Proceedings of the Second Biennial Conference of the South African Society for Engineering Education

11 – 12 June 2013

Vineyard Hotel
Cape Town, South Africa

Edited by Brandon Collier-Reed

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Message from the President of SASEE

It is my great pleasure to welcome you to the second biennial conference of the South African Society for Engineering Education (SASEE). SASEE was formally launched at its first conference held in 2011, and the two years have rolled around in a busy way. Two workshops were held in 2012, to keep the momentum going – one on curriculum and another on teaching large classes. We have been delighted at the attendance and engagement so far at SASEE events, and the emergence of this dynamic community.

We have had a very good response to our call for papers for this conference and we have an interesting three day programme lined up. This year we headlined our call with the theme of "Teaching professionals / Professional teaching: towards an ethical, efficient and engaged engineering education" and we look forward to discussions that respond to this challenge. We are aiming a focus towards the building of professionalism in engineering education, interrogating not only efficiency (the current focus on throughput) but also the ethical basis for our teaching and the need for engagement.

The stunning Vineyard Hotel will form the backdrop for our deliberations. We particularly welcome all out of town guests to Cape Town! We are hoping for critical engagement with the current challenges we face in engineering education as well as the presentation of innovative work that is designing and trialling new ways forward. The SASEE conference is an important coming together of both research and practice-based scholarly work, covering topics at all the levels of policy, curriculum, and teaching and learning.

We are particularly grateful to our sponsors who have assisted in making this event happen. ECSA (The Engineering Council of South Africa) has played an on-going role in supporting SASEE at so many levels and we are also delighted that this year they have sponsored the Welcome Reception. We are pleased to welcome a new sponsor in FNB Platinum who made a generous contribution. Finally, we would also like to thank our exhibitors, Oxford University Press and Juta, for their participation in this event.

Prof Jenni Case
President, SASEE

Conference Review Procedure

These proceedings are a published record of the Second Biennial Conference of the South African Society for Engineering Education (SASEE). The purpose of these proceedings is to disseminate original research and new developments within the discipline of Engineering Education.

All papers and extended abstracts accepted for this conference went through a multiple- review process *prior to publication*. Authors initially submitted extended abstracts which were double-blind reviewed by at least one member of the SASEE or Centre for Research in Engineering Education Executive. Based on the outcome of this review, authors were invited to either develop this extended abstract into a full paper, or were invited to revise their extended abstracts based on the reviewers comments for resubmission. The resultant papers and extended abstracts were then further reviewed by at least two reviewers using a double-blind peer review process. Authors were required to consider and implement the suggested changes where required.

The reviewers for the papers and extended abstracts were drawn from the SASEE Executive, SASEE membership, and the Centre for Research in Engineering Education (CREE) as appropriate.

The rejection rate for full papers was **14%** and for extended abstracts was **13%**.

SASEE Biennial Conference Organising Committee, 2013

Prof Jenni Case UCT)

Dr Debby Blaine (US)

Dr Keith Jacobs (UNISA)

A/Prof Brandon Collier-Reed (UCT)

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An investigation into causes of poor performance in a final level course in Mechanical Engineering

B.R. Graham[1] & M. Walker[2]
Department of Mechanical Engineering, Faculty of Engineering and the Built Environment, Durban University of Technology, P.O. Box 1334, Durban, 4001, South Africa
[1]bruceg@dut.ac.za, [2]walker@dut.ac.za

As engineering educators many of us still teach in the manner in which we were taught. We need to question whether these pedagogies are relevant for current students (Felder, 2012) and understand their weaknesses before adapting teaching practices. This paper will explore methods that were used, by the first author, in the course Hydraulic Machines III, to better understand the competencies and learning practices of the students in the class. The study was non experimental and both quantitative and qualitative in nature. The framework under which the research was carried out was grounded action research.

A grounded theory is one that "is inductively derived from the study of the phenomenon it represents" (Corbin & Strauss, 2007) whilst action research is evaluative and reflective with the aims of improving practice (Burns, 1999). Grounded action research is a process of continual discovery, learning, rediscovery, and relearning (Simmons & Gregory, 2003). Its purpose is to develop an operation theory from the grounded theory and hence to create and apply practical solutions to social problems. This framework allows the freedom to refine an investigation as it progresses as well as to implement potential solutions and determine their efficacy.

Over the preceding four semesters, conceptual and theory questions were added to assessments in order to test students' understanding of the material, its applicability and context, rather than their ability to 'plug and chug'. Anecdotal evidence suggested that students could answer calculation problems adequately, but struggled with conceptual and theory problems. This paper shows that students, by and large, appear to struggle most with both conceptual questions and questions relating to the hydraulic machines section.

In order to determine if performance was generally poor, limited to certain sections of the syllabus, or related to certain question types such as calculations or conceptual problems, the performance of students in individual questions in the June 2012 exam was recorded.

Analysis showed performance in calculation problems to be much better than in conceptual ones. The average score for all calculation problems, bar one, was significantly higher than those for conceptual problems. The calculation question with the worst performance was the section covered last in class and not assessed in tests. Students under pressure as the exam approached may have opted to ignore this section and concentrate on sections they were more familiar with.

After this initial study it was decided to rearrange the syllabus, covering this section earlier, to see if this would improve results. Extra resources such as videos, tutorials, examples and quizzes were added to the subject's online platform to support this section and to provide support with regard conceptual questions.

The following semester's tests and exam results were analysed to see if these interventions were successful. Analysis of test results showed no real change. To determine why these interventions were not successful students were surveyed, and data from the online platform analysed to determine the extent that online resources were utilised. Usage was found to be limited.

Analysis of the test results also showed that moving the section, previously covered last, did not have a positive impact on the students' results. Analysis of the subsequent exam once again confirmed this.

Based on the analysis of test results, and usage of the online platform, it was decided to interview students to see if any further light could be shed on the problems identified. Weaker students would be interviewed as future interventions would be aimed at students like these.
15 students who had not met the exam subminimum for the course were invited to be interviewed and 10 accepted. This was an informal interview held with the students on an individual basis. This group cannot be seen as representative of the class but it does well to represent the weaker students and help direct both future interventions and investigations.
The predominant study method utilised by these students was to work through past test papers. Test papers were chosen over exam papers due to the availability of full model answers. Prescribed tutorials were generally not attempted; the reasons given by most students were "*these have no answers"*.

When asked why they did not use the online examples the response can be summed up in the words of one student "*it's how we learn, we do past papers, we don't go online"*. When asked why other online resources such as videos and quizzes were not used, the consensus was that they did not see any value in doing this '*extra work'*.

All of the students indicated that they would attempt calculation problems before attempting theory/conceptual questions. A minority even admitted that even if the theory questions were very easy they would not know as they would not read the question until they had answered all calculations questions first. When questioned as to why he didn't engage with the conceptual questions one student replied "*our minds are not programmed to think like that*".

Perhaps a self-reinforcing loop may be present within the department. If in lower level subjects a student is expected to answer only calculation questions, the weaker student will practice calculations at the expense of understanding the context and applicability. By the time he reaches final level subjects he has developed, up until this point, a 'successful' method of study.

Although the information gathered from the interviews cannot be applied to the class as a whole, it does indicate that further research should be undertaken to determine the prevalence of these attitudes and study methods within the class as a whole. Further research and a change in teaching methods and assessment practices, within the subject and the department, are needed to address these concerns.

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