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Insight to Global Engineering Challenges: Study and Analysis

1 INTRODUCTION

Engineering has been a major field of science pursued as an education and career by the major percentage of students. Engineering in itself has covered a million or more milestone of advancements since its inception. Eight decades before Herbert Hoover was mocked by a lady for being an engineer as at those times engineering wasn't considered a gentlemanly career. It has evolved through those decades and stands currently as a field preferred and adopted as the lifetime work by millions of students of both sex. In spite of these great progress there are challenges continue to prevail that has to be paid constant attention and addressed in the way engineering is taught and learned.

This paper portrays one initiative which IFEES and SPEED have taken together to analyse the various engineering problems faced by students across the globe. A survey was conducted and administered to different countries students to survey the various issues, problems, and challenges facing the education system from a student's perspective. The results of this survey will be used by both IFEES and SPEED separately, who will address them later in their respective approaches to benefit the student fraternity. This analysis will also provide a comparison between the various engineering trends and methodologies practiced in different countries.

1.1 Engineering Education

Engineering Education (EE) is the process of teaching principles and imparting knowledge related to the field of engineering. There has been a continual improvement in the content of EE provided to the students every year. The curriculum is constantly under review and it keeps changing based on the technology requirements of the outer world. In the present scenario, there is not only a considerable amount of work being conducted on the content being delivered but also on the process of delivering EE to students. Academicians across the globe are working on to inculcate various EE pedagogies into their curriculum. This surge in EE pedagogy is mainly aimed towards elevating the quality of engineers graduating every year to fit into continuously growing industry needs.

Students are currently more inclined towards programs which are regularly adapting and improving their course structure preparing them better to work after graduating. One way this can be achieved is by taking student feedback into consideration to evaluate the efficiency of a course. Measuring the performance of the stakeholders, taking into account the various issues, problems and challenges they are facing and addressing them is very much essential for sustainability. This highlights the seriousness of gauging student's needs in the current education scenario.

1.2 Student Platform for Engineering Education Development (SPEED) and International Federation for Engineering Education Societies (IFEES)

The search to improve education is eternal. Educators across the globe strive to improve Engineering Education methodologies in the past, and present. There have been many organizations and, initiatives that have risen for this very same purpose. International Federation of Engineering Education Societies (IFEES) [2] and Student Platform for Engineering Education Development (SPEED) [3] are organizations which work to improve the quality of EE provided to the students. While both these organizations work for the same cause, they take a completely different approach. IFEES concentrates on a more top-down approach whereas SPEED believes in a bottom-top approach by giving student the role to bring a change in the system.

SPEED strives to empower students to become a factor of change in EE by providing them with the skills, knowledge and resources necessary to become a global engineer and show them how they can think globally and act locally. IFEES through the collaboration with its member societies works to establish an effective EE process of high quality around the world in order to assure a global supply of well-prepared engineering graduates. IFEES strengthens its member organizations and their capacity to support faculty and students. It attracts corporate participation to help connect engineering graduates with international corporations which have a pressing need for well-trained engineers who can work in a global environment.

2 FOCUS AREAS OF SURVEY

2.1 Comparison on growth in engineering education among various countries

The Shanghai academic ranking of world universities for the year 2013, places 30 of the top 50 universities in the United States of America. The remaining 20 universities have their origin from Canada, China, Israel, Japan, Singapore, South Korea, Switzerland and United Kingdom [1]. These rankings show a lack of uniform distribution of good engineering universities across the globe. While some countries like USA have been constantly improving the quality of EE delivered to their students, the same cannot be said for the majority of developing countries. A global study on EE has been created to analyze the evolution of EE in different countries across the globe. This study will help SPEED & IFEES compare how EE has been evolving in different countries.

2.2 Teaching methodologies practiced in various countries

EE has evolved from the traditional classroom learning to using of presentation slides, animated videos and simulation software's for teaching engineering. There has been immense focus on interdisciplinary, project, community, entrepreneurship and outcome based EE in the recent years. Though there has been great development in the various engineering methodologies practiced in few countries, there has been a complete lack for the same in other countries. This survey was expected

to provide statistical data which would help make a comparison between many countries and identify the reason for the difference.

2.3 Measure of research and international exposure

The era for international practice for engineers has arrived; many engineering universities are revisiting their programs to prepare graduates for a global marketplace. This includes international student exchange programs, foreign intern opportunities, foreign-language training, and education in cultural awareness. The survey results will help us understand the amount of global exposure present for student engineering graduates, the international opportunities available for them and also the hurdles they face in the process of attaining global exposure. The results will also give a broad insight to the countries which foster research opportunities for engineering students and the resources available for funding the research.

2.4 Financial funding availability for engineering education

One of the reasons a lot of interested and capable students are not entering engineering schools is lack of funding. A certain section of the survey has been prepared to shed light on this global challenge and identify the funding opportunities available for young engineering aspirants across various borders. Results will also give us a ratio of engineering graduates opting out of their engineering field after graduation and reasons for the same.

3 SURVEY DISSEMINATION

3.1 Survey Distribution

Survey was translated into English, Spanish and Portuguese. As English and Spanish being one of the most widely spoken languages in the world, participation from a wider range of engineering students was expected. Survey link was sent through mails to ten active SPEED members from different countries and all SPEED members across the globe who filled the survey themselves and also spread it out to their student community. The link was also forwarded to IFEES and GEDC representatives to spread it out to their member organizations, deans, professors and industry representatives who could share it with their student contacts. Promotion was also done through social media by sharing the link through SPEED Facebook page. An iPod shuffle was announced as a raffle for the person who shared the survey link on Facebook.

The authors debated whether or not sending a personalized email would be more effective than a general email. It would be easier for the recipient to forward a general mail rather than a personalized mail as it would reduce their effort drafting a new mail. It was decided that for sending a second email, the authors went with a personalized version, hoping that the direct attention would increase the likelihood of the information being forwarded. Emails sent out to deans and students contained mostly the same information with slight adjustments in the greetings and increased professionally in the tone. In order to motivate the students to participate in the survey, the authors announced a mini-iPad to one of the survey participant who won the raffle.

3.2 Survey Tracking

All the survey invitations sent were updates in a excel sheet to keep a track of the responses received, to avoid sending multiple mails to the same recipient. Follow up mails were sent after 2 weeks to students studying in countries which has less responses. All students who filled the survey were sent a thank you mail for filling the survey and were requested to share the survey with more students.

4 SURVEY RESULTS

The survey was answered by engineering students from thirteen countries which comprise of Argentina, Brazil, Columbia, Ecuador, India, Italy, Malaysia, Mexico, Nepal, Portugal, Singapore, United Kingdom and United States of America. Majority of the survey responses were received from students currently pursuing their under graduation and few responses were gathered from Masters and Doctoral students. Figure 4.2 illustrates survey participants the field of study.

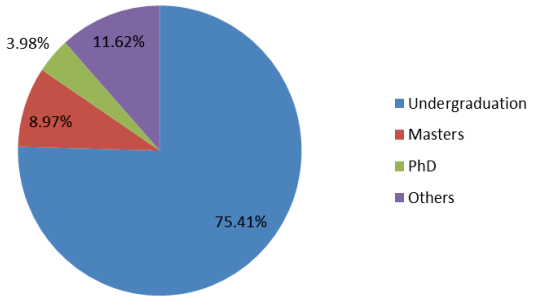

Fig 4.1 Discipline of survey recipients

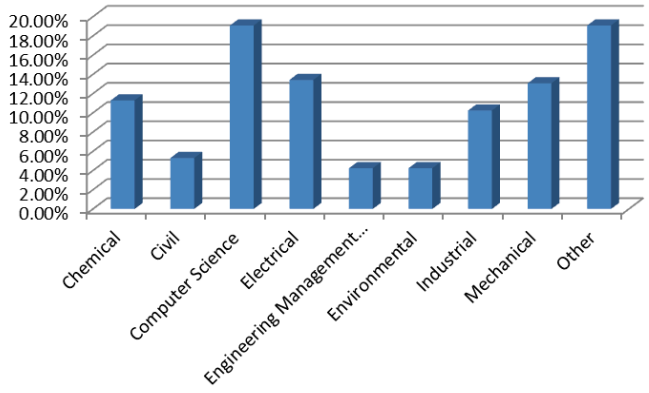

Fig 4.2 Field of Engineering

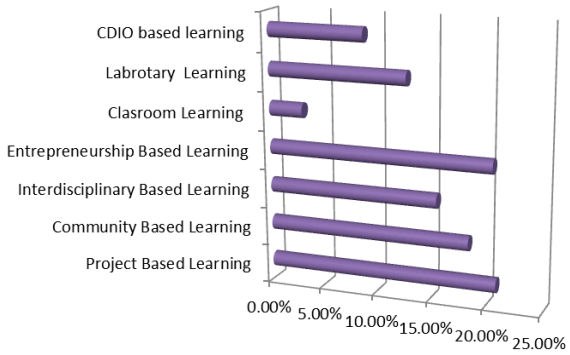

Fig 4.3 Engineering Methodologies lacking in current EE

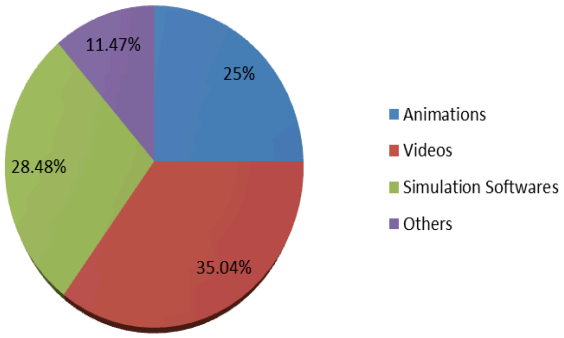

Fig 4.4 Teaching approaches used in EE

Figure 4.3 highlights the lack of various engineering methodologies in current EE. As seen above, there is deficit in community, entrepreneurship, interdisciplinary and project based learning. A large chuck of participants believes there is a great need to inculcate project and entrepreneurship based learning in their curriculum. This would improve the understanding of engineering concepts during their course of study and also inspire and groom engineers to become a technology entrepreneur. Figure 4.4 outlines the progress in teaching approaches in current EE. Instructors are using animations, simulation software's and videos to improve knowledge transfer to the students. 73.2% of the survey participants feel the curriculum is emphasized more on theory rather than practical work. While many feel the ideal balance for theoretical and practical work in the curriculum should be 50-50, few students voted for a higher percentage of practical work reducing the theoretical work to less than 50%.

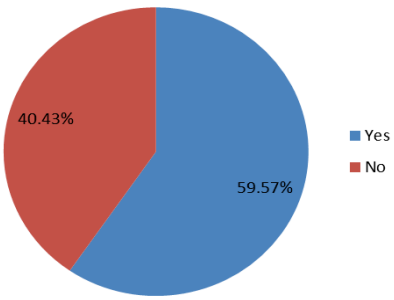

Fig 4.5 Availability of research opportunities

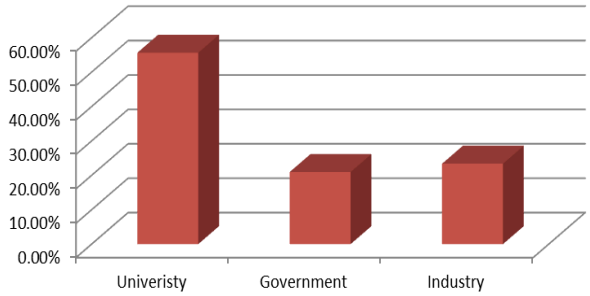

Fig 4.6 Source of research funds

Figure 4.5 provides an overview of the research opportunities available for students. While majority of the students have voted yes, further improvement in this area is required. Majority of the students who voted yes are students residing in Argentina, Brazil, Colombia, India and Nepal. More than 50% of the students receive funds for research from their universities, while others get them from government and industry.

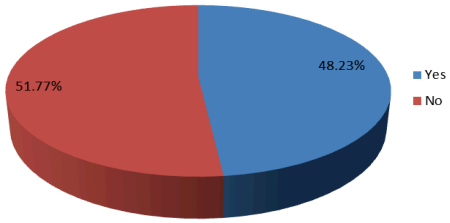

Fig 4.7 Availability of international exchange programs

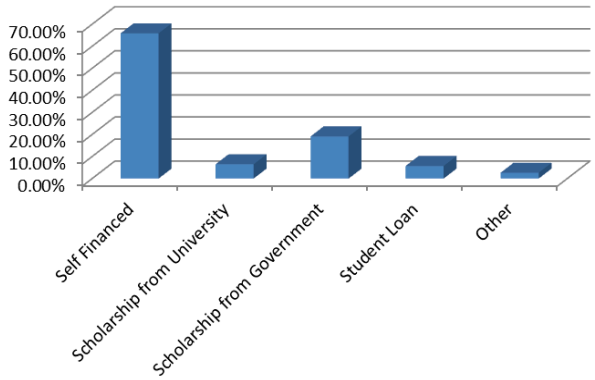

Fig 4.8 Source of funds of engineering schools

There had been a considerable amount of development in the number of foreign exchange programs between engineering schools and also industry. Figure 4.7 show more than half of the students have international exchange programs accessible to them. This improvement will expose the students to global, cultural challenges and help them broaden their professional network. This will help students take up international work and research opportunities with ease after completion of study. Some of the major challenges faced by students aspiring for international programs are the lack of awareness about exchange programs, funds for international expenditure, cultural boundaries, communication gap between different countries and non-uniformity in the quality of EE provided across various countries. Lack of funds is also depicted in Figure 4.8 where bulk to the funding for their engineering schools is self-financed by the students. This portrays lacking in funding opportunities from universities, government organizations and other sources. This also results in interested students opting out of engineering field due to lack of funds.

5 FUTURE WORK

The future scope of work will include disseminating this survey to students from more countries for further responses. Efforts will be made to ensure effective participation from Africa, Europe and Australian continents where minimal participation has been recorded. SPEED will identify the most pressing issues using complete survey responses and involve students in engineering education dialogues to bring about a change in the local EE community. SPEED will use the 10th Global Student Forum which is being held in Dubai this year as a global platform. Students all across the globe will be invited to participate and develop action plans to overcome many of the challenges mentioned in this paper. Upon returning back to their respective communities after the forum, the students will work on the action plans developed to address the challenges being faced in their local engineering community. SPEED will constantly help mentor the students in implementing the action plans with constant guidance and resources to have maximum positive impact on EE.

REFERENCES

[1] http://www.shanghairanking.com/FieldENG2013.html

[2] http://www.ifees.net/

[3] http://worldspeed.org