptualise issues that go beyond one country would be enhanced. For example, the College staff were able to write a research proposal with faculty staff from two different countries, to address research projects that had major similarities but also accommodated the cultural differences between the two countries. The funding agency set a condition for mutual partnership between two countries.

In the future, such opportunities will rise further, and it will be prudent for any college and its faculty staff to take full advantage of such opportunities. The College has several faculty members who have discovered synergies and similarities in research agendas across the globe. They are collaborating in their research and the benefits are trickling down to the graduate students, who now have a better understanding of engineering research in a global context. The solutions provided by their research may benefit citizens of the two countries and will also prepare the students for the global context. The future holds promise for the active participation in twinning grants and joint funding of intercontinental projects. Any college with an environment of global understanding, global participation and global preparedness stands a great chance of succeeding in the future.

## CONCLUSIONS

In the past, having a globalised curriculum with international issues may have been a choice but in the current environment it is a necessity [5]. Leading companies, who will be employing engineering students, are present in more than one country and their needs of addressing the R&D, training and engineering design in a consistent manner is becoming a top priority.

Their business operations also are becoming global and, therefore, they need employees who are comfortable and knowledgeable about international issues. This requires a change of mindset. First, by transforming the curriculum, the students are being educated to understand that they must be globally sensitive, prepared and competent.

Second, they must have factual information to be able to work in different parts of the world. Third, they should be able to understand the difference between trade practices and policies that affect their organisation.

The NIU-CEET has students representing several countries, as well as faculty staff who have migrated from several parts of the world. It is their commitment and knowledge that makes this endeavour possible and successful. The future holds tremendous promise for the young graduates who have been exposed to an internationalised curriculum in engineering.

#### REFERENCES

1. Borri, C., Guberti, E. and Melsa, J., International dimensions in engineering education. *European J. of Engng. Educ.*, 32, 6, 627-637 (2007).
2. Mazumder, A., Making of a global engineer: culture and technology. *Proc. 2009 American Society for Engng. Educ. Annual Conf. and Exposition* (2009).
3. Downey, G.L., Lucena, J.C., Moskal, B.M., Parkhurst, R., Bigley, T., Hays, C., Jesiek, B.K., Kelly, L., Miller, J., Ruff, S., Lehr, J.L. and Nichols-Belo, A., The globally competent engineer: working effectively with people who define problems differently. *J. of Engng. Educ.*, 95, 2, 1-17 (2006).
4. Downey, G.L. and Lucena, J.C., Distinguished lecture: globalization, leadership and diversity in engineering education. *ASEE Annual Conf.*, Chicago (2006).
5. Harris, S., Internationalizing the university. *Educational Philosophy and Theory*, 40, 2, 346-357 (2008).