OPENING MINDS:
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Life Skills for Engineers: An Initiative towards Developing Holistic Graduates

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1 INTRODUCTION

Engineering education has long since emphasized the importance of developing non-technical competence, also referred to as "soft-skills" (UNESCO, 2010). This is reflected in the inclusion of non-technical criteria as mandates by engineering accrediting bodies such as the Accreditation Board for Engineering Technology, and the Institute of Engineers Sri Lanka (ABET, 2014; IESL, 2014).

Despite this emphasis, there is little evidence of inclusion of non-technical skills in educational programs (Trevelyan, 2010). This is especially true for programs in Asia; studies have helped identify that despite the immense technical rigor of Asian engineering courses, the emphasis on professional development is very low (Sarkar *et al*., 2016). This also echoes with the finding that South Asian engineering graduates were considered less employable for non-technical roles (Trevelyan and Tilli, 2010). Another study found that failures in work settings were mostly due to engineers' failures in human interactions (Trevelyan, 2010).

The demonstrated need for developing a "holistic" graduate also equipped with essential non-technical skills, led to the development of the Life Skills for Engineers course that is currently offered to the 2nd year undergraduate engineering students at the University of Moratuwa as an elective. The present paper evaluates the course's effectiveness and methodology based on the course conducted in 2016. Specifically, the paper evaluates the overall student growth in relation to a number of non-technical competencies which were addressed through the course. The study also takes into account qualitative feedback from students on the perceived usefulness of the course for their professional development. Based on these understandings, the paper seeks to identify what aspects of the course can be further improved for future programmes.

2 METHODOLOGY

2.1 Program Design

The course was designed to develop a number of non-technical competencies. In addition to non-technical skills, the course aimed to develop social awareness. The course was developed based on the P3 Model of Growth – which emphasized the role of the engineering student at self, interpersonal and team (community) levels, and had already been adapted for an engineering development program (Silva and Yarlagadda, 2013a). The present course is a less-resource intensive

version of the original program (Silva and Yaragadda, 2013b). This version of the course equipped the students through stages 1-6 of the P3 Model which consists of 9 stages. This course was developed around the competencies covered in these 6 stages.

2.2 Course Structure and Components

The course structure included 14 weeks of lectures, across which 7 topics were covered: Introduction to Engineering Success, Awareness for Engineers, Communication for Engineers, Connect for Engineers, Drive for Engineers, Mentoring Skills for Engineers, and Leadership for Engineers. The topics reflect stages 1-6 of the P3 Model, as well as the competencies which were to be developed in the students. All lectures were activity and discussion based to emphasize a coaching style.

A series of online activities were mandated on a tailor-made online learning platform. These activities were designed to engage students in promoting a better understanding of the targeted competencies and understanding their practical application in their personal/academic lives. Additionally, students were required to maintain a self-reflective journal, and design and complete a humanitarian activity in a community as a group project.

The student groups for the humanitarian projects were assigned a "mentor" – a course alumnae to provide additional support and guidance in the course. These alumni "mentors" were provided with a one-day training program to build basic mentoring skills. This training focused more on creating awareness of the role and skills needed as a mentor rather than on training on skills needed to be competent as a mentor.

Participating in the course was considered to be a basic criteria for being trained as a mentor.

A number of assessments were interspersed across the course duration. The central assessment of students' progress in relation to the six course competencies was through evaluations by the mentors at the beginning, mid and final stages of the course. Additionally, the competency of awareness was also evaluated through two online commenting activities, and through the level of self-reflection in their reflective journal entries. The level of leadership demonstrated was also extensively assessed through the students' contribution in the humanitarian project presentation at the final stage of the course. Finally, feedback was collected at the end of the course as well.

3 RESULTS AND DISCUSSION

3.1 Quantitative Findings

In the present study, the evaluation is only based on the Mentor evaluations on course competencies at the commencement, mid and final stages of the course. The first assessment was based on students' performance of an in-class activity at the start of the course. The second assessment was based on students' performance during the presentation of proposals for a humanitarian project (midterm). The final assessment was based on students' final presentation of their humanitarian projects at the end of the course. During the three assessments, mentors scored each student on a set of criteria representing the level of each competency that should ideally be demonstrated at that stage in the course.

The scores were computed as percentages. Complete data-sets from 36 students were used for the subsequent analyses presented in this paper.

Figure 1 presents the average scores (as a percentage) that students demonstrated in the 6 competencies of Awareness, Communication, Connecting, Drive, Mentoring, and Leadership as Engineers during 3 stages of evaluation. The above

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evaluations were conducted by the Mentors, although it must be noted that the same mentor did not evaluate at all 3 stages.

Figure 2 indicates the average level of overall growth the students demonstrated in the competencies of the P3 model. Overall growth was calculated by subtracting "final evaluation – initial evaluation" graphs. Different stages of the model demonstrate different levels of growth. The largest growth is seen for the Drive and Connect, followed by Aware and Communicate.

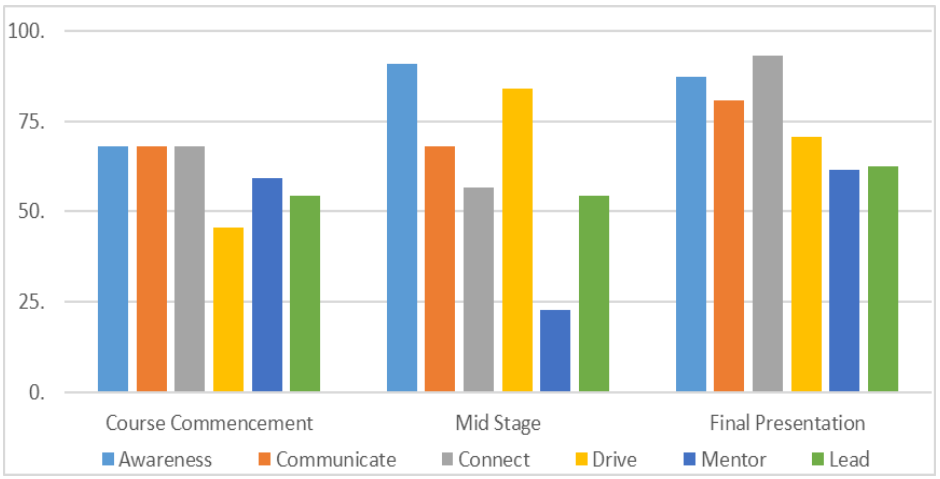

Figure 1: Percentages of competencies achieved over three stages of evaluation

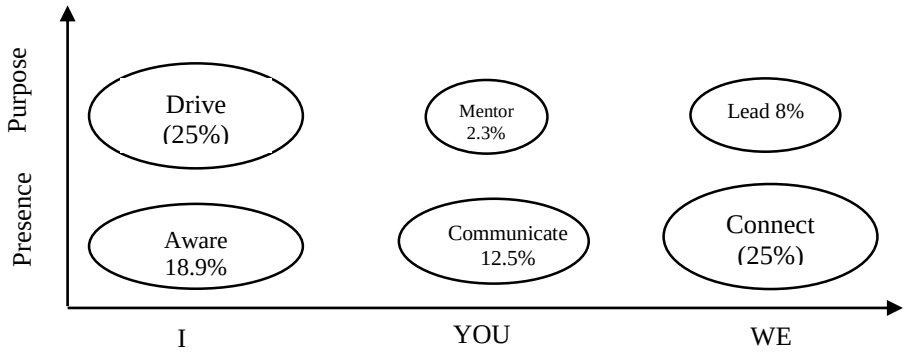

Figure 2. Level of growth in each stage on the adapted P3 Growths Model for the course

3.2 Qualitative Findings

Feedback was received at the end of the course, and students were required to provide feedback on their learning and development. Even though the quantitative data does not reveal consistent growth in all competencies, the qualitative data is very positive, and all students attest to personal growth and development. Identified limitations as per qualitative feedback were mainly related to the work-load of the course being taxing and challenging for a full-time student.

3.3 Discussion

The overall results indicate that the course has been successful in facilitating student development in non-technical areas. The quantitative graphs do not show a consistent development pattern, with most competency scores dropping during the 2nd evaluation stage, and then peaking at the final stage. However, while interpreting these fluctuations, it is crucial to note that the evaluation at each level for the same quality (e.g. Awareness) was conducted at a progressively higher level, meaning that to be considered competent at stage 2 in awareness for example, the criteria evaluated were of a higher standard. This meant that students who did not meet the higher level of competency could have still demonstrated a level of growth that was not captured by the current evaluations. Despite this dip, an overall positive growth on all competencies is seen when comparing the difference between final and the initial rating.

Nevertheless, better methods of evaluating development across the competency should be identified in future installments of the course. Additionally, mentors showed variations in their evaluation abilities, even though two or more mentors evaluated each group and their average scores is what is reported. It was however not possible to maintain the same team of evaluators over each group throughout the 3 stages, which may have contributed to an anomaly in the evaluation scores. Furthermore, mentors' personal biases during evaluation cannot be accounted for. More extensive training for mentors and standardization of assessments need to occur in subsequent batches.

When understanding the growth effect sizes for each of the 6 P3 competencies, the largest growth is demonstrated in *Drive* and *Connect*. This could be because the humanitarian project component of the subject really put to test the students' ability to connect with diverse communities, and drive themselves towards a purpose which is beyond their selves.

"The humanitarian project helped us learn what we are capable of, and what can we do to the society as educated people. It helped improve our team work ability, presenting skills, and ability to connect."

"Having a powerful purpose and a good driving force, is the power to achieve your targets. So as engineering students this course was so impactful for our motivation. I was able to see beyond the bubble and identify who is a true engineer, and that is what motivates me."

The next highest growth effect is seen for *Awareness* which was also intensively practiced in exercises such as the reflective journal, the gratitude journal (online), and daily wellness meter (online).

"Things that I thought which were my faults/mistakes such as being humble, being so open and helpful, I realized that they were not my weaknesses but my strengths. I learnt how to treat people and how to handle every obstacles, changes and how to get them into my development."

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The lowest growth effect is seen for *mentor* and *lead*, which are the two final lessons, and students are not provided many opportunities to practice and hone these skills and competencies.

A crucial point to be noted in understanding the effectiveness of the entire course is that the level of student engagement with the course components is likely to have varied given their other academic commitments. Certain students have expressed that the course workload was far too taxing, making it difficult to provide their fullest for the course.

"This semester had a tight schedule. Even though I completed all the course work on website I found it harder at times due to the heavy load of this semester. It was really stressful."

"Sometimes the workload too much for us because it was tough to balance all with course works, reports and other things."

Additionally, certain students' prioritizing technical subjects when pressed for time may have reduced their motivation towards full and timely engagement with the course components, leading to an overall reduced effectiveness.

4 CONCLUSIONS

The qualitative feedback, and overall growth scores (final score – initial score) would indicate that the course has been effective in supporting student development on the competencies. The course components, contents, and evaluation methods can be improved further based on the qualitative findings to make it more suiTable for an undergraduate student.

REFERENCES

ABET (2014). *Criteria for Accrediting Engineering Programs*. Retrieved from http://www.abet.org/wp-content/uploads/2015/05/E001-15-16-EAC-Criteria-03-10-15.pdf

IESL (2014). *Engineering Programme Accreditation Manual*. The Institution of Engineers, Sri Lanka: Institution of Engineers Sri Lanka. Retrieved from http://www.iesl.lk/Resources/PDF/Accreditation/Accreditaton%20Manual%20-%20March%202014.pdf

Sarkar, Alam F., R., Brooy, R., and Chowdhury, H. (2016). *Engineering Education in 21st Century*. . doi:10.1063/1.4958344

Silva, P., and Yarlagadda, P. (2013a). Holistic Success in Higher Education in Engineering and Technology: A Coaching Approach towards Developing Complete Graduates. *GSTF International Journal of Engineering Technology*, *2*(1), 80-86. doi:10.5176/2251-3701_2.1.37

Silva, P., and Yarlagadda, P. (2013b). *Complete And Competent Engineers:A Coaching Model To Developing Holistic Graduates*. . doi:10.1016/j.sbspro.2014.01.399

Trevelyan, J. (2010). Reconstructing Engineering from Practice. *Engineering Studies*, *2*(3), 175–195. doi:10.1080/19378629.2010.520135

Trevelyan, J., and Tilli, S. (2010). Labour force outcomes for engineering graduates in Australia. *Australasian Journal of Engineering Education*, *16*(2), 110–122.

UNESCO. (2010). *Engineering: Issues Challenges and Opportunities for Development* (ISBN 978-92-3-104156-3). United Nations Educational, Scientific and Cultural Organization 7, place de Fontenoy, 75352 Paris 07 SP, France: UNESCO