THE IMPACT OF SCIENCE FOUNDATION PROGRAMMES ON THE SUCCESS RATE OF FIRST-YEAR STUDENTS IN A BLENDED TEACHING AND LEARNING ENVIRONMENT

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ABSTRACT

This article highlights some successes as achieved with an extended Science Foundation Provision Programme for first-year engineering students at the University of South Africa's Science and Engineering School in Johannesburg. The learners were mainly from disadvantaged environments. Strategies ranged from upgradation of study material, intensive monitoring of online study activities; the appointment of online tutors to assist students; as well as the introduction of face-to-face tutor classes held regularly throughout the course. Owing to these strategies, the online activity of students active in modules in Civil and Chemical Engineering grew on average from about 50% to about 80%; that of students active in Electrical and Mining Engineering improved from 40% to 60%; and that of students active in Mechanical and Industrial Engineering went up from 20% to about 60%. Correspondingly, students' success rate increased up to 40% in Chemical Engineering, up to 45% in Electrical Engineering and up to 40% in Mechanical and Industrial Engineering. Even in challenging cognitive subjects such as Chemical Processing, and Digital and Analogue Electronics, students coped well. It is believed that several lessons can be learned by other environments from this exercise.

Keywords: Open distance learning, engineering tuition, science and technology tuition, media teaching, tutor teaching

INTRODUCTION

Engineering faculties at South African universities experience substantial challenges because of the high cost of teaching as well as the considerable cognitive challenges associated with science and engineering tuition, ranging from mere technological knowledge to cognitive analysis associated with problem-solving and design. Some of the current challenges facing South Africa as identified by the Dean's Forum of the Engineering Council in 2017, (Engineering Council of South Africa 2017) is that between 30 and 35 per cent of youth under the age of 35 in South Africa are unemployed. Certain sectors of the SA mining industry are experiencing a decline in mining activities, especially in the gold mining sector, because of either a decline in resources or stiffer international competition. Competition in the manufacturing sectors in general is also a challenge since South African labour laws and protocols are unfavourable compared to those of other developing nations such as China, India, Korea and Japan. The youth, in 2017, demanded free education up to tertiary level which have put extreme pressure on financial resources. Most engineering schools are understaffed and under facilitated in terms of laboratories and training equipment. The recruitment of high-level expertise and teaching staff are difficult.

In recent years, leading academics such as Prof Richard van der Ross, Prof James W Gerwel and Prof Barney Pityana have introduced reforms in the education system in South Africa in order to address specific needs in South Africa, particularly by developing infrastructures to address the imbalances of the past (Van der Ross 2014; Gerwel 2014; Pityana 2016). One of the particular initiatives, was the introduction of a multimillion science campus in the South of Johannesburg, introducing degree programmes in science engineering and technology programmes as main tuition programmes, and introducing distance tuition with so-called "open distance learning" (ODL) methodology as main instructional medium. Particularly, recent reforms included the introduction of a science foundation teaching programmes in order to address the backlog in the schooling system; various extended teaching programmes (Moodley et al. 2016, 84–103); the introduction of tutors as lecturer assistants (Hassan 2017, 99–115), computer- and tablet-assisted teaching programmes (Adamiak 2017, 230–248; Rusznyak et al. 2017, 207–226; Foo and Ng 1996, 131–142); distance teaching and Open Distance Leaning (ODL) (Moodley et al. 2016, 84); and new didactic techniques such as a greater use of media in teaching (Snyman and Pistorius 1995, 199-203).

This article presents some recent developments at the University of South Africa's School of Science, Engineering and Technology (CSET) with regard to teaching and learning methodologies in the science foundation programme which, and which we believe, have made substantial progress with regard to solving current challenges in science and engineering tuition.

EXISTING TUITION APPROACHES AT UNISA

At UNISA CSET, students receive vocational training for the National Diploma, the Baccalaureus Technologiae, and Master of Technology. A blended instructional model combines face-to-face and online teaching of engineering modules. Students working in the industry, migrate to the main campus in Johannesburg for block courses in practical training. The School of Engineering currently employs about 60 academics and 30 support staff members. During 2016 the Engineering School was evaluated by an accreditation team of the Engineering Council of South Africa and was granted full accreditation to offer programmes until 2020.

A main strategic initiative in the last five years at the School of Engineering, was to focus on providing good online study material, and good guidance and links to open-source study material. The online teaching process have been personalised to some extent, by adding audio and video podcast material to existing and upgraded study material. Particularly, in the latter five years, an exerted effort was made to existing teaching and training modules were upgraded. Figure 1 outlines the extent and progress made in this regard.

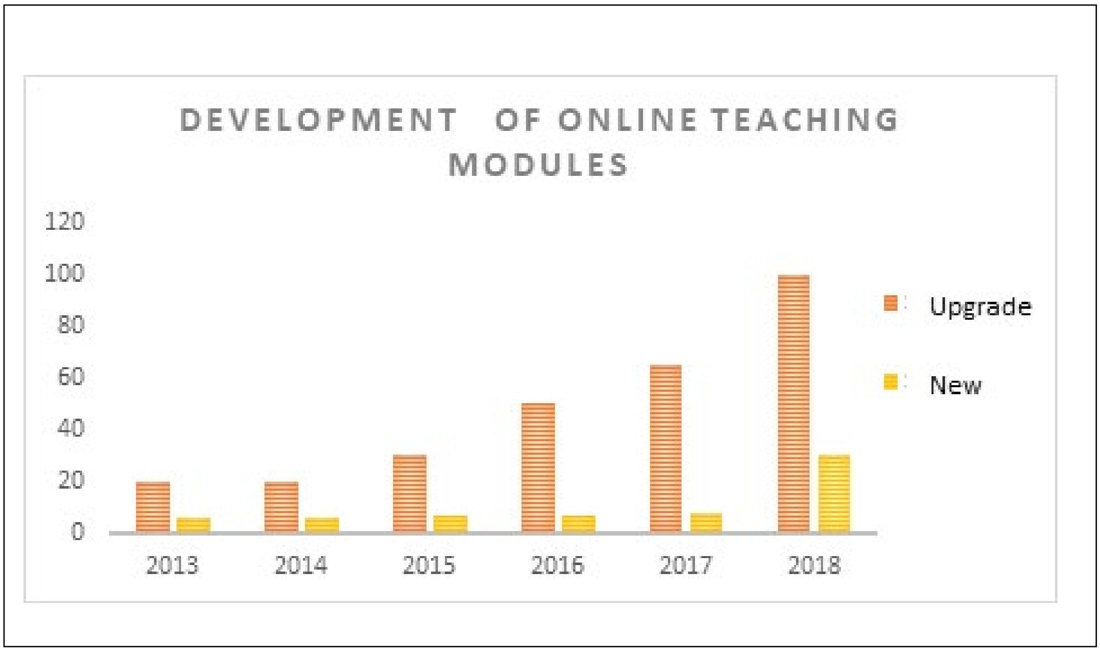


Figure 1: Investment in the development of online study models and new modules, and the upgrade of existing modules at the School of Engineering

The School of Engineering uses a blended mode of delivery which incorporates a variety of teaching and learning styles, course materials and learning technologies such as classroom instruction (face-to-face tutorials and discussion classes), print, CD-ROMs and DVDs, e-mails, online tuition platforms (asynchronous and synchronous online delivery and tools), and e-books.

In essence, blended learning is "the organic integration of thoughtfully selected and complementary face-to-face and online approaches and technologies" (Howard, Remenyi, and

Pap, 2006, T3K-11 to T3K-16). According to them, blended learning is also concerned with leveraging the strengths of different kinds of learning activities and venues to achieve some overarching learning objectives. This mode of delivery takes on different configurations depending on the course content and pedagogy. In the School of Engineering, a significant portion of learning activities is online and the remainder is face to face. This combination includes:

- face-to-face instruction (discussion classes presented by lecturers and tutorials hosted by tutors), online tutorials and print;
- face-to-face instruction (discussion classes presented by lecturers and tutorials hosted by tutors), video podcasts/DVDs, online tutorials and print;
- CD-ROMs, print and campus-based labs.

INTRODUCTION OF A HIGH-IMPACT SCIENCE FOUNDATION DEVELOPMENT PROGRAMME AT THE SCHOOL FOR ENGINEERING AT THE UNIVERSITY OF SOUTH AFRICA

During the period 2014 to 2019, a special Science Foundation Provision Programme was introduced at UNISA CSET. The objectives of this programme were to (1) assist students from previously disadvantaged backgrounds and poor schooling environments and (2) provide a bridging path for these students to enter the main-stream of science and engineering curricula at UNISA CSET. It followed the Model 3 four-year programme, meaning that the regular first-year curriculum was extended over two years as prescribed by the Department of Higher Education. The regular first-year curriculum incorporated a combination of normal and augmented foundational modules.

The extended four-year programme modules were indicated in the administration system by a simple addition of the prefix X to the regular mainstream module code. The selection criteria for the programmes included South African citizenship; first-time registration for a qualification at tertiary level; a mark of 49 per cent or less in mathematics and/or English in Grade 12 in the NSC and at the HG or a mark of 59 per cent or less at the SG; and a matric point score of 24 or lower calculated according to APS procedures.

Management approaches

The following management approaches were followed in order to facilitate the programme:

- A proposal was presented to the UNISA executive management committee in 2011 under the Special Programme Initiative at UNISA.
- A detailed budget and a management and operational budget were presented over a period of five years.
- A cohort proposal was submitted to the Department of Education and partial seed funding was motivated for the programme.
- The funding was approved in 2012 and special arrangements were made in order to formally introduce the programme at the College for Science Engineering and Technology in 2013.
- A special programme manager with a suitable didactical background and management experience was recruited for the programme.
- A special support structure for linking with the existing tutor management programme and the managers of satellite campuses was facilitated in 2012.

Extent of the programme

The following modules were identified as high-risk modules and were included in the Science Foundation Provision Programme:

Table 1: Subjects offered

Module Name	Module Code
Chemical Engineering Technology II	CEM2601
Chemical Process Industries II	CPI1501
Chemical Engineering Drawing I	DCE1501
Digital Systems I	DIG1501
Engineering Drawing I: Civil Engineering	DRW1501
Electronics I	ECT1501
Electrical Engineering I	ELE1501
Introduction to Pulp and Paper Technology	IPM101P
Mechanical Engineering Drawing I	MED161Q
Mineral Exploitation I	MEP171X
Mechanical Manufacturing Engineering I	MME1501
Qualitative Techniques I	QUT151Z
Surveying Theory I	SRV1501
Theory of Structures II	TST2601

A number of tutors, called e-tutors, were appointed and allocated to the designated modules. These tutors were available on 24-hour basis online, telephonically and by e-mail to assist students.

A number of face-to-face tutors were appointed at Unisa centres throughout the country.

Students could attend tutorial sessions and interact with tutors face to face and request lecturing on specific topics. In Table 2, the centres where these modules were presented on a regular basis are given.

Table 2: Subjects offered at the Unisa Regional Centres

Region	Regional Hub	Regional Service Centre	Agency	Modules Tutored	Number of Face-to-Face Tutors	School of Engineering Departments
Gauteng	Sunnyside Pretoria	Sunnyside Pretoria		DCE1501	1	Chemical Engineering
				DIG1501, ELE1501	1	Electrical Engineering
				MEP171X	1	Mining Engineering
				MED161Q	1	Mechanical Engineering
		Johannesburg		DRW1501, DCE1501 MED161Q	1	Civil & Chemical Engineering, Mechanical & Industrial Engineering
				ELE1501, DIG1501	1	Electrical Engineering
				MME1501	1	Mechanical & Industrial Engineering
		Florida Science Campus		ELE1501, ECT1501	1	Electrical Engineering
		Vaal				
		Ekurhuleni				
Midlands		Rustenburg		MEP171X	1	Mining Engineering
		Bloemfontein				
		Kimberley				
		Kroonstad				
		Mahikeng				
		Potchefstroom				
Mpumalanga		Nelspruit				
		Middelburg		SCV1501,	1	Civil Engineering
				MED161Q, DRW1501	1	Mechanical & Civil Engineering
Limpopo	Polokwane		Giyani			
			Makhado			
KwaZulu-Natal	Durban Central	Pietermaritzburg				
		Newcastle				
		Richards Bay				
		Wild Coast				
		Bright Site				
Western Cape		Cape Town				
			George			
Eastern Cape	East London	Mthatha				
		Port Elizabeth				

Number of face-to-face tutors = 11
Number of online tutors = 20

METHODOLOGIES FOLLOWED

The students for the Science Foundation Programme were selected based on their final year school exit exam results, and according to previous statistics as available to the programme managers of the programme, would have difficulty if they entered the main stream programme. It was noted that most of the students came from disadvantaged communities. All students entered the programme on a voluntarily basis after UNISA administrative people dealing with admissions made an offer to such students.

Primary lecturers who managed and lectured the regular mainstream courses, were appointed to manage and lecture the Science Foundation Programme as well. A large number of full-time, fixed-term contract lecturers were selectively appointed to run and manage the foundation courses. These lectures were nomenclated as face-to-face tutors. The main author of this article served as programme manager and coordinator for the SFP program, and reported directly to the Director of the School of Engineering of CSET. They had quarterly meetings in order to manage and guide the programme, and also to evaluate the results that emanated from the programmer.

Eight assignments and one mock examination or portfolio formed part of the continuous formative assessment system. Students who were enrolled for the extended four-year courses wrote the same final examinationas the one for regular mainstream students.

The programme was furthermore largely delivered via the so-called e-tutor system. E-tutorials were delivered on Unisa's electronic and software learning management system MyUnisa. This rich and highly interactive learning environment offered students a variety of learning tools. Informal student networking also extended to social media such as WhatsApp, Facebook, Twitter or Skype.

Tutorials were interactive and concentrated on activities, assessment and, to a lesser extent, content. The tutoring strategy was grounded on motivational and foundational philosophies according to which the tutor tracked the learning process of students through continuous assessment to identify knowledge and academic skills gaps and take remedial action. This provided experiences that complemented the normal study environment. Tutorials were offered in both face-to-face and online (e-tutoring) modes.

A special managing structure was introduced, and at least three e-tutors were appointed per online module. Each e-tutor was allocated to a group of at the very most 200 students for approximately 100 hours of tutoring over 15 to 20 weeks for a semester module and 30 to 40 weeks for a year module (the number of weeks is based on the period between the first day of registration and the final examination date). The group was then split into subgroups of 50 students. Group allocation could be random, or according to biographic and academic criteria defined by lecturers. Smaller groups ensured that every student got the opportunity to participate in discussions. They also allowed e-tutors to track student participation and progress, and personalised learning support. As part of an automated process, a tutorial site was created once a tutor and a group of 50 students were linked in a tutorial group. The tutor, who received notification of being linked to a group of students at his/her preferred e-mail address, had to prepare the site for tutorials within 24 hours.

Face-to-face tutoring took place in contact classes at a Unisa learning centre. Face-to-face tutors had access to a wide range of electronic technologies to enhance classroom interaction. The smart board, which is by far the most interactive, has capabilities such as the display of digital images which can be manipulated by using a pen or a highlighting tool. Touch screens allowed tutors to run programmes directly from the screen for different purposes such as mind mapping, brainstorming, combining text, images, diagrams or videos, and surfing the internet. The student experience of the face-to-face interaction was the same as that of an e-tutorial on myUnisa. The smart board can also be used to record tutorials for revision and assessment purposes.

For face-to-face tutoring (which includes video-conferencing or satellite modes), a tutor had a maximum of 3 groups of 25 students. Each group had approximately 40 tutorial hours spread over a maximum of 20 weeks for a semester or 40 weeks for an academic year. The groups were small for the same reason as that for e-tutoring.

The e-tutor system ran continuously with the online presentation of the foundation modules. Face-to-face sessions were announced well in advance on the online platform. Attendance of the face-to-face tutorial sessions was optional.

Face-to-face tutorials started in February of each year. By then the minimum number of students had enrolled for tutorials at the different learning centres. Students enrolled for tutorials by completing and submitting a form online or at a learning centre. Once a group was established, the Regional Academic Coordinator (RAC) contacted the tutor to negotiate his/her preferred tutorial schedule.

A tutorial was divided into units or topics and focused on a specific difficult concept. Different tutorial elements or activities determined tutorial interaction. The structured tutorial framework assumed that a student had studied the recommended learning resources and completed the learning activities, and was able to participate in a tutorial. Each tutor had to follow the prescribed methodology when delivering tutorials.

Support of media material during the project

Research has shown that the video podcast mode of tuition proved to be a good strategical approach in terms of development hours versus presentation. Video podcasts to augment existing online training modules seem to be particularly viable.

To stimulate this form of teaching, a podcast studio was established in the Department of Electrical and Mining Engineering. Lecturers walked a short distance from their offices to a well-equipped studio with diverse video recording and processing equipment, and software where they could, with little effort, make high-impact video podcasts. In next to no time these podcasts and video casts were available on the myUnisa online tuition software platform. Both the bandwidth and storage capacity per module page has been expanded to accommodate larger quantities of these units. The video casts personalised online teaching, introduced lecturers, gave an overview of study material, and explained complex aspects of science, mathematics and engineering. Study material was delivered to students in a more personalised, visual and media-assisted format.

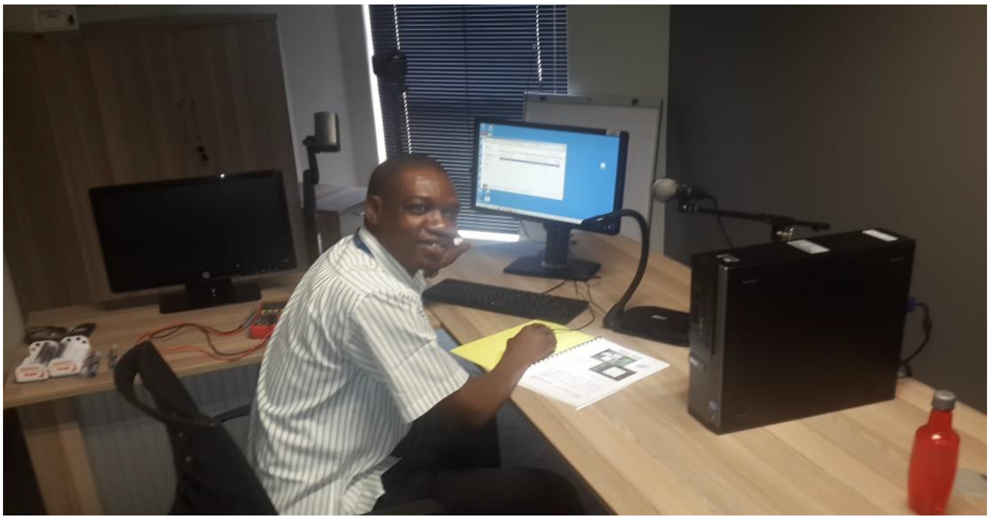


Figure 2: An interactive video studio that has been set up at the UNISA School of Engineering. The studio is near lecturers' offices and can be used to make high-quality video podcast study material for existing online tuition software on myUnisa.

This particular methodology particularly followed from earlier research and development initiatives of the authors in the mid-nineties, and on which the authors successively built in the latter years. (Snyman and Botha 1993, 224–230; Snyman and Pistorius 1995, 199–203; Snyman and Erhardt 2002, 27–29).

The mathematics teaching group used the facility quite extensively and the results of these new teaching methodologies have recently been published (Huntley 2017). In the course of this project, e-tutors were encouraged to use this facility to augment existing module material by making media clips available as additional online media material. E-tutors were also asked to take a survey and evaluate existing media material on the Web and to recommend and post references of links of good and most relevant media material on the module online platform.

The main lecturer played a guiding role by selecting the best available material and referencing only the best and most suitable material. Unisa's high-bandwidth network system supported the communication and distribution of the modules throughout the country.

THE RESULTS AS WERE ACHIEVED

Trends observed in the respective engineering tuition streams

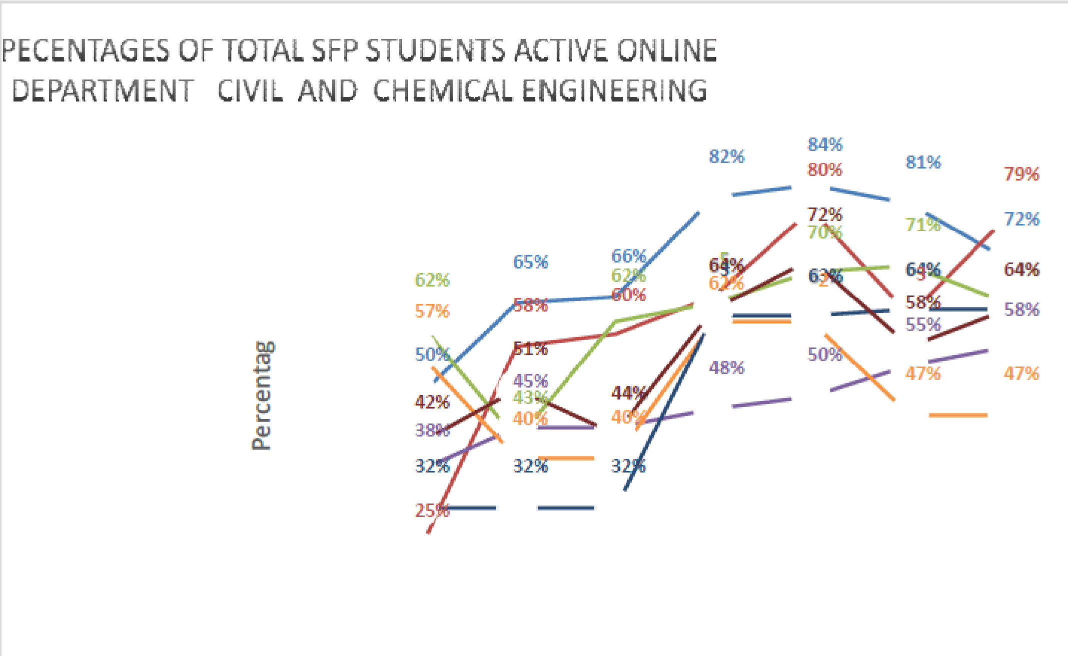
Figures 3, 4 and 5 show data compilations of the observed (1) student activity online, (2) the evaluated success rate of students per semester; and (3) the evaluated overall average success rate per discipline. The evaluated discipline groups were Civil and Chemical Engineering, Electrical and Mining Engineering and Mechanical and Industrial Engineering according to the existing departments in the School of Engineering.

The objective of the learner-centred blended approaches to teaching and learning was to achieve a success rate of above 50 per cent in all modules. Failure in some modules could be attributed to the heavy engineering curriculum structure; challenges in the conceptual understanding of the course content; a heavy workload owing to assignments, tutorials, deadlines, and examination; students' motivation levels and their ability to cope; their study strategies/methods, study skills and habits; poor prior knowledge; constraints such as internet connectivity/affordability; proximity to Unisa learning centres for face-to-face instruction; and access to computer labs or video conferencing facilities. An evaluation of the trends in the respective statistics revealed the following:

- There seemed to be an increase in student activity with time lapse per semester. Students' online activity in modules in Civil and Chemical Engineering increased from about 50 per cent to about 80 per cent (Fig 3(a)) over the seven-semester evaluation period; that of students active in Electrical and Mining Engineering grew from 40 per cent to 60 per cent; and that of students in Mechanical and Industrial Engineering went up from 20 per cent to about 60 per cent. Modules that scored the highest activity were Introduction to Pulp and Paper Technology (IPM101P) (90%) and Qualitative Techniques (QUT 151Z) (80%), whereas modules such as Surveying Theory (SRV 1501) and Digital Technology (DIG 1501) scored the lowest activity (50% and 45% respectively). The increase in online activity could be attributed to the fact that students get more acquainted with module strategies, outlines and evaluation strategies. It could also indicate that the module material was acceptable and quite effective in teaching a particular discipline. Only occasionally downward trends were observed over time.

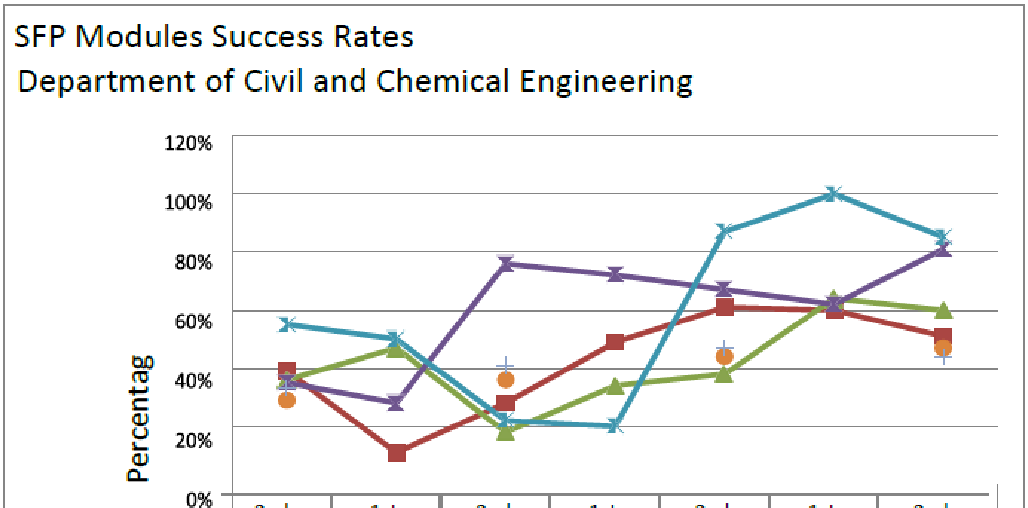
- There seemed to be an increase in the success rate over the seven-semester evaluation period for most of the modules. The success rate of students in a module such as Paper Technology (IPM101P) increased from 45 per cent to 85 per cent, while that of students in a module such as Qualitative Techniques (QUT151Z) improved from 20 per cent to 80 per cent. This seemed to indicate that the module presentation strategies and presentation were quite effective in conveying discipline principles, increasing cognitive skills and conveying technological knowledge. However, subjects such as Chemical Process Industries (CPI 12601), Digital Electronics DIG 15101 and Electronics ELE 1501 scored lower average success rates throughout (40%, 40% and 40% respectively), and lower increases in success rates over seven semesters (10%, 10%, 20% respectively). About 30% of each module were application and tutorial outcomes based.
- A further interesting observation was that subjects with a high technological-knowledge content such as Introduction to Pulp and Paper Industries (IPM 1501) and Mechanical Manufacturing Engineering (MME1501) scored the highest average success rates with respectively 70 per cent and 80 per cent. More cognitively challenging and conceptual understanding modules and tutorial outcomes and application outcome-based modules such as Chemical Process Industries (CPI 12601), Digital Electronics (DIG 15101) and Electrical Engineering (ELE 1501) scored much lower average success rates throughout (45%, 45%, 45% respectively). Particularly promising is to see that several cognitive challenging subjects such as Surveying Theory (SRV 1501), Theory of Structures (TST 2601), Electronics (ECT1501) and Mechanical Manufacturing Engineering (MME 1501) showed increases of respectively 20 per cent, 60 per cent, 10 per cent and 80 per cent in their success rates over the evaluation period.
- The general increases in the average success rates for all the modules in the three engineering group disciplines of Civil and Chemical Engineering, Electrical and Mining Engineering, and Mechanical and Industrial Engineering, were respectively 35–56 per cent, 34–57 per cent and 41–81 per cent. These increases could be attributed to the above parameters, namely good module development and introduction, acquaintance with the online module strategies and the impact of e-tutoring and face-to-face tutoring. Superimposed on these trends may be the impact of the higher cognitive challenges associated with particular sets of modules, which may be, to a certain extent, also discipline based. Lecturers, e-tutors and students agreed that Electrical Engineering is cognitively challenging because of the abstract and less physical nature of the discipline.

a



	2nd semester 2013	1st semester 2014	2nd semester 2014	1st semester 2015	2nd semester 2015	1st semester 2016	2nd semester 2016
CEM2601	50%	65%	66%	82%	84%	81%	72%
CPI2601	25%	58%	60%	66%	80%	63%	79%
DCE1501	62%	43%	62%	65%	70%	71%	65%
DRW1501	38%	45%	45%	48%	50%	55%	58%
SRV1501 (Yr)	57%	40%	40%	62%	62%	47%	47%
TST2601 (Yr)	32%	32%	32%	63%	63%	64%	64%
Overall Average Percentages of SFP Students Active Online per Semester	42%	51%	44%	64%	72%	58%	64%

b



	2nd semester 2013	1st semester 2014	2nd semester 2014	1st semester 2015	2nd semester 2015	1st semester 2016	2nd semester 2016
CPI2601-1S	39%	11%	28%	49%	61%	60%	51%
DCE1501-1S	36%	47%	18%	34%	38%	64%	60%
DRW1501-1S	35%	28%	76%	72%	67%	62%	81%
IPM101P	55%	50%	22%	20%	87%	100%	85%
SRV1501 (Yr)	29%		36%		44%		47%
TST2601 (Yr)	33%		41%		47%		44%

c

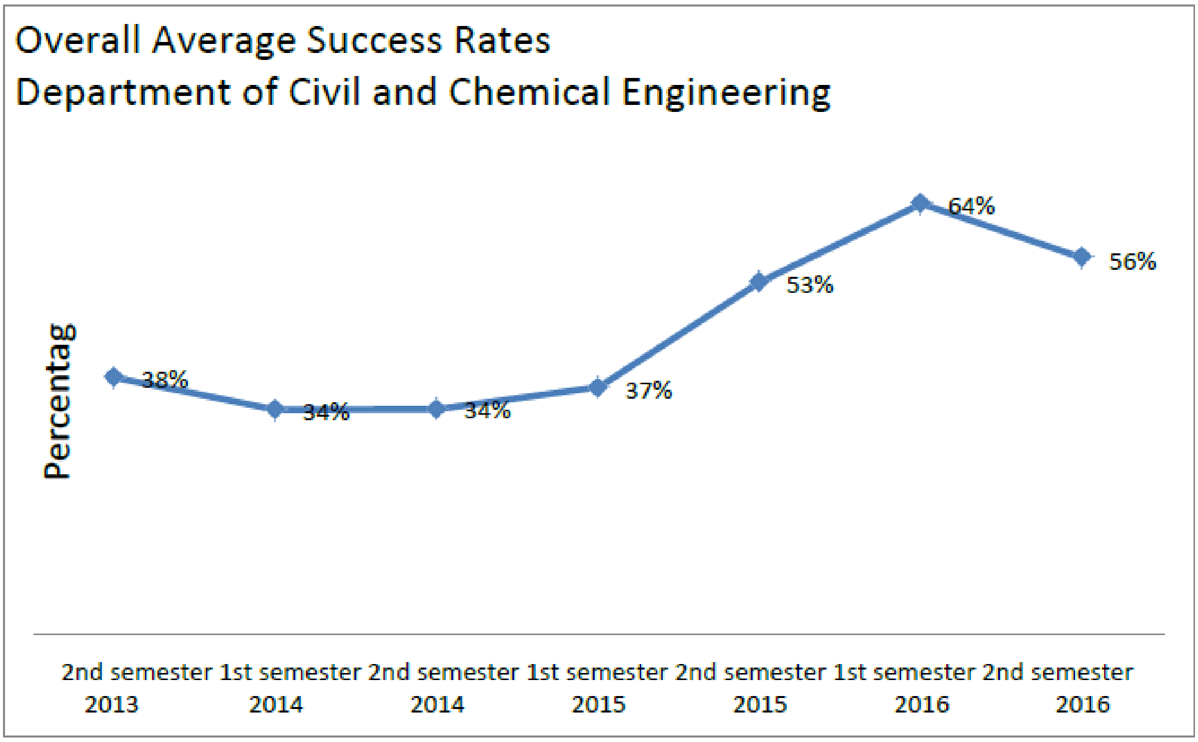
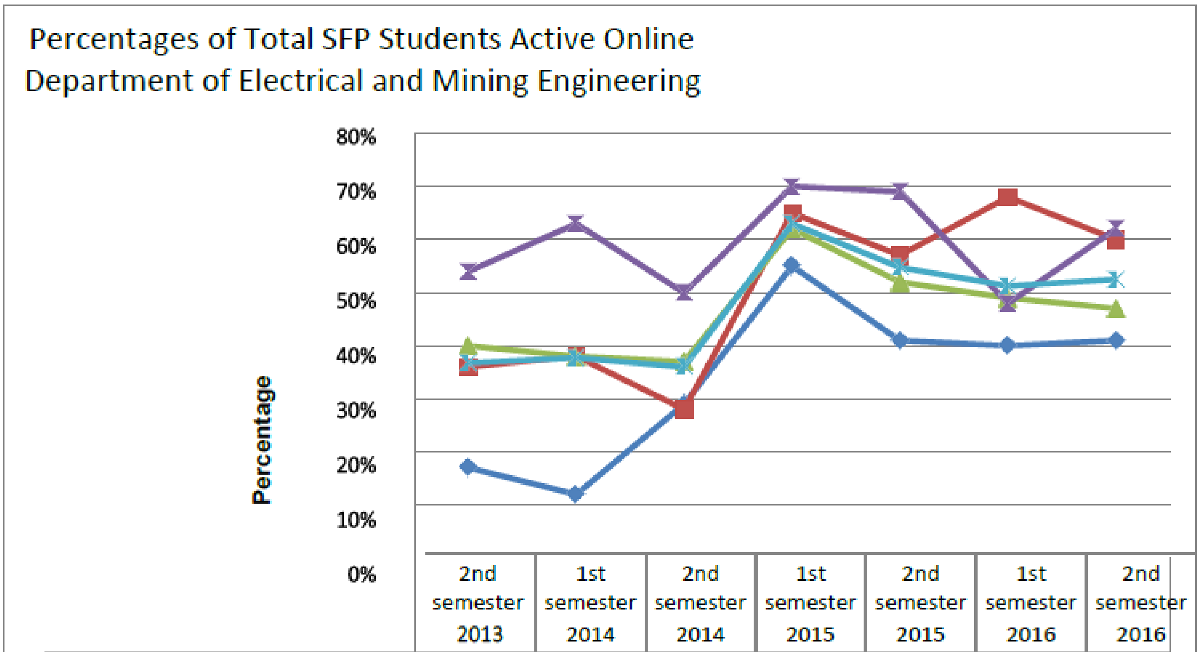


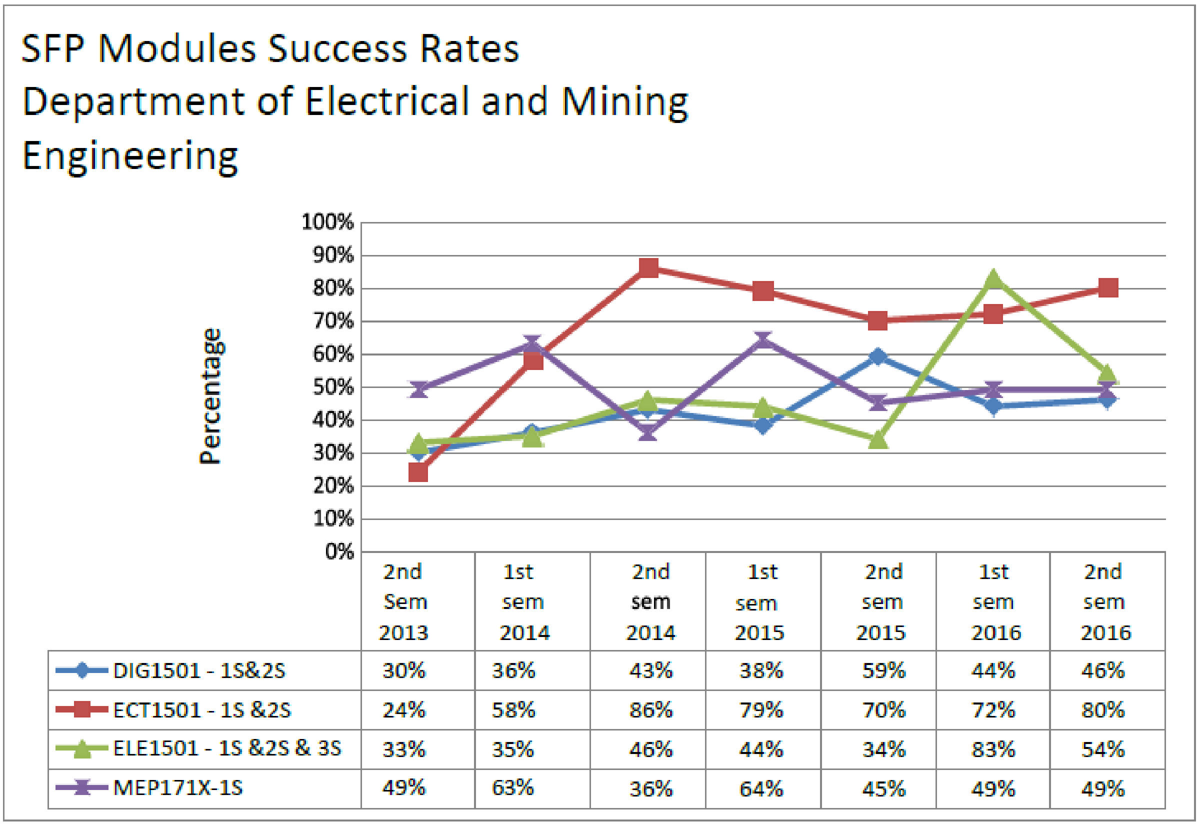
Figure 3: Trends observed for (a) the online activity, (b) success rates achieved for subjects as in Table 1, and (c) overall average success rates achieved for the Department Civil and Chemical Engineering.

a



	2nd semester 2013	1st semester 2014	2nd semester 2014	1st semester 2015	2nd semester 2015	1st semester 2016	2nd semester 2016
DIG1501	17%	12%	29%	55%	41%	40%	41%
ECT1501	36%	38%	28%	65%	57%	68%	60%
ELE1501	40%	38%	37%	62%	52%	49%	47%
MEP171X	54%	63%	50%	70%	69%	48%	62%
Overall Average Percentages of SFP Students Active Online per Semester	37%	38%	36%	63%	55%	51%	53%

b



	2nd Sem 2013	1st sem 2014	2nd sem 2014	1st sem 2015	2nd sem 2015	1st sem 2016	2nd sem 2016
DIG1501 - 1S&2S	30%	36%	43%	38%	59%	44%	46%
ECT1501 - 1S &2S	24%	58%	86%	79%	70%	72%	80%
ELE1501 - 1S &2S & 3S	33%	35%	46%	44%	34%	83%	54%
MEP171X-1S	49%	63%	36%	64%	45%	49%	49%

c

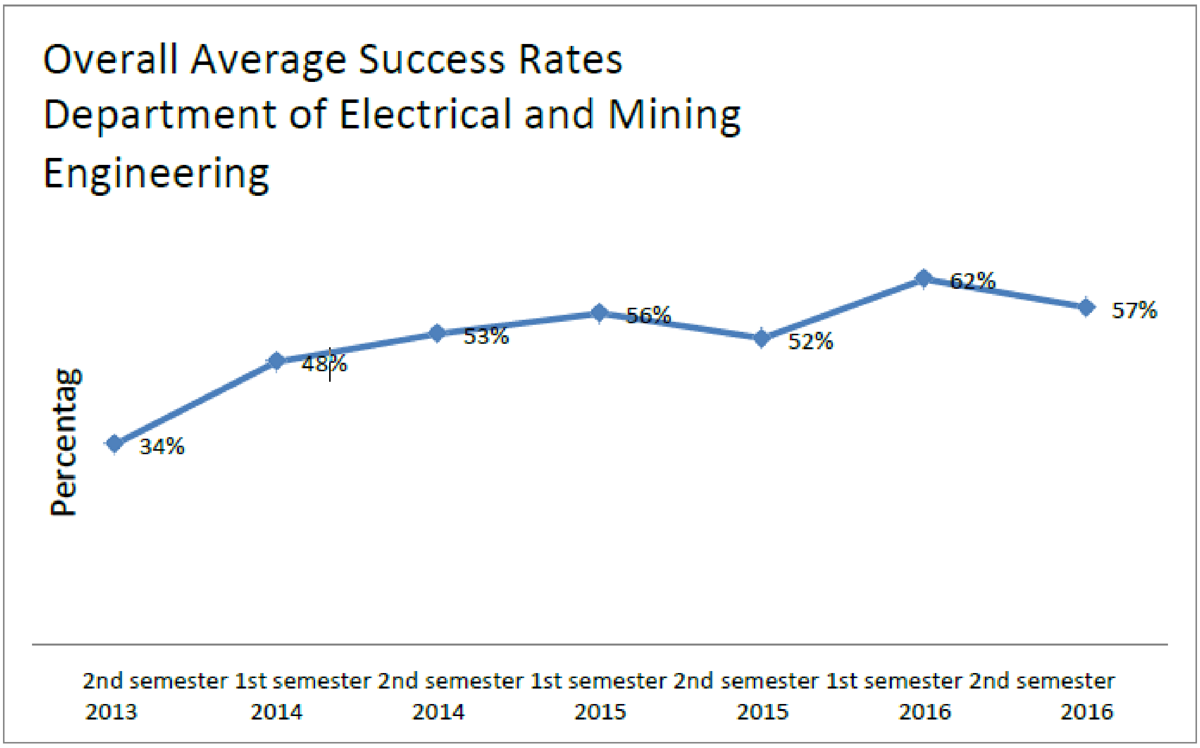


Figure 4: Trends observed for the (a) online activity, (b) success rates achieved for subjects as in Table 1, and (c) overall average success rates achieved for the Department Electrical and Mining Engineering.

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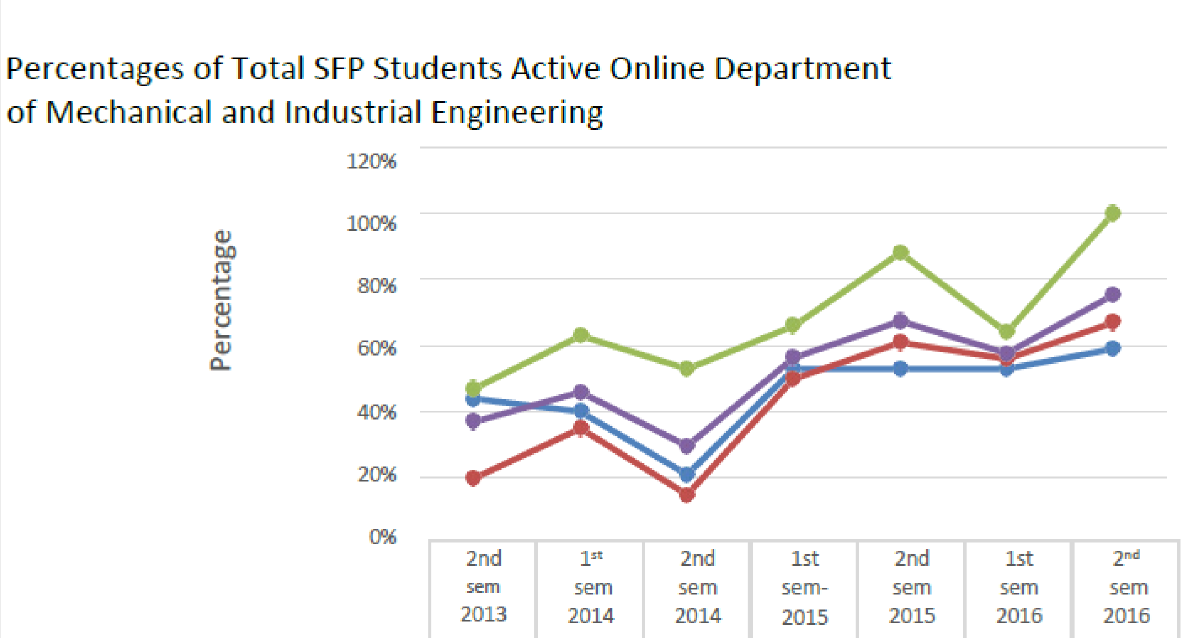
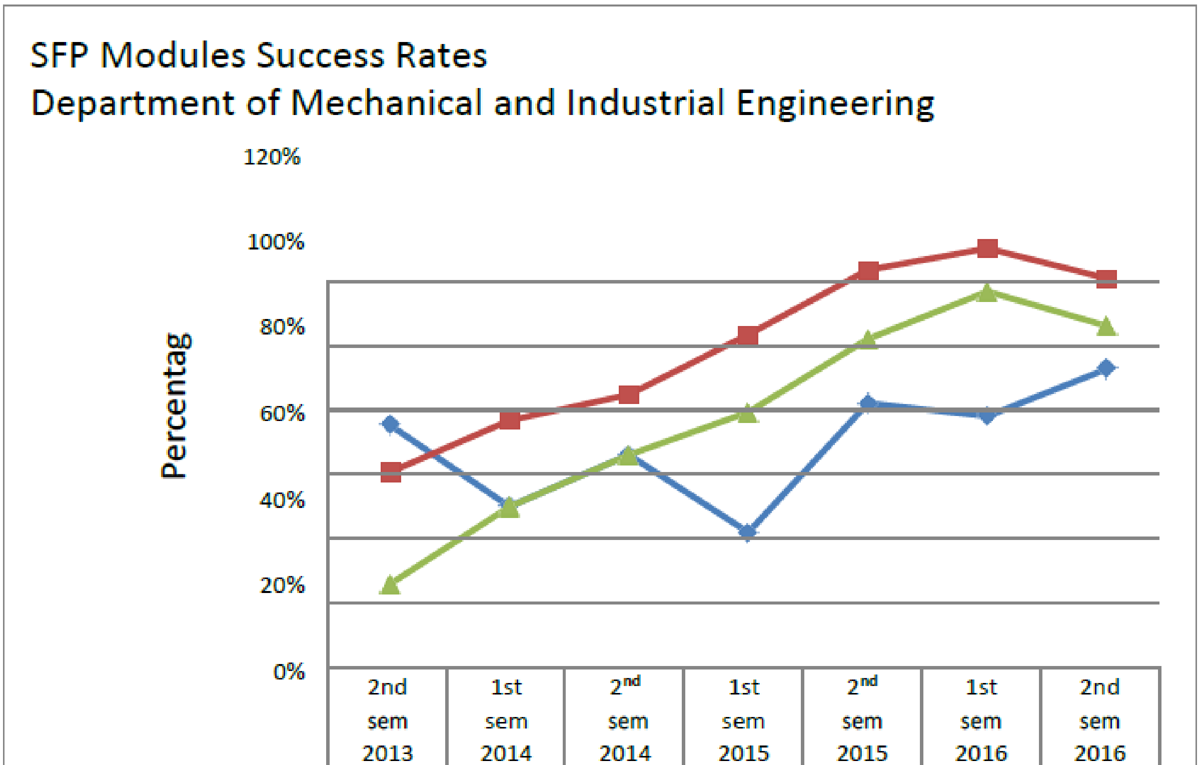


	2nd sem 2013	1st sem 2014	2nd sem 2014	1st sem-2015	2nd sem 2015	1st sem 2016	2nd sem 2016
MED161Q	44%	40%	21%	53%	53%	53%	59%
MME1501	20%	35%	15%	50%	61%	56%	67%
QUT151Z	47%	63%	53%	66%	88%	64%	100%
Overall Average Percentages of SFP Students Active Online per Semester	37%	46%	30%	56%	67%	58%	75%

b



	2nd sem 2013	1st sem 2014	2nd sem 2014	1st sem 2015	2nd sem 2015	1st sem 2016	2nd sem 2016
MED161Q - 1S & 2S	57%	38%	50%	32%	62%	59%	70%
MME1501	46%	58%	64%	78%	93%	98%	91%
QUT151Z	20%	38%	50%	60%	77%	88%	80%

c

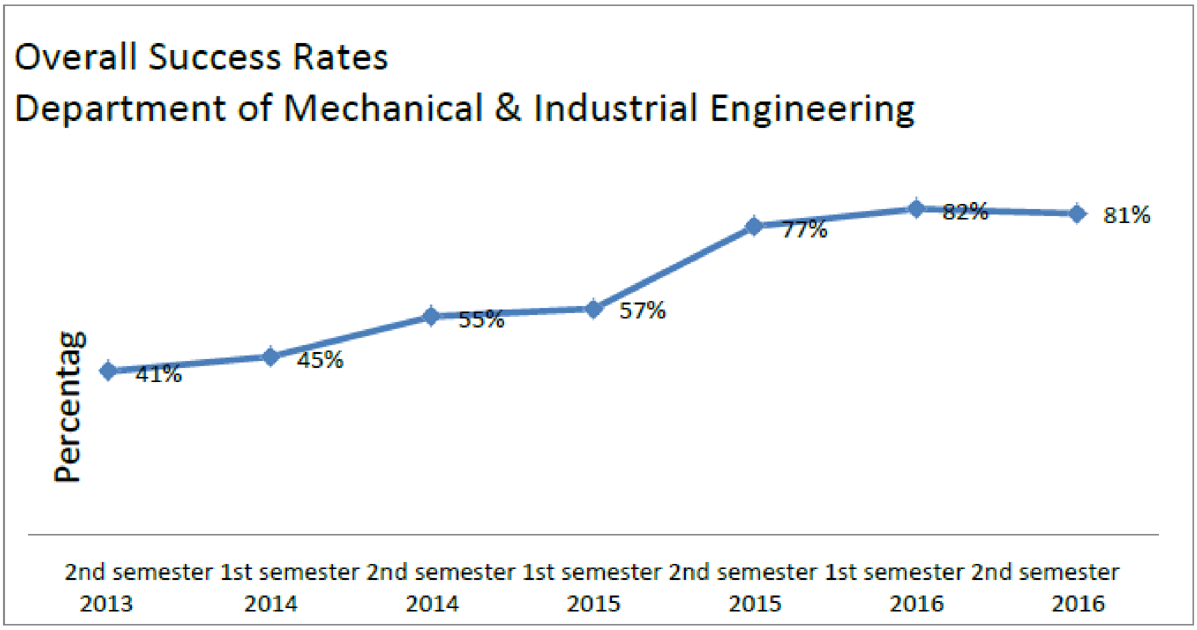


Figure 5: Trends observed for the (a) online activity, (b) success rates achieved for subjects as in table 1, and (c) overall average success rates achieved for the Department Industrial and Mechanical Engineering.

CONCLUSIONS

The following conclusions and recommendations are derived from the case studies and statistics:

1. The results of this study are, generally, in line with international success strategies that have been observed in science and technology teaching (Case and Marshall 2004, 605–615; Wang 2008, 411–419; Case and Gunstone 2003, 801; Chen, Wei, and Li 2016, 148–165; Chen and Wu 2015, 108–121; Skuballa, Dammert, and Renkl 2018, 35–46; Singh and Haileselassie 2010, 42; Garrison and Cleveland-Innes. 2005, 133–148; Boling et al. 2012, 118–126; McDonald 2008). The results as were achieved also aligns well with other Science Foundation Programmes as presented in South Africa (Mabila et al. 2006; STEM Education 2020; Centre for Science Access 2019). The unique contribution of the programme at the University of South Africa, CSET and as presented in this article, may be the explicit implementation of Open Distance Learning Approach as main tuition vehicle, the use of upgraded and dedicated developed high quality study material modules that was developed over a number of years, and which were moderated by a team of didactical experts. The impact of more media and open resource citations used in the modules, and also the extensive use of both on line "e tutors" as well as a high number of "face to face tutors" in order to obtain a balance between on line tuition and "personalised"

between tuition, were all unique contributions in this programme.

2. It is clear that strategically well-planned programmes piloted at SA universities with regard to the provision of Science Foundation Programmes improved the success rate of disadvantaged students.
3. The development and introduction of higher-quality online study material had a marked influence on the success rate of students. This seemingly correlated with the increase in both the quantity and quality of modules that were developed over time by the School of Engineering.
4. The online activity with time lapse and participation in the programmes as monitored in this study were seemingly connected with both the acceptability and quality of the online study material.
5. There seemed to be a direct correlation between the online activity and the success rate of students monitored in this study. This indicates that the exposure of the students to the study material had a positive impact on their success rate despite the fact that students did not attend day classes as offered by other engineering schools in South Africa.
6. It is evident from the results of this study that the addition of a personalised component to online teaching in the form of e-tutors and "face-to- face" tutors who assisted students by means of electronic communication enhanced the success rate of students. These strategies were all implemented in order to more "personalise" the tuition, while simultaneously providing extensive study material and references to good open source material as are available on the Web. It is believed that the face-to-face intervention in addition to online teaching (the blended approach), had a positive impact on the success rate of the students.
7. It is believed that the implementation of more of these strategies in the South African higher education scenario, could empower future "foundation" students significantly. Visionary leadership and closer cooperation between government, local municipalities, local industries, microenterprises and community leaders can enhance some of the success trends in this study, promote job creation and ensure economic growth and social upliftment.

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