Did the four-year extended programme make a difference towards the success rate of the engineering faculty?

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ABSTRACT
The four-year extended programme was offered from 2016 to 2018 at the Vaal University of Technology and statistically never been proved to be successful. Oral feedback from the faculty always portray the programme to be successful, as students moved fluently through their years of study. The purpose of the extended programme was to improve the academic performance of students who are at risk due to their educational backgrounds. The key role of the extended qualification is therefore, to support educationally disadvantaged students who are underprepared despite meeting minimum admission criteria, by enabling them to be placed on an extended curriculum that will give them the academic foundations for successfully completing their studies. The purpose of this paper will be to statistically prove that the students who received the extended curriculum, based on the specific model followed, will perform well and they made a positive difference towards the success rate of the engineering faculty.

Keywords: Foundation; extended programmes; gender equality; engineering

INTRODUCTION
The Vaal University of Technology (VUT) has been experimenting with uplifting programmes in the Faculty of Engineering and Technology since 2002. The first programme, the introduction to engineering programme started in 2002 and was phased out during 2015. During 2016 the extended programme was implemented to replace the introduction programme. The main advantage for the students was that they were now registered for a four-year extended diploma programme and not only for a one-year short academic learning programme. The conditions were still the same, in other words the students still needed to pass all their foundational subjects before they could enrol for the following year. The students completed a foundational curriculum developed for one year which was then divided into five modules. Each module had to be successfully completed before commencing with the following module.

The modules were divided into the two semesters. During semester one, modules one and two had to be completed, while modules three, four and five had to be completed during semester two. The logical reasoning behind the curriculum development was to prepare the students for access as well as for success in the entire diploma programme (Govender, 2017). Semester one was utilised to get the students acclimated into a higher education environment, while the academic pace was limited to ensure students can cope with the change from the secondary school environment to a higher education environment. During semester two the academic pace was picked up and the workload completed was similar as what other students experienced in the mainstream, three-year diploma course (Calcagno, Crosta, Bailey, & Jenkins, 2007; Complete College America, 2016).
The engineering foundational year was developed as a generic programme and all students had to take the core subjects consisting of Mathematics, Science, Language Literacy, Computer Literacy and Entrepreneurial Skills (Guy, Cornick, Holt, & Russell, 2015). The study material included some information of each discipline offered in the Faculty of Engineering and Technology at the VUT. Therefore, the student completed the foundational year by repeating what has been done in high school, without them realising it, as the curriculum was based on academic problem solving, as well as real-world applications. It was essential for the curriculum developer that the students would start realising why it is necessary for them to do the specific subjects.

At the end of the foundational academic year, the students would participate in a colloquium where they then showcased their work. These work pieces ranged from prototypes to computer applications developed for a specific purpose. Students were confronted with problems that the community experienced and asked to find a solution in order to assist the community. In order to complete the task, they had to apply all the academic knowledge gained throughout the year (and sometimes investigate new concepts) to find a sustainable solution to the problem. Therefore, the application of the extended programme curriculum was presented in the form of a prototype or a computer application (project-based learning) that proved that the problem could be solved (Swart, & Sutherland, 2007).

THE EXTENDED PROGRAMME CURRICULUM DEVELOPMENT

From the background study completed by the curriculum developer, it seemed that the students attempted their higher education academic studies under-prepared (Hillman, 2005; Hayward, & Willett, 2014). This was mainly due to the lack of life, communication, numeric and literacy skills (Vygotsky, 1986; Yusof, Sadikin, & Phang, 2013; Mohd-Yusof, Phang, Sadikin, and Helmi, 2014; Bailey &Jaggars, 2016; Norodien-Fataar, 2016). Consequently, the introduction programme and extended programme lead to participation within the higher education sector and eventually assisted in providing quality graduates. This in turn assisted in retaining more students, as they became better prepared for the first year (Jaggars, Hodara, Cho, & Xu, 2015). It has been statistically proven that the introduction programme had a positive effect on the diploma programme subjects (Sutherland, 2009; May, & David, 2011; Vandal, 2016). Therefore, the students who completed the introduction programme had a higher graduation rate than the students not completing the introduction programme (Cho, Kopko, Jenkins, & Jaggars, 2012; Scott-Clayton, Crosta, & Belfield, 2014; Sutherland, 2014; Mohd-Yusof, Sadikin, Phang, & Abdul Aziz, 2016). Also proven was the fact that fewer students dropped out of the programme, therefor the decision to use this programme to retain not only female, but all participating students (Sutherland, 2014; Jones, 2015; Samsuri, Mohd-Yusof, & Abdul Aziz, 2017).

The curriculum development framework model, depicted in Figure 1, has been developed and implemented to broaden access through alternative admission to accommodate under-prepared engineering students. The main recommendation from the findings of the above-mentioned study is the formulation of the curriculum framework (Sutherland, 2009; Mohd-Yusof, Helmi, Phang, & Mohammad, 2015). A framework that aims at providing structured guidance, in the form of a skeleton profile, that provides strength to the inner sub-structures of curriculum development, institutional development and programme development (Svinicki, 2010). Hence the curriculum framework can be described as a sustainable practice that comprised a methodology, technique and innovative used resources that has a proven record of success in providing continuous improvements in academic performance, quality performance or other measureable factors (Calcagno, Crosta, Bailey, & Jenkins, 2007; Jenkins, Speroni, Belfield, Jaggars, & Edgecombe, 2010; Clarke & Braun, 2013). Although this programme was implemented to enhance engineering students throughout their studies, it was also used to study gender equality. Female students may
have experienced extra problems during their study period that their male counterparts were not experiencing, which may have affected their dropout rate negatively. By enhancing the students to perform better after completing the foundational year, it was hoped to find that more female students stayed in the engineering programmes.

Figure 1: Curriculum Development Framework (Source: Sutherland, 2009)

GENDER EQUALITY

Gender bias should be considered as important, both for social or ethical reasons but also from a realistic engineering viewpoint. Throughout the year’s universities have tried to increase the intake of female engineering students and ensure that they complete the undergraduate studies (Jordan, 2014). However, it is a timeously task and continuous research needs to be undertaken to ensure that female students retain in the study programmes (Camacho, & Lord, 2011). The VUT used the extended programme to ensure that female students receive the best foundation within the engineering undergraduate studies, so that they can graduate successfully.

However, it is not only the higher education institutions that need to sustain the females they have enrolled in their study programmes. Female students should be aware what they will encounter in the discipline they want to study. Therefore, they need to prepare themselves for what will come as soon as they have picked a specific discipline (Chemers, Zurbriggen, Syed, Goza, & Bearman, 2011; National Science Foundation. 2017). It would have been wise to have completed an aptitude test first before picking a discipline. Engineering is not a glamorous career; on the contrary, it involves hard work, long hours and dedication towards each project undertaken. It has to be a conscious choice to follow this career as a female, because it might interfere with social as well as family responsibilities (Cech, & Blair-Loy, 2010). Due to the long hours involved at work, family responsibilities will have to be balanced very delicately. It is possible, as many female engineers are
doing just this on a daily basis, but it is not easy, and an understanding spouse or life partner can make it work (Hatmaker, 2013).
The foundational programme introduces the students to the different disciplines on offer at the VUT. After they have completed the first year of study successfully, they might decide to change disciple due to the information gathered during the foundational year. Academically it should not be problematic to change disciplines, as a generic programme was offered for all. Now it is possible to see if this programme assisted students with their undergraduate studies and if the VUT indeed retained more students and also if the female student’s dropout rate was lower than for those students doing a three-year undergraduate diploma.

RESULTS

The overall success rate of the students in the foundational year is depicted in Figure 2. The statistics shows how the students succeeded during 2016 and 2017. The foundational students of 2018 were not taken into consideration, as they have not yet completed any mainstream subjects. They are currently enrolled for them.

![Foundational Success Rate](image)

**Figure 2: Students success rate during their foundational year**

Figure 3 represent the total percentage of female students registered in the different disciplines on offer for the foundational year 2016. The majority of the disciplines do not reach the 50% mark for female students registered. The chemical department is the only department with a high female representation. Figure 4 represent the total percentage of female students registered in the different disciplines on offer for the foundational year 2017. The majority of the disciplines do not reach the 50% mark for female students registered. The chemical department dropped while the metallurgy department picked up the amount of female students registered for 217.
The aim is to retain the students and in particular the female students. During the years 2016 and 2017 the female retention rate was high for each department that had female students registered.

Figure 5 depicts the percentage of female students that were retained from each discipline. This implied that even though the registration rate of female students in the departments are low, retention of these students is high, and, in the end, more female students will graduate and placed into the world of work.

From Figure 5 it is clearly visible that the female students are performing well in their academic careers. This proofs that the dropout rate becomes lower as the retention rate becomes higher.
CONCLUSIONS

Even though the majority of higher education institutions try to retain their students within the engineering study field, the VUTs foundational programme had a positive outcome. Students complete the undergraduate qualification in the appropriate time span. No bottle-necking, or in other words, students failing repeatedly in one specific year of their study. The results show a good flow of students throughout each year.

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