

The Rise of Student-to-Student Learning

Youth-Led Programs Impacting Engineering Education Globally

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Abstract—Around the globe, students and young engineers are playing an increasing role in the coordination and delivery of engineering education programs. Many youth-led initiatives are now conducted with students involved in all aspects of their creation, organisation and delivery. This trend presents an exciting opportunity for the education of engineering students, both those involved in delivery of the courses and for participants.

This paper profiles four leading youth-led engineering education programs and analyses their structure and growth in recent years. Profiled are initiatives coordinated by *Engineers Without Borders – Australia (EWB-A)*; the *Board of European Students of Technology (BEST)*; the *Electrical Engineering Students' European Association (EESTEC)*; and the *Student Platform for Engineering Education Development (SPEED)*. Each case study includes a brief history of the organisation, program overview, growth analysis and future projections.

The common features amongst these programs were analysed, as were the aspects which made them distinct from traditional university offerings. Key findings about the initiatives include: an international focus; the mixture of formal learning and social aspects; an integral role of volunteers within the organisation; the use of residential programs; and the role of internal professional development of committee members and volunteers.

Additionally, this paper outlines the benefits for universities and provides a guide for how engineering faculties can support and nurture these initiatives and effectively create partnerships.

Index Terms—student-led learning; engineering education; Gen Y; global engineer;

I. INTRODUCTION

The creation and growth of student-led initiatives is an emerging dimension of the engineering education sector. These initiatives provide unique learning and development opportunities in international environments.

The four leading educational programs profiled in this paper are geographically diverse, being coordinated by Engineers Without Borders Australia, EWB-A (Australia); The Board of European Students of Technology, BEST (Europe, various), Electrical Engineering Students' European Association, EESTEC (Europe, various) and the Student Platform for Engineering Education Development, SPEED (Global). The focus of these organisations vary widely, spanning the engineering education spectrum from

technical expertise to professional skills development each having a meaningful impact on this important field.

II. CASE STUDY ONE: ENGINEERS WITHOUT BORDERS – AUSTRALIA (EWB-A)

EWB-A “works with disadvantaged communities to improve their quality of life through education and the implementation of sustainable engineering projects. Through the process of helping people in need we become more socially aware and responsible, improve ourselves, inspire others to action and further our ultimate goal of sustainable development. (Engineers Without Borders – Australia, Organisational Summary)”

One of many distinct Engineers Without Borders organisations around the world, EWB-A was founded in 2003 and has a growing membership of over 1,500 students and professionals. An international development organisation, EWB-A's programs fall into two broad categories: (1) Working with Communities and (2) Learning and Change. Its international projects are focused on south and south-east Asia, where it deploys over 30 volunteers each year to work with developing communities on technical projects. It is worth noting that while EWB-A is not a youth-based organisation and has a growing number of older members, its focus and mission attract significant numbers of students and young professionals.

As part of its Learning and Change initiatives, EWB-A runs a series of educational events for students from first year through to honours projects. EWB-A's premier educational program is the *EWB Challenge*, a design project for first-year engineering students (of all disciplines), conducted at various universities in Australia and New Zealand. Students work in teams of up to six to develop conceptual designs for projects that contribute towards real, sustainable international development for a developing community (which varies each year) [1]. This program was launched in 2007 and has expanded to involve over 7,000 students from 26 participating universities.

EWB-A also coordinates an *Undergraduate Research Program* where students interested in humanitarian and international development are able to elect to study topics within this field as part of their project requirement of their degree. This program sees about 10 to 15 student projects each year which span for one or two semesters. Within this initiative, students are based in Australia and work with current and returned volunteers on real-world projects from disadvantaged communities in the region. Another program coordinated by EWB-A is EWB Innovators, where teams of 4 to 16 students work in collaboration

in support of international volunteers and gain course credit for their work.

To achieve its impact in the higher education sector, EWB-A uses a partnership model with Australian universities. Becoming a partner with EWB-A provides the university with access to its programs, volunteers and guest speakers. In return EWB-A is provided with funding, workspace and support. This has been an effective way of expanding its programs and has yielded positive outcomes for both EWB-A and the partnering universities, described in detail at [2].

Another non-formal education initiative coordinated by EWB-A is the *Development Education and Leadership Experience*. This program involves a small group of students and young professionals spending three to four weeks in a developing country (previously Cambodia and India). This program exposes participants to local customs and lifestyle as well the chance to see firsthand local development organisations in action. The emphasis on this program is to provide a broad coverage of cultural issues and applied technologies through immersion.

Since its foundation, EWB-A continues to grow each year in membership, community projects, staff numbers and student engagement. EWB-A is continuing to build its presence and impact on the Australia engineering education sector, by growing participation the *EWB Challenge and Undergraduate Research Program*. In the medium term, it is also seeking to develop further offerings at a post-graduate level in humanitarian and international development engineering.

III. CASE STUDY TWO: BOARD OF EUROPEAN STUDENTS OF TECHNOLOGY (BEST)

BEST is “a growing non-profit and non-political organisation who provides communication, cooperation and exchange possibilities for students all over Europe. BEST strives to help European students of technology to become internationally minded, by reaching a better understanding of European cultures and developing capacities to work on an international basis. “Learning makes the master”, but the final goal is a good working place, therefore BEST offers services like an international career centre to broaden the horizons for the choice on the job market. BEST brings all the partners in the “student – company – university” triangle closer. (Board of European Students of Technology, Organisational Summary)”

BEST, a well-established group with a rich history, was founded in 1989 and has expanded to 89 Local BEST Groups (LBG) with some 2,800 members across 30 European countries. Coordinated by a six-member International Board, the organisation is supported by international committees; Marketing, External Events, Education, Information Technology, Corporate Relations and Training.

BEST coordinates four main types of events: *Courses, Engineering Competitions, Events on Education and Leisure Events*. Although different in focus, the basic structure of these is similar. A BEST event generally caters for 22 to 30 engineering students from across Europe who travel to the host country (coordinated by a LBG) and then live communally for one to two weeks. The day is spent in classes and focusing on the academic component, while the evenings include a robust social program. The main event on BEST’s calendar are its *Courses* and *Engineering Competition* program. *Courses* include visits to com-

panies, industrial facilities and research centres, taking part in case studies and a series of lectures. During BEST’s *Engineering Competitions* students work in teams applying their technical, problem solving, communication and social skills to compete in various categories: team design, negotiation/debates and case studies. In 2010 there were 96 events of these types across Europe [3].

BEST aims to provide course of high academic quality with the academic component being coordinated in cooperation with the local host university. At the end of the courses student undertake an examination to test their knowledge and on completion receive a certificate. These steps assist students receive academic credit for undertaking the courses, as this is not always guaranteed with the various European home universities making the decision.

Further to its standard courses, BEST also coordinates events directly on the topic of education, through their *BEST Events on Education*. The *Educational Symposia* events cover a range of topics relating to engineering education in Europe including student mobility, e-learning, professional competencies, innovation, service learning, ethics, sustainable development and curriculum development. BEST have a dedicated Educational Committee (EduCo) who is responsible for the organisation of these symposiums in conjunction with a local host group. A related initiative is the *BEST Academics and Companies* (BACo), a forum where students, academics and industry representatives meet to discuss and share issues relating to education. The final type of activity coordinated by BEST are its Leisure Events, which rather than technical topics aim to improve cultural interactions and incorporate a social activity, such as ski weeks or an adventure program.

Activities are organised in four rounds per year, corresponding with the seasons, with the bulk of events being run over the summer. Each season, interested students are able to for the *Courses, Engineering Competitions, Events on Education* or *Leisure Activities*. Course costs are very low, due to the support of universities and corporate partners and voluntary student organisation of these events. The costs born by the student depend on their country of origin to create greater accessibility with leisure events being the highest cost, and education symposia without charge.

BEST continues to attract new members and has formalised processes in place to create new local groups. BEST has a strong sense of community – “BEST spirit” – and does an excellent job of engaging students and continuing to keep them involved in the organisation. Each year its course offerings continue to grow in size and scope.

IV. CASE STUDY THREE: ELECTRICAL ENGINEERING STUDENTS’ EUROPEAN ASSOCIATION (EESTEC)

EESTEC is “a non-political, non-profit organisation of, and for, Electrical Engineering and Computer Science (EECS) students at universities, institutes and technical schools in Europe awarding an engineering degree. The aim is to promote and develop international contacts and the exchange of ideas among the students of EECS. The association achieves its aim through improving technical knowledge of EECS students, introducing them to the industry and the educational system of other countries. (Electrical Engineering Students’ European Association, Organisational Summary)”. EESTEC’s vision lies in unit-

ing electrical engineering and computer science students across Europe to reach their full potential in academic and social life.

EESTEC was formed in 1986, to address the lack of a European-wide society for electrical engineering students (with a previous organisation having folded some years earlier). Nowadays, EESTEC is present in 26 countries and 51 universities across Europe with 2,500 active members.

As an organisation, EESTEC is focused on the education and development of its student member with its key initiatives being workshops, exchanges, training and internships. EESTEC's most important initiatives are its workshops which comprise of the majority of their events in recent years. These events are generally intensive residential programs with a focus on a single technical topic. About 40 workshops are conducted each year in various European locations, with EESTEC having a strong presence in central and Eastern Europe.

Previous workshops have covered a broad range of technical and industrial topics including robotics, bio-engineering, micro-devices, business and women in engineering. To make their programs more interesting and attractive for its members, EESTEC use creative names to describe their courses including, *Plop, Plop, Fizz, Fizz, Oh, What a Robot it is?* (robotics); *Above us only Sky!* (avionics) and *Conquer the Markets* (business). The courses are week-long events that include lectures, company visits and practical working sessions. Each workshop generally has 30 participants from around 10 countries across Europe. Hosted in conjunction with a Local Committee and university the technical quality is high. Also significant is the exposure to local culture of the host country which is both a drawback for the participating students and provides important educational benefits.

Internal training of its active members is another important part of EESTEC's offerings and has grown in scope and importance in recent years. The EESTEC Training System was established at the organisation's Congress in 2008 which saw the acceptance of a "training system strategy" and the election of the first training coordinator. The purpose of the training program is to provide *Training for Trainers* (T4T), developing skills within the organisation to effectively conduct the other workshops. This T4T program trains 16 members each year, selected on their previous involvement in EESTEC, expertise and interest. This course runs a minimum of eight days and provides skills to effectively conduct workshops on a broad range of topics such as public relations and marketing, sustainability, leadership, project management, or any other topic the members hold a strong interest. Graduates of this program become Official EESTEC Trainers and play an important role in the organisation. These Trainers are involved in the development of EESTEC courses, developing materials, video training, online support systems and supporting local initiatives. The organisation's aim is to have one qualified trainer within each EESTEC Local Committee in Europe, and with early rounds of training having been completed, progress is being made [4].

With its new training program in place, the future of EESTEC educational events is positive. The quality of its workshops continues to improve and the development of its active volunteers will positively serve the organisation well into the future.

V. CASE STUDY FOUR: 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 provide opinion and create an impact on future development of engineering education and its effect on society and environment. Through engineering education initiatives and collaboration with academia, industry, society and government, SPEED is committed to improving the future of engineering education whilst embracing the considerable engineering challenges being faced in the 21st Century. (Student Platform for Engineering Education Development, Organisational Summary)"

Founded in 2005, SPEED was created to address the lack of student participation in the development of engineering education. It also filled the need for a global organisation that provides engineering students with an opportunity to collaborate internationally. It has since grown to 500 affiliates (people receiving correspondence) from 60 countries, approximately 200 members and an elected executive committee of 5 members. Countries with the most active members include the United States of America, India, Australia, China, Brazil and Portugal.

The key events coordinated by SPEED are its *Global Student Forums* (GSF) which are held, on average, once a year in conjunction with a major international engineering education conference, generally either the American Society for Engineering Education (ASEE) Global Colloquium or a gathering of the International Federation of Engineering Education Societies (IFEES). Truly international, the previous GSFs have been held in Brazil, Turkey, South Africa, India, Russia and Hungary, with the most recent forum being a part of the 2010 World Engineering Education Forum in Singapore. Further to the GSFs, SPEED members are involved in other engineering education initiatives. These include supporting local workshops coordinated by the Indian Society for Technical Education; developing academic papers on engineering education; and conducting an annual survey on the engineering profession's major challenges [5].

Global Student Forums are intensive residential gatherings that run for one to two weeks and include workshops, guest lecturers, social events and the development of local Action Plans. Rather than developing the technical skills of participating students, SPEED aims empowering students and provide them with the skills, knowledge and resources to become a more effective global engineer. With a focus on creating positive changes within engineering education, this includes the ability to create change within students own local communities. Action Plans are local initiatives run by members and in the past have resulted in regional forums, female student support programs and mentoring skills initiatives among others[6].

Major outcomes for participating students include an opportunity to meet with academics and senior decision-makers within engineering education; collaborate in international environments; and develop their leadership and communication skills. Each year the GSFs focus on a different theme in engineering education and have included: Developing Future Global Engineers; Ensuring Equitable and Diverse Global Representation in Engineering Education; GLOCAL (Global + Local) Engineer: Skills and Competencies; and Sustainability in Education.

SPEED will continue to hold and grow their GSFs, although will broaden their focus to hold them with other international gatherings rather than focusing on the ASEE Global Colloquiums which has been the emphasis in the past. Also, they will seek to participate in the European Society for Engineering Education (SEFI) Engineering Education Flash Week to be held in Lisbon, Portugal in September 2011. Other than its formal events, SPEED will continue to grow and develop its international partnerships in support of its mission to develop future global engineer leaders and make a positive impact on the engineering education sector.

VI. NOTABLE FEATURES AND RESULTS

While being distinct educational programs, the initiatives analysed in the case studies, did share some important traits, which are worth highlighting. These include the following.

- **Internationally-Focused** – One of the most notable common features of these programs is the emphasis on global engineering and working in international environments. The programs coordinate by EWB-A focus on challenges in disadvantaged communities in the developing world, while each of the other initiatives are targeted at an international student collective who travel outside of their home countries to participate.
- **Beyond Technical Topics** – Each of the case studies offers educational initiatives that deliberately cover much more than just technical course material. There is a strong emphasis on teamwork, communication, inter-cultural understanding and leadership. This makes the programs particularly valuable in developing students' skills in areas that complement those covered by university programs.
- **Combine Social and Professional Development** – Making events that are fun for participants is a very important part of these programs. As these are not compulsory parts of degree programs, there is a need to make the courses attractive to potential students. Also, as the events are organised and supported by volunteers, it is important to make it an enjoyable process for those involved behind the scenes.
- **Volunteer Supported** – Each of the organisations described are volunteer organisations with strong support by students in local chapters and those serving on executive and organising committees. This high level of service demonstrates a commitment by students to being part of a community and wanting to be involved in the personal and professional development of their fellow students.
- **Residential** – Each of the organisations examined coordinated events that involve students living together for the duration of the initiative. This has the powerful effect of making much stronger personal bonds and friendships between the students than would form by interacting just in the classroom. As described above, these programs have a strong international focus and by spending time outside the classroom, students have much greater exposure to local culture, food, customs and language.
- **Internal Professional Development** – More than simply developing the skills and knowledge of participating students, the profiled organisations all had a

strong emphasis on the professional development of their own executive members. EWB-A holds a National Council and an annual Conference which focus on staff and volunteers from the various chapters. BEST and EESTEC have formal training programs for their local group volunteers and organisers. SPEED encourage local development initiatives and encourage their members to publish papers and attend other academic conferences. This approach improves the outcomes of these organisations, is beneficial for active volunteers and demonstrates the commitment to professional conduct.

- **Cross-Cultural, Multi-Disciplinary Exposure** – Each of these cases involves introducing participating students to foreign environments in an educational context. This practice of broadening both technical and cultural exposure provides opportunity to learn about issues within society and engineering education in different parts of the world and their implications in an increasingly interconnected and interdependent environment.

Analysing the distinct features of student-led educational programs is a useful tool in determining the aspects attractive to potential students participation. These common features lay the foundation for a successful student-to-student learning program in which motivated student leaders can interactively teach their peers, establishing a successful and sustainable educational model.

VII. OPPORTUNITIES FOR UNIVERSITIES

Student and youth-led initiatives provide an exciting new dimension in engineering education and there is significant potential for universities to be involved. Each of the profiled organisations maintain relationships with universities from formal partnerships (EWB-A) to the provision of host locations and teacher support during workshops (EESTEC). As has been shown, students involved in both the organisation and participation in these projects benefit through improved skills and an expanding their own personal networks. As such, engineering departments and universities should actively encourage these programs.

Based on these case studies the recommendations for universities are as follows.

- Student-led initiatives should be encouraged and supported to provide an extra dimension to engineering education.
- Material support through providing funds or workspaces (without charge) is essential in ensuring these activities are able to proceed.
- Staff should be available to provide professional expertise both in technical topics, but also in building the capacity of students to coordinate these events.
- Formal partnerships between universities and student organisations provides an outstanding opportunity for long-term development of innovative educational programs.
- Voluntary service of students in support of these initiatives, and the skills gained, should be acknowledged including formally through course credit.

These actions are small in scope but are important enablers in allowing student and youth-led educational pro-

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grams to thrive. Additionally, each of these programs serves to enhance student learning, interest and connectedness to participant's topic of study and can be used as a model to develop new initiatives. Globally, these programs are still a small part of engineering education, but as these featured programs demonstrate, there is both significant growth expected and much more potential to serve the evolving engineering education system to best face the futures challenges.

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