

Inclusive engineering education: making engineering degree work for more students

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CONTEXT

In an increasingly interconnected and rapidly changing world, the role of vibrant, creative and diverse engineering workforce is critical. To contribute to technological advancements, engage in global collaboration, solve complex problems, encourage a more social and leadership skill, it is necessary for the future engineers to be more diverse in its racial, gender, and socioeconomic representation. Many Australian universities followed the recent government objectives aimed to increase participation in Higher Education (HE) and created the courses and programmes providing alternative pathways to HE for students from non-traditional, mature students and low socioeconomic status (SES) backgrounds. However, the majority of non-traditional students select non-engineering courses as the option of university pathway.

PURPOSE

This study focused on research of student's commitments during their study at the Western Sydney University, The College together with an example of successful development and integration of Social Media project (YouTube Channel) to the first year engineering curriculum.

APPROACH

The quantitative data were collected from three engineering courses: Standard Diploma in Engineering, Extended Diploma in Engineering and Associate Degree in Engineering (online course). The analysis of student's workload was conducted from the student's diaries where students recorded the time they spend on the different activities during the week. The analysis of YouTube Channel created for the first year engineering students was conducted according to the number of views, audience retention, number of shares and comments.

RESULTS

This study demonstrated that the students from the university pathway programs, such as the Diploma and Extended Diploma in Engineering are required to spend significant amounts of time which is not directly linked to their studies, such as part-time job, care responsibilities and travel time. To increase student's engagement and learning performance in engineering academic pathway program a multimedia Project in the form of YouTube Channel was created and integrated into the first year engineering subject curriculum. Created videos received very positive feedback from students which also led to the improved unit assessment results and demonstrated the strong interest with the wider engineering community.

KEYWORDS

Engineering pathway, non-traditional students, social media, YouTube

Introduction

Throughout the developed world, including Australia, policies aimed at widening participation in higher education (HE) are increasingly being implemented to improve the quality of the national workforce (Carpenter, Dearlove, & Marland, 2015). In Australia, this policy agenda has been driven by the Review of Australian higher education (Brooks, 2004) which has set a target to increase the intake of students so that a larger proportion of the population will hold an undergraduate degree by 2020. There has been progress in this regard in Australia proved by the increased rate of higher education participation over the past decade for individuals from disadvantaged backgrounds (Li, et al, 2017).

While more students from low socioeconomic status (low-SES) enrolling at the university, it is also well recognised (Steinberg & Monahan, 2007) that students from a low-SES group are in general less prepared to fit into the university system.

Students from low SES backgrounds often have complex lives and competing priorities. Many of these students required to have a job and many have other caring responsibilities. They must balance academic study with these caring and related responsibilities, which often include the need to engage in paid employment while studying.

For that reason, some innovative approaches in high education found to be quite effective, especially for the students from low-SES. Social Media is well known as an effective “problem-solving tool”. When people have a question one strategy they can use to get an answer is friendsourcing - broadcasting the question to one or more of their social networks. For example, people can post a question via a status update on Facebook, share interesting YouTube videos or send a message to a group chat on a messaging app (Khojasteh, et al, 2017). A similar effect was observed in education, where Social Media was well recognised for providing students and educators socially engaged educational experiences with unsupervised and informal tools and spaces where authentic learning occurs (Oliveiar, et al, 2017).

This study focused on research of student’s commitments during their first year engineering study at the Western Sydney University (WSU), The College together with an example of successful development and integration of Social Media project (YouTube Channel) to the first year engineering courses.

The study of student’s workload in the university pathway programs

The analysis of student’s workload was conducted from the student’s diaries where students recorded the time they spend on the different activities during the week: from Monday to Sunday. The quantitative data were collected at the WSU, the College from three engineering courses: Standard Diploma in Engineering, Extended Diploma in Engineering and Associate Degree in Engineering (online course). Successful completion of the Diploma courses grants student entry into the second year of study in the Bachelor Degrees in Engineering at the Western Sydney University. The data was collected during week 4 in the Second Term of the Diploma Programs and during week 5 in the Quarter 3 of the Associate Degree Program.

The total of 109 students agreed to participate in the study.

The parameters of each course are summarised in Table 1.

Table 1

| Program | Mode of delivery | Entry requirements | Length of study | Number of students participated in the study |
|------------------|------------------|----------------------------|----------------------|--|
| Standard Diploma | Face-to-face | ATAR 50 | 12 months, full time | 35 |
| Extended Diploma | Face-to-face | Open access | 16 months, full time | 53 |
| Associate Degree | Online | 3-year industry experience | 4 years, part time | 21 |

As a first step in data analysis from the students' diaries, we excluded data of students who did not complete any parts of the questionnaires. In addition, the data were evaluated for irregularities. Specifically, we looked for anyone who responded to each survey item with the same answers (e.g., marked "0" for all time spend for the face-to face study).

To understand and compare student's commitments during the weekdays and the weekend, the total number of hours students spend for each activity was calculated from Monday to Friday and from Saturday to Sunday separately. The summary of the student's commitments as average hours during the weekday and the weekend for three programs – Standard Diploma in Engineering, Extended Diploma in Engineering and Associate Degree in Engineering are shown in Figure 1.

As demonstrated in Figure 1, both Extended and Standard Diploma students indicated a large amount of time associated with the part time job with an average time of 8.5 hours on the weekday and 7.16 hours on the weekend for the Standard Diploma and 6.3 hours on the weekday and 6.6 hours on the weekend for Extended Diploma.

Students from online Associate Degree in Engineering (Figure 1c) spend 35 – 40 hours a week for the full time job. They attend online sessions during the weekdays and spend the most time for the self-study during the weekends.

Many students indicated having care responsibilities, such as looking after siblings and parents/grandparents. The average time associated with care responsibilities are shown to be more on the weekdays which is usually related to the family responsibilities students have to share with their parents.

Also, students indicted a large amount of time they spend for traveling to and from their home campus that often has a significant influence on their attendance of the face-to-face classes.

The above results raise an important message that non-traditional students, such as students from the low SES backgrounds, can be less successful in the HE not just because of the previous academic achievements, but also because of the significant time they are required to allocate to the non-study commitments. These students often don't have a sufficient level of support from the family (David, 2010, Brooks, 2004; Murphy, 2009), and often need to support themselves and their family working part time or looking after young brothers and sisters. That creates an extra challenge for teachers to maintain student's attendance and to keep their study motivation.

To enhance student's academic performance and motivation the development of multi-mode learning where students can obtain an extra help from co-curricular resources with the possibility to socialise with peers could be the option. With new technologies, it has now become possible for educators to self-create high-quality online resources (Bae & Lee, 2015) which can be further integrated to the course and serve as a self-study, revision tool or an alternative option for students.

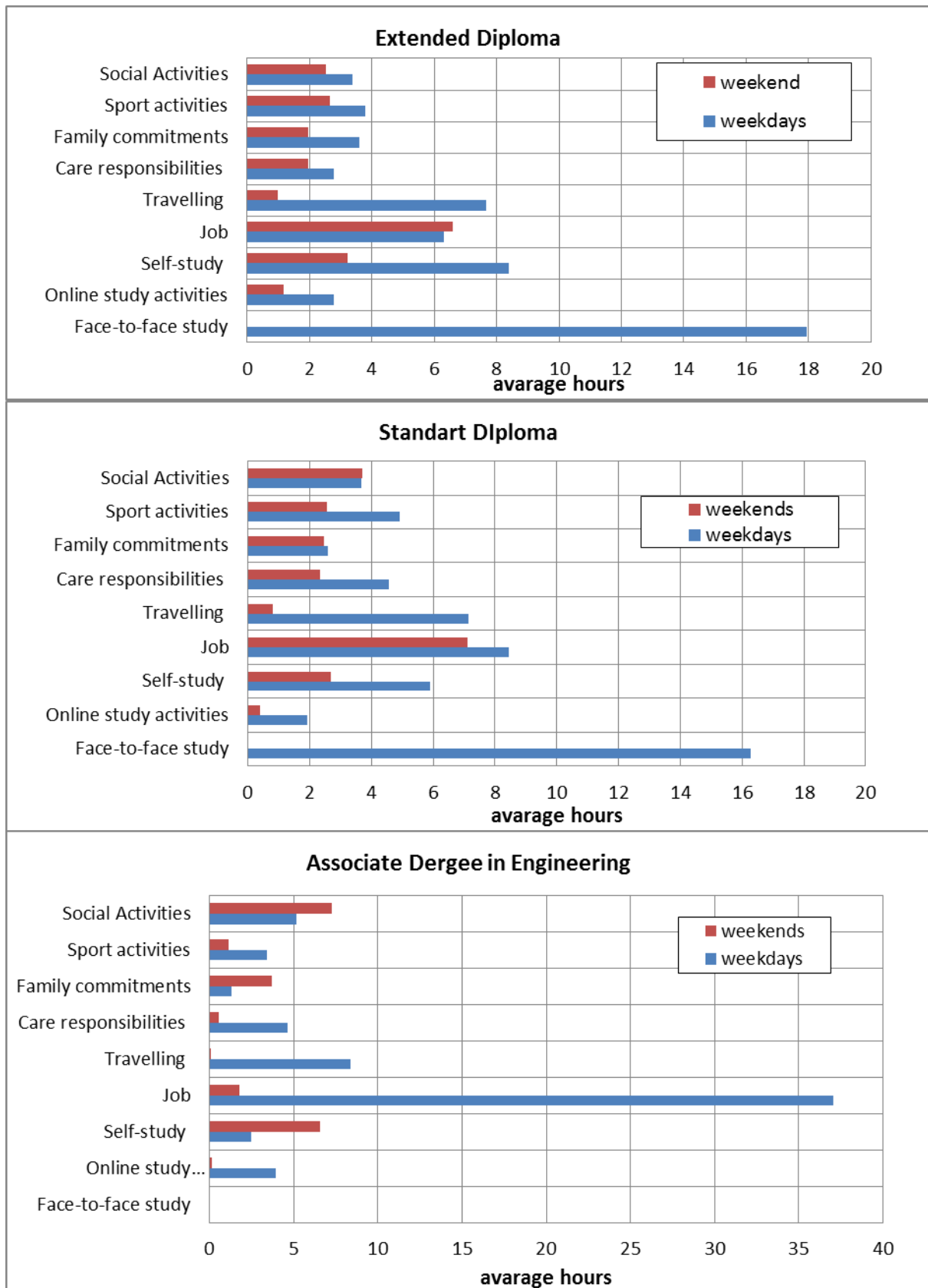


Figure 1. The summary of (A) Standard Diploma, (B) Extended Diploma and (C) Associate Degree student's commitments during the week.

Development and integration of the YouTube Channel to the first year engineering courses

According to usage statistics, all adults aged 16+ have a profile on at least one social networking site. But we can also predict that within university range this percentage is even much higher. YouTube become one of the most popular sources for students to search for video lessons and tutorials. But the large number of videos and the general low ability of first year students to search, locate, process, evaluate and use information leads to information overload, inability to find the needed information and to extract the important points. Also, it has been demonstrated that only a minority of YouTube videos related to the particular topic are useful for teaching due to misleading content and poor quality.

To increase WSU, the College student's engagement and learning performance in engineering academic pathway program a YouTube Chanel named Engineering by Steps was created.

Link to YouTube Channel:

<https://www.youtube.com/channel/UCMBAI3O8EDKdXwpUDU3mMBw>

The series of video tutorials in Electrical Fundamentals that are similar to the classroom working environment were created using a hand writing tool and an instructor voice over. All videos were made available to the public with enabling comments.

The videos received very positive feedback from students which also was combined with the improved unit assessment results.

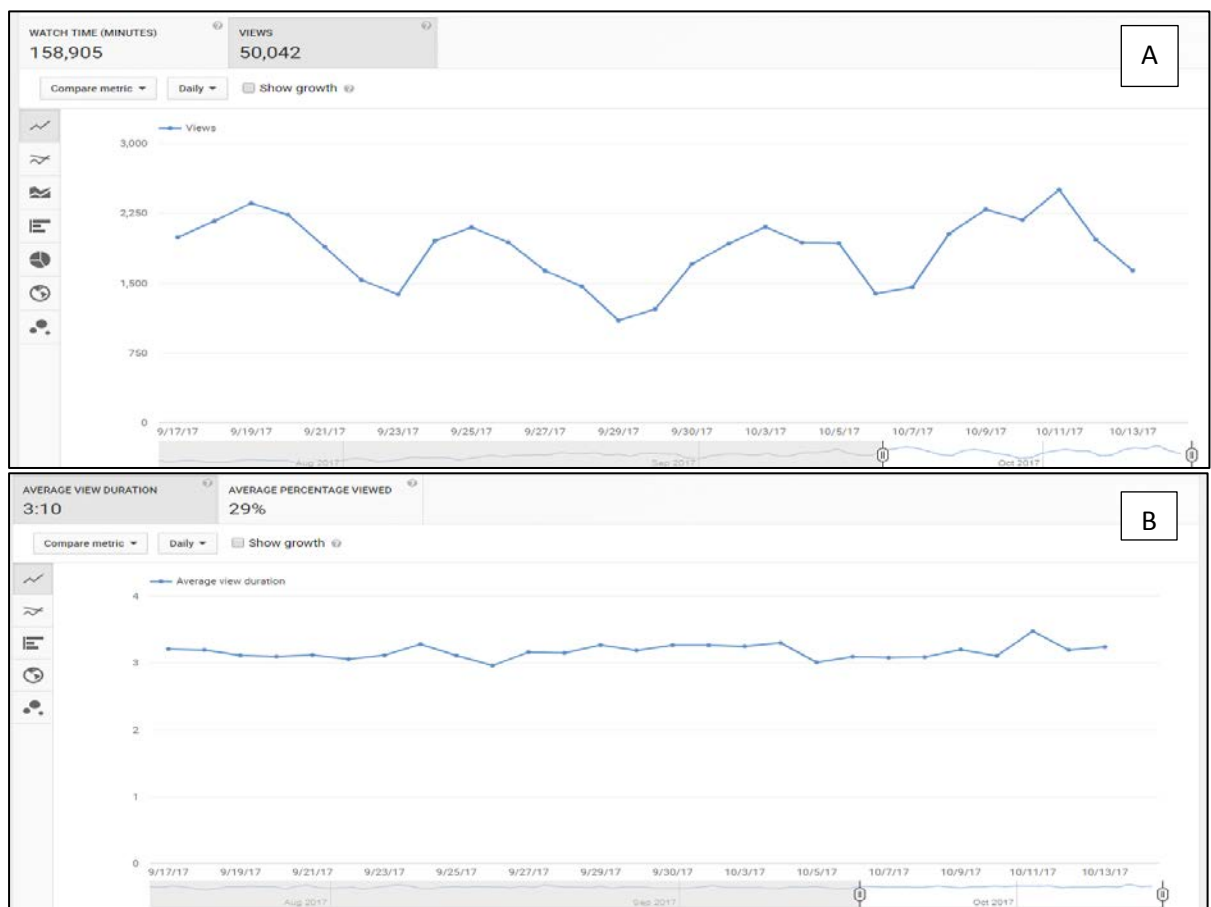


Figure 2. (A) Audience number of views and (B) retention (average minutes) reports

The YouTube statistics report (Figure 2) demonstrates stable audience interest with an average of 2000 views per day (Figure 2a) and good audience retention (Figure 2b) with an average of 3 minutes watching time per video, considering that an average length of the videos is 5 minutes. The YouTube channel wasn't specifically advertised, however for the period of three years the videos attracted over one million views, over 4,500 people subscribed, over 600 comments were posted and the videos were shared 3,500 times showing the strong interest with the wider engineering community.

When video tutorials were introduced for the first time in 2014, student's average learning experiences in the Electrical Fundamentals, collected from the student's surveys on the unit (Figure 3) showed a significant increase in the unit's 2014 score when compared to those from 2012 and 2013.

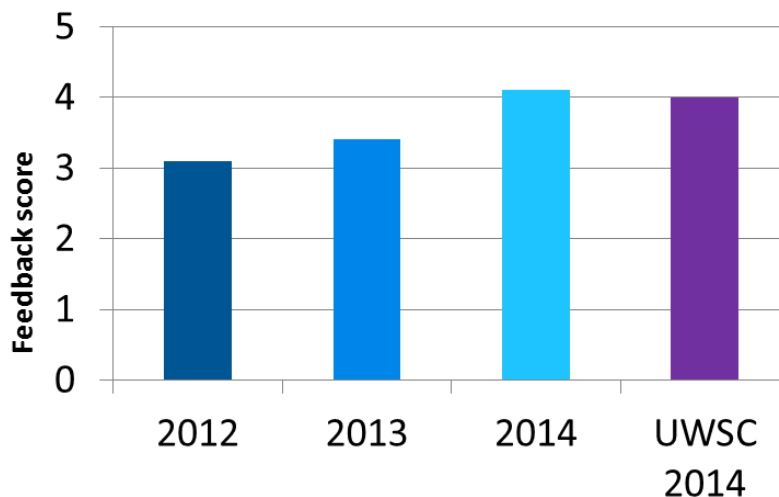


Figure 3. Feedback on student's learning experience for the Electrical Fundamentals unit from 2012 to 2014 (blue) compared to WSU, the College's average feedback on all units offered campus-wide in 2014 (purple).

Student's comments from the questionnaires and surveys, as well as public comments from the YouTube channel, indicated that Social Media project had been well received. Some examples of comments include the following:

'Thank you so much, it helps a lot, I wish if you can solve many problems'

'Video tutorial was useful in my study, especially when I was studying for a test at home. It did help me understand topics and it would be better if I could have video tutorials in all my subjects, especially physics and maths'

'The videos helped me to understand the topic and basically I passed the midsemester exam by referring to the video tutorials'

'I used videos as a guide to do extra questions and revisions'

Conclusion

As demonstrated in this study, the journey for non-traditional students in the university pathway program isn't always easy and overwhelmed with a large number of personal commitments that are not directly associated with the study. However even being in the group of considerable financial disadvantage and low socio-economic status, the students can be motivated, talented and willing to succeed in the course which evidenced by their successful progression towards a university degree.

The development of video tutorials based on the student's needs to improve their understanding of the unit's content, helped them to learn and revise materials in their own time and to engage them in the study. From the analysis of students' feedback, YouTube data and final student's grades it can be concluded that the integration of Social Media component into the first year engineering curriculum was effective in improving the learning process, especially on issues related to an understanding of the concepts studied in class. Throughout this study, the positive global perception and satisfaction of the participants after the implementation of the videos is noticed.

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