Using blended teaching to overcome millennial classroom barriers

Faculty of Engineering

Project: Blended teaching and learning in Engineering
Vice-Dean: Teaching: Prof Anton Basson ahb@sun.ac.za
Blended Learning Coordinator: Dr Moira Bladergroen mbladergroen@sun.ac.za

Context

Background overview

With the maturing of our democracy, the demographics of student enrolments at Stellenbosch University have changed at a rapid pace and class sizes have increased at an alarming rate. The lecturer: student ratio has consequently become unbalanced. Add to this the challenging research output requirements for lecturers and you have a recipe for burnout and dissatisfaction with the teaching-learning context.

During 2014, Faculty management therefore embarked on a process of collaborative planning to evaluate the usefulness of a blended teaching and learning (BTL) approach in the Faculty. During 2015, a blended learning coordinator was employed to start the process of the thoughtful integration of a BTL pedagogy in the modules offered at the Faculty.

The implementation process of the project followed a top-down approach, i.e. the idea of BTL was embraced by the broader institution as a whole. The Vice-Dean: Teaching collaboratively developed the Faculty's own unique broad aims and objectives in line with those of the tertiary institution at large. The various departmental heads were encouraged (1) to identify their unique challenges and (2) to identify participants whose workload was heavy and who could therefore benefit from a blended learning approach.

The modules that formed part of the project were identified according to the following criteria:

- Modules with a high lecturer: student ratio (e.g. 800 students per module).
- Modules with a traditionally a low pass rate.
- Lecturers with information and communication technology (ICT) interventions that they wanted to put through a trial run. The focus for such a trial run had to be increasing student throughput whilst still maintaining the high-quality teaching and learning experiences of the students.

The lecturers chose their own blended learning intervention strategies. During the run of the project, additional members joined on the basis of their interest in the new and innovative use of technologies in the classroom. After each year of implementations (i.e. 2015 and 2016), questionnaires were used to gain information on students' perceived experiences on the implementation and use of BTL.

**Figure 1: New and innovative uses of technology

Project objectives

The objectives of the project were (1) to improve the teaching productivity of lecturers given the large, diverse class sizes and the demand for higher research outputs, (2) to improve the learning productivity of students by, amongst others, creating available time whilst still maintaining or improving educational standards and the throughput rate and (3) to make students more accountable for their own learning. In addition, assistance was needed by students who were lagging behind because of limited one-on-one time with lecturers and tutors.

Established practice

In the past, most lecturers followed the traditional face-to-face approach using the chalkboard as their main teaching tool. A large number of the lecturer participants also used the Socrates method of teaching (i.e. the question-and-answer approach). They furthermore preferred PowerPoint presentations when presenting their lectures in the formal lecture style.

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The challenge

Although the Faculty is located in a developing country, it has not escaped the impact of the millennials, also referred to as "digital natives" (Prensky, 2001). A study done by Howe and Strauss (2009) suggests that millennials use digital technologies more than their parents and that they use social media extensively. Prensky (2001) suggests that the single biggest problem facing education today is "our digital immigrant instructors, who speak an outdated language (that of the pre-digital age) and are struggling to teach a population that speaks an entirely new language".

The Faculty itself is dealing with students who are "used to receiving information really fast; like to parallel process and multi-task; prefer their graphics before their text rather than the opposite; prefer random access (like hypertext); function best when networked; thrive on instant gratification and frequent rewards, and prefer games to 'serious' work" (Prensky, 2001). On the other hand the digital immigrant instructor tends to stand with one foot in the past whilst adapting to the new digital environment. This tendency makes the lecturer from the traditional teaching and learning era an ideal candidate for a BTL approach.

The Faculty has an added challenge to that of the trendy millennials, namely the impact of a socio-culturally diverse cohort of students. The remnants of the apartheid system and the failure in education of the new democratic government have led to the output of students with varied secondary-education development. This disparity has caused a mismatch of tertiary-education successes on tertiary level. The Faculty has been hard-pressed to rethink the didactics of engineering teaching and learning.

Advantages associated with the integration of technology

By implementing this project with the hope of driving the introduction of BTL, the following advantages may be obtained:

- The trial run of an innovative teaching method, since traditional teaching methods are no longer appropriate.
- The transfer of knowledge to develop the level of understanding of students and their application of skills and for them to express this in a reflective way.
- Assistance in the professional relationship between lecturer and student, i.e. encouraging students to participate and engage in the teaching and learning moment.
- The improvement of the critical thinking skills of students.
- The improvement of the applied knowledge of students, i.e. bridging the theory-practice divide.
- The management by students of their own learning, i.e. learning in their own time and space and at their own pace.

Other relevant role-players

This case study involved all five departments in the Faculty. See Table 1 below for the participating lecturers and modules.

Table 1: BTL participating academic staff and modules for 2015 to 2016

Lecturers	Modules	Lecturers	Modules
Corné Coetzee, Debby Blaine, Dawie van den Heever, Jacques Miuyser, Piero Trinchero	Engineering Drawing 123	Johann de Swardt	Design (e) 344
		Joubert van Eeden	Industrial Management 354
Billy Boshoff, Roman Lennet	Strength of Materials 143	Percy van der Gryp	Chemical Engineering 354 (Reaction Engineering II)
Gideon Wiid, Jacky Gilmore	Electro-Techniques 143	Willie Smit	Modelling 334
Carl Tshamala	Thermodynamics 214	Lidia Auret, Tobi Louw	Chemical Engineering 344 & 426
Debby Blaine	Material Science A 244	Louzanne Oosthuysen	Industrial Practice 442
Johann van der Spuy	Fluid Mechanics 244	Mike Owen	Heat Transfer A414
Stephan Matope	Manufacturing Processes 244	Richard Walls James Bekker	Structural Design 424 Simulation 442

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The blended learning coordinator (BLC) was an active participant in the preparations of the BTL interventions and in the executions of the questionnaires. The direct and active involvement of the Vice-Dean in this large project gave the participants the necessary authority, access to resources and the uniformity of Faculty hierarchy. This was specifically significant to encourage collaboration and collegiality amongst the participants. The departmental managers played an active role in encouraging the lecturers and giving them the freedom to be creative and innovative in their interventions.

Learning and assessment activities

Educational approach

The project is firmly based on a constructivist view of teaching and learning. The project methodology is also guided by a constructivist epistemology, where epistemology is concerned with the nature of the knowledge generated in the research. The researchers' constructivist epistemology allows for the generalisation of results within the engineering context.

Learning and assessment activities

The learning activities were module and intervention-specific. The following learning activities were trialled, as presented in Table 2 below:

- Vodcasts that focus on key background information. The aim with these videos was to ensure that all students, irrespective of socio-economic or educational background, have the same basic understanding of key concepts and principles required at the start of the module.
- Podcasts of revision lectures for first years and of modules with a high impact value in the second year of Engineering studies.
- Vodcasts of strategic problem-solving activities for students to use in their own time, thereby creating more time for more contact face-to-face lectures.
- Demonstration videos to assist students in their preparation for laboratory practicals.
- Videos that pre-empt possible questions (taken from traditional experiences) and that may assist students in their problem-solving activities during tutorials.
- Strategic videos that demonstrate practical activities in the world of work.
- Simulation videos that illustrate the practical application of the theory.

Live lecture video recordings	Videos of key topics and/ or formative assessments	Videos as preparation for lab practicals	Various
Engineering Mathematics 242	Numerical Methods 262	Building Materials 254	Industrial Management 354 (Wiki for group work)
Strength of Materials 143	Chemical Engineering 344	Design (e) 344	Industrial Practice 442
Numerical Methods 262	Fluid Mechanics 244	Electro-Techniques 143	
Revision lectures (different modules)	Manufacturing Processes 244	Control Systems 354	

Table 2: Examples of implemented project initiatives

Learning environment

Technology resources

All resources and activities were run from SUNLearn. The following technology resources were used: document cameras, video camera laptops, Camtasia Studio, Format Factory, YouTube and videos from partner universities.

Support challenges

The lecturers were supported by the BLC and the IT specialist (Mr Andre du Toit) assigned to the Faculty. The students were supported through

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the process set out by the Faculty for student learning. Particular support included collaboration with departmental managers to identify and contact specific lecturers who could be supported largely by the BTL initiative.

Student experience

Student feedback on the learning experience

A questionnaire was created to explore the students' experience of the BTL interventions. The questionnaire was distributed through three main ways, namely hard copy and electronic means using SUNLearn and SurveyMonkey software. It was left to the lecturers to decide how the data in their modules should be collected; the questions were all identical irrespective of the mode of data collection. The questionnaires were all completed during the last two weeks before the completion of a module; some modules ran in the first half of the year and other modules in the second half of the year.

The first set of questions explored the time that students spent per week on BTL interventions and, if they did not have any interventions, whether they would have spent more or less time to achieve the same level of learning. The second set of questions explored the reasoning behind students' quantitative responses. The questions explored whether the BTL interventions affected the way in which they learned, how much they learned and what they found most helpful and least helpful in the BTL interventions.

The empirical analysis revealed that students from all four academic year groups viewed the innovative BTL experiences as positive. The average amount of time spent on these interventions varied from thirty minutes to two hours. The time spent was determined by the students' own need either for information to assist their study processes or to consolidate information, deepen understanding and subsequently learn more, faster. Motivation and aspiration for time spent were internal, as the BTL interventions did not specify the time to be spent on them.

The technology uptake produced weighty positive experiences and the need for flawless technology exposure is worth mentioning. At the time of the project, the ICT available to staff was limited and fairly dated. The findings support the need to fast-track ICT infrastructure, since students see the interventions as a means to solve perceived challenges with a large curriculum.

**Figure 3: Students valued the opportunities that the learning technologies provided

General

Opportunities

Students' main arguments for the continuation of the interventions was the ability to study in their own time and space and at their own pace and having a back-up system during unforeseen circumstances or when they needed to consolidate, confirm or revise content for formal testing, tutorials and practicals.

Even though one specific group indicated that more time was spent on the interventions, it is significant to note that (1) the interventions replaced the traditional project approach and that (2) students, by their own accounts, highlighted the opportunity to merge theory and practice, thereby deepening their learning, understanding and practical skills. Therefore

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despite more time spent on the interventions, the students preferred the interventions to remain as a method for formative and summative assessment.

Challenges

Even though students did not complain about any negative experiences with the lecturers' presentations themselves, it may be useful to invest in a well-structured ICT system, since negative technical aspects could overshadow any other negative impacts of BTL interventions. A longitudinal study will give insight into this currently novel intervention.

Although lecturers used technology in one way or another before the BTL interventions, they felt challenged by the following issues:

- Context-specific issues, such as large classes, work overload and pressure to publish in accredited academic journals.
- Knowledge-transfer challenges: The University at large is a research-based university and very little time is available for academic staff to be truly innovative in their teaching and still to do justice to their research outputs. Pressure exerted by management for research outputs has led to the neglect of teaching and learning initiatives.
- Didactical challenges: Lecturers felt ill-prepared to teach, even though they were experts in their subject matter.
- Lecturers felt the need to act as external motivational agents and struggled to hand students control of their own learning.

Advice

Good collaboration among the departments regarding their modules and BTL interventions is of high importance as students have limited study time available. The time management of the curriculum where BTL teaching and learning are used needs to be explored more.

Other concluding thoughts

The engineering curriculum across the globe is often perceived as very broad and students often feel overwhelmed by the degree of theoretical and practical work. With class sizes, student diversities and millennial needs that are rapidly increasing and the pressure on lecturers to produce research outputs, students often feel discontent with their academic outcomes. BTL intervention offers an opportunity to evaluate teaching and learning strategies and to alleviate the above-mentioned challenges. There is still, however, a need for face-to-face exposures and lectures, which is not unexpected since face-to-face teaching and learning have been the mode of exposure for these students for more than 12 years of formal schooling.

References

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