

## **A survey of past participants on the value of the Global Engineering Teams program in the modern workplace**

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### **Abstract**

The rapidly changing workplace requires that educational institutions produce engineers with suitable skills to perform effectively. This necessitates alterations to the traditional ex-cathedra methods of teaching. Global Engineering Teams (GET) is an educational initiative by the Technical University of Berlin, in partnership with other universities across the world, based on the concepts of project-oriented, problem-based and blended learning where post-graduate engineers engage in remote, multi-cultural, team-based work for clients in industry. This study presents a survey of 27 GET alumni exploring the effectiveness of the course in providing preparation for their working environments. The results indicated a highly positive experience amongst participants in relation to the skills they had acquired for performing real-life projects with team members from different backgrounds. However, responses were more wide-ranging regarding the technical aspects of the projects and the style of supervision. Various tentative interpretations of the results are discussed and it is concluded that while GET has been quite successful in general, further work is needed to understand how improvements can be made. Recommendations are made for further research.

### **Introduction**

One of the challenges of engineering education is to provide graduates with training that is relevant to the rapidly evolving work environment. Traditional lecture-based programs do not equip students adequately for modern projects which often involve participation in multi-disciplinary teams comprised of employees from diverse educational and cultural backgrounds (Eisenberg et al., 2009). These projects also have long timelines, involve interaction with clients in industry and are often managed online from remote locations. There is therefore a need for institutions to employ a more holistic approach in their curricula in order to expose students to the pressures of industry and international, inter-professional teamwork. Global Engineering Teams (GET) is a university program which aims to provide post-graduate engineers with such an experience (Oladiran et al., 2011). This study presents a survey of previous participants about the relevance and value of their GET experience now that they are in the workplace.

### **Global Engineering Teams**

GET is a Masters-level, industry-funded, project-based course provided by a network of universities, among others the Technische Universität Berlin (TUB, Germany), Stellenbosch University (SBU, South Africa), University of Botswana (UoB), Pontificia Universidad Católica (PUC, Chile), and University of Sao Paulo (USP, Brazil). Students from these universities are placed in teams with a maximum of two members from a particular country allowed. Each team is then assigned a real-life project proposed and funded by an external company and supervised by a staff member from one of the partner institutions (Scheffer et al., 2012). The team members only meet face-to-face at the beginning and end of the project and are otherwise geographically dispersed. The students and educators assemble for an initial kick-off meeting hosted by a partner university in April, allowing time for lectures, team-

building and project planning. The duration of the projects is 25 weeks and technical deliverables are evaluated over several phases. At the end of the course in October the teams meet again at TUB for a final presentation of their project results to an audience of examiners, industry partners and fellow students. As of 2012, the list of GET alumni members has grown to well over 150.

As explained in Eisenberg & Scheffer (2009), the educational philosophy behind GET is based on three state-of-the-art approaches: Project-Oriented Learning (POL), Problem-Based Learning (PBL) and Blended Learning (BLE). POL (Heitmann, 1996) emphasises "student-centred learning through projects". These projects expose the student to real life work scenarios with the goal of producing realistic products or outcomes. POL teaches learners to synthesize the various core concepts of their discipline, as well as time management skills and efficient use of materials. Taking responsibility for an entire project from start to finish also fosters more authentic acquisition of knowledge and skills at their own pace, while also encouraging creativity and self-evaluation. The GET program is structured to provide a project environment within which these professional skills can be learned while also stimulating intercultural knowledge using international teams. PBL, first applied in the medical field, focuses on exposing students to the complexity of real-life challenges through intentionally "ill-structured" problems (Gallagher, 1997). In these scenario-based formats, an enquiry model is used such that students are encouraged to seek out the information they deem necessary to solve the problem themselves. The student is taught autonomous problem-solving skills such as developing a clear hypothesis or problem definition, gathering relevant information and arriving at unique solutions. The GET style of supervision encourages students to take greater accountability for their project progress and to remain life-long learners, something which is very applicable to the field of engineering. Lastly, BLE (also known as "hybrid-learning", "mixed learning" or "multi-method learning") involves the combining of multiple approaches to teaching and learning (Garrison & Kanuka, 2004; Littlejohn & Pegler, 2006). Traditional methods such as ex-cathedra lectures are integrated with games, exercises and e-learning tools. Educational content is transferred in a variety of formats and contexts, offering an environment for holistic learning and the development of a wide range of competencies, including creativity, critical thinking and communication skills.

The GET program was founded in 2004 as a demonstrator for action research that aims to improve the efficiency of modern engineering education (Eisenberg, M., et al., 2007, Uziak, J., et al., 2010). It followed from the successful launch of a similar program named Global Product Development (GPD) in 2002, which was a collaboration between TUB and two other universities; Seoul National University, Seoul, Korea and University of Michigan, Ann Arbor, USA. While sharing many similar features, GDP funding comes from national grants and projects are thus open ended and decided by students, whereas the GET funding model relies on the industrial sponsor to cover costs for a specified project while receiving cheap problem solving services. GDP also contains a stronger lecturing component, whereas GET provides a supervisor to advise to students as needed. The goal of both GDP and GET is to develop unique competences in their students, while at the same time providing an experimental setup for research on education.

## Methods

This study aimed to determine the perceived value of the GET course for alumni who are currently working as engineers. The investigation was conducted with an online survey that the participants answered using a five-point Likert scale (see **Error! Reference source not found.**)

**\* 1. The GET course prepared me well for aspects of my work that are...**

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
team-based	<input type="radio"/>				
project-based	<input type="radio"/>				
unsupervised	<input type="radio"/>				
managed online	<input type="radio"/>				
time-pressured	<input type="radio"/>				

**\* 2. The GET course prepared me well to interact with people in the workplace from...**

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
other companies	<input type="radio"/>				
other professions	<input type="radio"/>				
other cultures	<input type="radio"/>				
other countries	<input type="radio"/>				

**\* 3. The independent and uncontrolled work environment of the GET course accelerated my learning experience...**

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
<input type="radio"/>				

**\* 4. I learned important professional skills in the GET program that I would not have learned in a traditional lecture-based curriculum**

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
<input type="radio"/>				

**\* 5. My GET project was a realistic example of the technical challenges I experience in the workplace...**

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
<input type="radio"/>				

**Figure 1.** The survey questions used for the study

The questionnaire consisted of five questions. The first question focused on the various types of work the program had attempted to simulate. It asked how effectively the GET course had prepared them for work that is team-based, project-based, unsupervised, managed online and subject to time-pressure. The second question focused on the skills the participants had learned in order to work with colleagues in a globalized and multi-disciplinary work environment. It asked about the efficacy of the GET course in preparing them to work with people from other companies, professions, cultures and countries. Question 3 aimed to ascertain if there had been a marked improvement in learning due to the GET learning environment, while question 4 focused on whether the skills learned on the course would not have been acquired in a traditional class-room setting. Lastly, question 5 explored the relevance of the GET course-work in relation to real-world work challenges experienced in the workplace. The survey also contained a biographical section, asking the participants to indicate their gender and age as well as the field and country of their current employment.

## Results

Twenty-seven GET alumni responded to the online questionnaire. The group consisted of 2 females and 25 males, and the average age was  $29 \pm 2$  years. While the participants were from a variety of disciplines, the primary qualifications included mechanical, electronic and mechatronic engineering. The cohort covered a range of employment sectors from the fields of transport (5), energy (5), IT (4) academia (3), medicine (2), sales (3) and others. Participants were also working around the world in South Africa (11), Germany (8), Brazil (4), USA (1), Botswana (1), Chile (1) and Canada (1). The results of the five survey questions are given below. **Error! Reference source not found.** presents the responses to question 1.

**Table 1.** Results for question 1 of the survey

	<b>Strongly disagree</b>	<b>Disagree</b>	<b>Neutral</b>	<b>Agree</b>	<b>Strongly agree</b>	<b>Total</b>	<b>Mean</b>
<b>Team-based</b>	0%	0%	7.4%	55.6%	37.0%	27	4.30
<b>Project-based</b>	0%	3.7%	11.1%	51.9%	33.3%	27	4.15
<b>Unsupervised</b>	0%	3.7%	48.2%	29.6%	18.5%	27	3.63
<b>Managed online</b>	0%	0%	29.6%	33.3%	37.0%	27	4.07
<b>Time-pressured</b>	0%	7.41%	14.8%	66.7%	11.1%	27	3.81

The overwhelming majority (over 90%) of participants agreed that GET had prepared them well to do teamwork, with only two neutral and zero negative responses. Similarly, over 85% of them felt that their GET experience was good preparation for the projects in their workplace, and a third agreed strongly. The third highest score went to preparation for online work, although there was more of an even spread in opinion. Although eight participants were unsure whether they had learned relevant online skills, the highest number (10) felt strongly that they had and no participants disagreed. Interestingly, responses were mainly neutral concerning the aspect of supervision, with almost half of participants ambivalent. However, only one respondent disagreed that GET had prepared them for independent work, while an equal number of people to the neutral group either agreed or strongly agreed. It is also worth noting that none of the participants strongly disagreed with the fact that they had obtained some value from GET in these areas.

**Table 2.** Results for question 2 of the survey

	<b>Strongly disagree</b>	<b>Disagree</b>	<b>Neutral</b>	<b>Agree</b>	<b>Strongly agree</b>	<b>Total</b>	<b>Mean</b>
<b>Companies</b>	7.4%	7.4%	22.2%	48.2%	18.5%	27	3.67
<b>Professions</b>	3.7%	14.8%	25.9%	29.6%	25.9%	27	3.59
<b>Cultures</b>	0%	0%	3.7%	37.0%	59.3%	27	4.56
<b>Countries</b>	0%	0%	0%	37.0%	63.0%	27	4.63

In Table 2 it can be clearly seen that GET rated very highly for providing relevant and helpful exposure to work with people from other countries (100%) and cultures (96.3%). However, it is interesting that there was divided opinion about how it had prepared them to interact with other external companies and different professions. Nevertheless, over half the participants still agreed that their experience was helpful in their current work environment

**Table 3.** Results for question 3-5 of the survey

	<b>Strongly disagree</b>	<b>Disagree</b>	<b>Neutral</b>	<b>Agree</b>	<b>Strongly agree</b>	<b>Total</b>	<b>Mean</b>
<b>Question 3</b>	0%	11.1%	40.7%	33.3%	14.8%	27	3.52
<b>Question 4</b>	0%	3.7%	11.1%	40.7%	44.4%	27	4.26
<b>Question 5</b>	3.7%	11.1%	29.6%	37.0%	18.5%	27	3.56

The answers to question 3 (see Table 3) demonstrate that just under half (13) of the participants felt that their learning had been accelerated within the unstructured approach of GET projects. On the other hand, almost as many felt unsure that the course format had affected their learning positively, and three disagreed. Conversely, results for question 4 show that the participants were very confident that GET had equipped them with professional skills that are not easily obtained in traditional educational formats. Over 85% held this view, and almost half agreed strongly. Opinions varied more for question 5, which focused on the appropriateness of technical challenges experienced in GET projects. Around 55% of participants felt that their GET projects had provided realistic technical challenges that were relevant to their current work situation. The remaining 45% were either unsure or disagreed.

### Discussion

The survey results reflect a generally positive attitude amongst alumni towards the GET course and its value in the workplace. Some high-scoring aspects for which the course had provided a helpful experience included project work performed in teams and multi-cultural settings. These results should not be unexpected, as they pertain to the core elements of the GET experience for all students. On the other hand, while the GET program had consistently provided team-oriented projects that successfully simulated the work environment, it had been less consistent in preparing learners for independent work, internet collaboration and realistic time constraints.

There may be many reasons for this. Firstly, these aspects are more sensitive to team composition and project description. Some projects may provide vastly different challenges to others, while team dynamics also play a role in defining the student experience. This may serve to explain the wide-spread survey responses regarding exposure to other companies and professions, as well as the lower scores for help dealing with time-pressure. The second reason why some of the lower scoring categories may have a larger variability is that they are affected by the progress of technology. This is especially true of the aspect of online project management. Recent years have seen a significant rise in the availability of software tools for sharing and managing content. In the past, internet communication and data transfer was dominated first by email and then later by applications such as Skype. Today there are sophisticated content management packages that allow for detailed meeting activities, synchronized data storage and real-time content sharing, thus increasing the role of online tools in project work.

It also appears that the experience of project supervision was highly variable, with some of the lowest scores being given to this aspect of the GET course. On one hand, a large contingent of alumni was unsure if GET had equipped them to better perform autonomous work. On the other hand, they were unsure that the unstructured approach to learning had been beneficial in the uptake of knowledge. Several participants also felt that their projects were not necessarily a realistic example of the technical challenges they face. This may reflect on the course's dependence on industry partners for providing projects.

The survey has several notable limitations which may be used to inform future research. Firstly,

it is clear that the sample size for the survey was too small to draw strong conclusions. Future work should include means of reaching more alumni, either through social networking platforms or an updated contact database. Furthermore, future surveys may require longer and more detailed questions to extract key information regarding the efficacy of the GET course in preparing them for modern engineering work. While it is clear that GET students benefit from working on real-world projects in international teams, questions still remain to be answered about how effectively these projects are designed by industry partners and supervised by GET staff.

Nevertheless, it can be seen from the results of the survey that GET has been relatively successful in providing learners with professional experiences and technical skills which are unique to the POL, PBL and BLE approaches incorporated in the course. It is clear that the role of electronic resources and tools in BLE is changing as new technologies and software become available and that learner experiences vary regarding the student-centric, unstructured approach to problem solving. It remains unclear whether this is due to poor implementation of these approaches, or whether the learners themselves are just more familiar with highly supervised environments and therefore unaccustomed to it.

## Conclusion

The results of the survey demonstrate that the GET program was rated by the vast majority of past participants as good preparation for their current engineering jobs. Especially strong aspects of the course include relevant team- and industry-based projects with exceptional exposure to inter-cultural and international work. The less successful aspects highlighted were a lack of inter-disciplinary work and varied experiences with supervision and interaction with clients in industry. Future work should include surveys of a larger group of alumni to improve the strength of the statistics, as well as provide more discipline-specific insights. It would also be helpful to have more detailed questions regarding the link between the GET education philosophy, the GET project experience and the modern workplace environment.

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