

## Reimagine Student Perceptions of Barriers in Engineering Education through the 10th Global Student Forum

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## **INTRODUCTION**

Mentioning Diversity in Engineering Education usually refers majorly to racial diversity. It is also about the gender diversity or under represented groups currently pursuing engineering every year. But diversity in engineering education goes beyond race. Diverse perspectives in engineering education are critical for addressing the multi-disciplinary and global challenges we currently face. Unfolding through centuries with highly evolving engineering and technology, engineering students need to have access to education without borders. They need to learn to work in multidisciplinary projects which requires them to explore areas beyond the scope of their discipline, work and collaborate with people from different parts of the globe keeping in mind the difference in culture, language and time. Looking through the different borders, the classrooms should grow within and beyond the physical walls. Such growth will accommodate the different perspectives of border in engineering education. Students being stakeholders should be equipped with necessary knowledge and skills to address these challenges themselves to benefit their respective student community. Student Platform for Engineering Education Development (SPEED) is an interdisciplinary global student network which works towards engaging students in engineering education dialogues and initiatives. This paper is a detailed report of a SPEED initiative, the 10<sup>th</sup> Global Student Forum (GSF) and its outcomes. The 10<sup>th</sup> GSF was a three day student forum conducted by SPEED at Dubai, in December 2014. The forum aimed towards helping students develop initiatives to eliminate the barriers in their engineering education. They were guided by invited partners of SPEED from industry and academia to create realistic action plans and to realize them locally at their university. In this order in the forum the Students worked in three big topics, re-imagining EE in and out the classroom, re-imagining EE beyond the silos of discipline and re-imagining the EE through the world.

### **1 STUDENT PLATFORM FOR ENGINEERING EDUCATION DEVELOPMENT (SPEED)**

SPEED is a global, non-profit student organization that functions as an interdisciplinary network of engineering students who aspire to stimulate change and impact the development of engineering education (EE) and its effect on society, industry, the environment and local communities. In collaboration with academia, industry and government SPEED is committed to improving EE by channeling the student voice and perspective. Through local and global initiatives SPEED empowers students and encourages the development of professional, ethical and social responsibility. Furthermore, through insight into policy, academia/industry relations and organizational structure SPEED serves to continue the professional education of its members and participants of its forums [1].

SPEED was founded by a group of engineering students who were passionate towards bringing about a change in Engineering Education in 2006 at the 5th ASEE Global Colloquium on Engineering Education. Since then SPEED has been steadily growing to make its stand in the global engineering education community by engaging students in engineering education discussions. We have been partnering with other global engineering education organizations such as ASEE, IGIP, ISTE, IUCEE, LACCEI and WNSO to initiate dialogues with students in their respective countries.

## **2 GLOBAL STUDENT FORUM (GSF)**

The GSF is a global conference organized by the SPEED which draws academics representatives from government bodies, industry, non-profit organizations and an increasing number of students from around the world to discuss issues pertinent to engineering education. During the forum students are a part of an international experience, submerged in the atmosphere of cross-cultural communication and creative thinking. Participants take part in workshops aimed at providing them with tools to find innovative solutions with a global perspective and apply them in their local communities. They get a chance to learn about already existing student projects, get involved and/or start their own regional and global initiatives with the aim of maximizing the student voice within the engineering education community. The GSF is organized with the intention of:

- 1) Facilitating the presence of the students' voice in local and international dialogue surrounding engineering education.
- 2) Increasing students' conscience within the engineering education community and the autonomy of the students to improve their own education and that of their peers.
- 3) Establishing a virtual worldwide network of students to strengthen the international ties and promote the global development of engineers

Borrowing from the successes of previous GSF's in Brazil, Turkey, South Africa, India, Russia, Hungary, Singapore, Portugal, Argentina and Colombia, the 10th GSF was hosted in Dubai under a theme of Engineering Education without borders.

## **3 ENGINEERING EDUCATION WITHOUT BORDERS**

### **3.1 Introduction**

The world needs a new generation of engineers. We need professionals who are capable of innovating at a global scale, who have an open mind, who are resourceful, and who are able to work in interdisciplinary groups. We basically need engineers who are capable of jumping across borders, going around them, or even better: taking them down.

Borders can be seen as lines of division, edges or boundaries. They are necessary in order to define countries or areas, but they also represent barriers to engineering education. We need to jump across geo-political borders in order to have a global engineering community. We need to eliminate social and cultural barriers in order to have innovative and effective engineering solutions in remote places. We need to break down the divisions between engineering disciplines in order to have multidisciplinary team workers. Finally, we need to overcome mental borders in order to come up with non-traditional solutions.

The 10<sup>th</sup> GSF's main goal was to come up with student-generated action plans that can lead to overcoming borders and challenges in reaching a global Engineering Education. In order to achieve this we will learn from Dubai's birth from a desert, learn from its diverse engineering community, and have an impact on the local community.

The overall theme of 10th GSF was streamlined into 3 tracks. 1) Re-imagining EE beyond the silos of discipline; 2) Re-imagining EE through the world; 3) Re-imagining EE in and out of classroom.

### **3.2 Track 1 – Re-imagining EE in and out of classroom**

In this track, students re-thought about their educational experience, blend different forms of learning in and out of the classroom in order to overcome pedagogical barriers in the traditional classroom while still meeting stakeholder needs. Some of the key areas for brainstorming were: 1) What traditional learning models can be challenged to reflect the findings of new research in engineering education; 2) How can we transform learning in and out of the classroom; 3) How can we increase customization of curricula to meet individual learning needs, the retention of engineering students from primary school through graduate school, and the ease of assessing “real-world” skills in our engineers (creativity, resourcefulness, etc.); 4) What effect do student-teacher ratios have on students’ outcomes; 5) What technologies help, and what technologies do more harm than good?

### **3.3 Track 2 – Re-imagining EE beyond the silos of discipline**

In this track, students tackled the barriers of integration within engineering specialties as well as with other disciplines (humanities, sciences, arts, social sciences etc.) in order to create a more well-rounded and holistic engineer. Some of the key areas for brainstorming were: 1) How can we collaborate across disciplines in a model that breeds innovation and creativity; 2) What are the advantages of offering engineering degrees with varying degrees of cross-breeding with other majors outside of engineering; 3) How can we best prepare engineers for the multi-faceted skills and challenges they’ll face;

### **3.4 Track 3 – Re-imagining EE through the world**

In this track, students considered the development of the global engineer and productively collaborate internationally. Great innovation comes from the mixing of cultures, politics, and religious beliefs. It is the responsibility of the well-prepared global engineer to understand, respect, and work with these issues. Some of the key areas for brainstorming were, 1) How do we work across international borders when our very audience lacks facilitating technologies for communications; 2) How do we ensure that all engineers across the world are given access to the same opportunities; 3) How do we level the playing field for international collaboration;

## 4 HIGHLIGHT SESSIONS

### 4.1 Schedule




 <b>10th Global Student Forum</b> Dubai, United Arab Emirates <i>Engineering Education Without Borders</i>					  <b>SPEED</b>	
	Saturday, 29th November	Sunday, 30th November	Monday, 1st December	Tuesday, 2nd December		
7:30 - 8:00	Arrival and Accommodation	Breakfast	Breakfast	Breakfast		
8:00 - 8:30		Transportation	Transportation	Transportation		
8:30 - 9:00		Keynote Speaker	Track Experts Presentations & First Idea Pitches	Feedback Incorporation and Finalization		
9:00 - 9:30						
9:30 - 10:00		Break	Break	Break		
10:00 - 10:30		Presentation on Burj Khalifa	Narrowing of Ideas	Presentation and Election of Action Plan Winners for Each Track		
10:30 - 11:00						
11:00 - 11:30		Introduction to Brainstorming	Idea's Presentation and Formation of Groups	Lunch		
11:30 - 12:00						
12:00 - 12:30		Lunch	Lunch	Lunch		
12:30 - 13:00						
13:00 - 13:30		Introduction to Action Planning	Action Plan Development	Presentation and Election of Best Action Plan Overall Winner		
13:30 - 14:00						
14:00 - 14:30		Break	Break	Closing Ceremony		
14:30 - 15:00		Transportation	Action Plan Development			
15:00 - 15:30		Industrial Visit		Critique Stage	WEEF Networking Evening	
15:30 - 16:00						
16:00 - 16:30						
16:30 - 17:00		Transportation	Cultural Evening	SPEED General Assembly		
17:00 - 17:30						
17:30 - 18:00		Dinner	Transportation	Free		
18:00 - 18:30						
18:30 - 19:00	Free	Dinner	Free			
19:00 - 19:30						
19:30 - 20:00	Welcome Night	Cultural Evening	SPEED General Assembly			
20:00 - 20:30	Formal Introduction			Transportation		
20:30 - 21:00						
21:00 - 21:30	Free	Dinner	Free			
21:30 - 22:00						
22:00 - 22:30						

Fig. 1. 11<sup>th</sup> GSF Schedule

### 4.2 Day 1

**Keynote Speaker:** The keynote speech was delivered by Dr. David Delaine who spoke about “Action Planning an Educational Life”. He spoke about the importance of multidisciplinary research in engineering education. He encouraged the participants to be a reflexive engineer rather than just being a traditional engineer. He asked the participants to first understand the purpose of pursuing engineering. He emphasized on a peaceful change through love, peace and networking. The importance of having an action plan for education that included aspects such as a theme, objectives, tasks, responsibilities, timeline and evaluation was also made known.

**Presentation on Burj Khalifa:** Next session was guest lecture by David Bradford, project director of Burj Khalifa. He spoke about the planning and construction of the Burj Khalifa from its foundation. He focused on the important interdisciplinary learning and strategic planning and execution for successful completion of any project. He also shared few interesting facts about Burj Khalifa with the participants.

**Introduction to brainstorming:** The brainstorming session was facilitated by Joe Packhem, who is currently studying his masters in civil engineering from Marquette University, USA. He focused on the advantages of brainstorming in groups to

generate more ideas and also some tips on evaluating the ideas generated post brainstorming. The session ran over the basics of brainstorming. Students practiced brainstorming alone, in pairs and with groups. The session involved the students answering questions on their own by brainstorming. One question was

“What are the uses of sand?”

We were in Dubai and there was plenty of sand around. Students brainstormed for 30 seconds and then brainstormed in pairs for minute. After that students engaged in a group brainstorm sessions where they discussed their brainstorms. Discussions then moved to more relevant topics

“What is your preferred learning method?”

“How three students from different locations work on a single project?”

That was the next question covered in the same fashion of brainstorming as what are the uses of sand. This was a great opportunity for students to open up in a group discussion and learn from global viewpoints. The reason for this session was to prepare students for their action plan development in the next session.

Introduction to action planning was key session for the students to make change and to validate their efforts with the impact they created. Goncalo Guerreiro and Ana Rita Medeiros from Board of European Students of Technology (BEST) facilitated it. Both the facilitators talked about the importance of action planning and presented some useful tools like SWAT analysis [2], Gantt chart [3] that can used to develop a good action plan.

Industrial Visit: The first day ended with a visit to the Burj Khalifa. The participants got a chance to introspect everything they heard from David Bradford in the morning. It was also a good chance for students coming from different countries to bond after a daylong session. This was intended to inspire through artefacts. It was by itself a big statement for breaking the barriers with respect to disciplines of engineering and multi-cultural team involved in creating such a marvel.

### **4.3 Day 2**

The 2nd day started with presentations about the 3 tracks. All the students were guided to their respective track rooms where industrial and academic experts presented about the 3 tracks. They gave the participants a brief overview of the track and raised some questions for the students to think about. The participants were then given time to brainstorm among themselves about the track to generate ideas aligned with respect to the tracks. Participants were later divided into groups randomly. Each participant was then given 2-minute time to pitch their idea to the group.

Narrowing of Ideas: After the first pitch, the participants brainstormed in groups to narrow down the best ideas and present them to the whole track. The participants made posters describing their ideas and posted them on the walls after presentation. At the end of the session, the participants were allowed to choose the idea of their choice by pasting a post-it with their name on the poster. All the participants were then grouped again on the basis of their ideas chosen.

Action Plan Development: After the selection of idea, participants worked with their groups to develop an action plan to implement the idea. The participants were mailed all the different tools for action planning which were introduced on the day 1. All groups were then indulged in research required for the action plan development. The industry and academic experts were constantly providing comments and feedback to



all the groups throughout the session. At the end of the session, the participants completed their action plans and made posters describing the same. The posters were posted on the walls in the respective track rooms.

**Critique Stage:** In the critique stage, the participants from the other track rooms were invited to look at the action plans and provide comments. All the participants were provided with post-its to write their comments and stick it on the posters. The critique stage provided all the groups with very detailed feedback, which the participants incorporated in the action plans.

**Cultural Evening:** The cultural evening is a highlight of the GSF every year. GSF brings together students from many different nationalities, and the cultural evening is platform for them to show their culture to the others. Participants wear their traditional clothing, distribute their local delicacies and also play and dance on their traditional music. The session is filled with loads of energy and excitement as participants from different nationalities mix in together and enjoy each other's tradition. This session was aimed to provide the participants with global cultural awareness [4].



*Fig. 2.* Nationality of 10th GSF participants.

#### **4.4 Day 3**

The last day of GSF began with the action plan presentations. The participant groups after the action plan development went through steps that has sculpted their efforts to make it a real plan. It has received ideas and critiques equally from the peers, industry and academic experts. They were initially presented to the judges in their respective tracks. The winners of each track was announced who then competed against each other and final winner was announced.

The winner of the first track (re-imagining engineering education in and out of classroom) developed an action plan to redefine the classroom. The action plan aimed towards transforming learning and pedagogical system through interactive technology. It focussed on usage of existing solutions such as smart boards, software's which enable effective feedback and interactive classroom through flipped classrooms. Their plan was intended mainly to create awareness and to survey and benchmark techniques used around the world. This would help, rather not developed institutions to adopt them in a way that's is feasible for them.

The winner of the second track (engineering education beyond the silo's of discipline) developed an action plan to eliminate learning barriers among students from different educational backgrounds. This was expected to be achieved through a course that is going to be tailored to address common personally relevant goals of students from different academic backgrounds. This course will focus on higher collaboration beyond the level of discipline and higher attention to personal relevance. The course would be designed and tailored based on analysis of students feedback survey which would be taken in regular intervals. The highlight of the course would be its bottom to top approach rather than the traditional top to bottom approach.

The winner of the third track (re-imagining engineering education through the world) developed an action plan which was to create an online platform for educational crowd-funding. The mission of the action plan was to promote intercultural and intracultural educational field trips while eliminating existing financial barriers. This would be achieved through a global platform connecting students from different universities globally. The students would be grouped virtually and would be made to work on projects. The funds to be raised for the platform would be through crowdfunding. While working in groups from different nationalities, the students would overcome barriers of language, culture, time difference etc. This action plan was chosen as the best action plan among all the three track winners.

Networking evening : GSF is conducted every year before the World Engineering Education Forum (WEEF). All the delegates attending WEEF (starting on the next day) were invited to the networking evening to give students a chance to interact with them. Alexandra Seeman (GSF local) presented to everyone about the 10th GSF and also the action developed. The motive of this session is to make the other stakeholders realize that students can take a bigger role in the field of engineering education and deserve more credit. The session ended on a positive note with everyone appreciating the work and also providing some useful feedback for future.

## **5 INTERGENERATIONAL PANEL**

Inter-generational panel, as suggested by its name, is a panel discussion that is created by SPEED to indulge all the stakeholders of Engineering Education (EE) in one discussion. In 2014, the title topic of the discussion was Digital (Re)-Evolution in Engineering Education. It was strategically placed at the end of the Global Student Forum (GSF) and at the opening World Engineering Education Forum (WEEF), where the students have indulged in various brainstorming sessions, debates and presentations as described above and the opening of WEEF has industry and academia stakeholders. The panel discussion revolved around the role of technology in engineering education has evolved dramatically over the past decade. Today's engineering students are learning not only from the professor in the classroom, but also from a variety of digital resources including MOOCs, digital labs, online simulations, wikis, discussion boards, and even social media interactions. The attention span of today's learners has become noticeably shorter, with students opting for shorter more focused summary lectures, while supplementing their knowledge from digital sources later on. Classroom note-taking is gradually being replaced with digital notes, snapshots, and even video recording. Professors who used to find the use of smart phones in the classroom annoying are realizing that students actually use these devices to record and search for information during the lectures. In parallel, telepresence facilities are making it easier and more reliable to hold synchronous classroom sessions across different continents. In this session, educators, practitioners and students spanning a range of generations will debate the



critical role of technology in today's engineering education, and will present arguments in support of, or against, the proliferation of technology in today's classroom. The session structure was an inclusive discussion between the stakeholders represented from around the globe. It gave birth to the idea of "Techizens" who are from the current generation that embraces technology to a higher level, where there are migrants who are slowly transitioning to the use of technology at work. It was understood in a resonating thought that the state of Techizens is happening and the change is inevitable but embracing it makes a positive and progressive change in Engineering Education.

## 6 CONCLUSION

Once the students are in front each other, it is a realization that the first target of the forum was already reached i.e. the geographic borders have been broken. The students were initially excited with a creative yet insightful talk by one of the founding members which opened the forum in a positive way. The students were given a spin into the topic of engineering education, their role, the possibility for impact and the importance for such transformation which were received with an open mind. This created a basis for the activities that indulged the students in a deep conversations into engineering education. It was interesting to notice that the experts from both academia and industry were indulging in conversations and discussions which was a rare happening. These discussion were insightful for both the groups in the discussion. The action plan competition which was the cornerstone of the GSF happened on the last day. This competition is created to be a source of motivation towards taking actions and to make change locally. The action plans developed provides a basis for idea which can be developed further with the expertise that SPEED collective provides with its partners. The winner of the action plan competition set out to create an online platform for educational crowdfunding. The idea was typically to break borders and such a platform could be a tool that improves the mobility factor that is still considered a major hurdle. SPEED will be holding regional student forums with the same format at national level in Argentina, Austria, Colombia, India, Malaysia and Nigeria to reach out to more students globally.

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