

# Outcome-based Module for Continuous Assessments in Engineering Education: Case Study Department of Electrical and Electronic Engineering Science at the University of Johannesburg

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**Abstract**—A big challenge for all engineering universities is the high quality of their graduated students to match the professional engineering qualities that industry need. In South Africa, the Engineering council of South Africa (ECSA) always asked for proof of evidence that students have demonstrated their capabilities to pass all the knowledge areas in each one of their modules in their engineering degree curriculum. The department of electrical and electronic engineering science at the University of Johannesburg has introduced a new continuous assessment framework based on outcomes in the offered modules. This framework allows for a deeper assessment of knowledge. Advantages and disadvantages of this new assessment scheme are discussed in this paper as well as the solutions proposed to make it a flexible and successful for all students.

**Keywords**—Education, Engineering, Assessments, Throughput, Module.

## I. INTRODUCTION

Since 2011 the Department of Electrical and Electronic Engineering Science at the University of Johannesburg moved to a continuous assessment framework based on outcomes in the offered modules. This framework allows for a deeper assessment of knowledge.

The department changed its assessment strategy from the traditional summative assessment model consisting of semester tests and an examination to a more fine grained outcomes based continuous assessment model [1]. Each module or course was divided into a set of outcomes which encompassed key knowledge areas in the module. During the course of the semester three smaller formative assessments were designed and implemented for each outcome.

To pass a module the student would have to pass each outcome in that module separately. Although this process allowed us to ensure that students had demonstrated their grasp of each knowledge area in that module and that students could not slip through the module on an average mark by mastering one section of the work and not another the process revealed the heavy load placed on the students shoulders. The solution for this will be discussed in the coming sections and we will

show how we could adjust this assessment scheme without changing its core and main goal.

During 2015 academic year, I have had the opportunity to lecture three modules for my third year students, I have lectured Signals and Systems (SST3A11), Digital Signal Processing (SIG3B01) and Telecommunications (TEL3B01) modules, where students study analog signals and systems, digital signals and systems and analog modulations respectively.

Since 2011 until first semester of 2015, I used to follow the classic scheme of assessment suggested by the department, which heavily burdened both students and lecturers. This was noticed during both students' preparations for their tests and the little time lecturers had to provide more assistance to their students due to the overwhelming administration responsibilities generated by the new assessments system. As a result of this and despite the extra effort I usually do during my lectures, the throughput rates for my modules are always 65% to 80%. Therefore, I decided to present a new assessment scheme to improve my throughput rates, save time for my students and myself and to improve the quality of my lecturing and skills. Very good results have been achieved and the throughput rates scored high values even 100% as will be explained in details in the coming sections.

The paper is organized as follows. A coverage of the assessments methods that have been used during the academic year of 2015 is presented in Section II. Finally, a conclusion summarizing the achievements which led to the improvement of the throughput rates is presented in Section III.

## II. ASSESSMENTS

The department of Electrical and Electronic Engineering Science changed its assessment strategy from the traditional summative assessment model consisting of semester tests and an exam to a more fine grained outcomes based continuous assessment model. Each module was divided into a set of outcomes which encompass key knowledge areas in the module and which could also be seen as a chapter with a common theme. The system is considered to be efficient in terms of knowledge acquisition and serves as a guarantee to the

| Assessments  | Kind of Assessment | Assessment Details             | Assessment Weight                | Outcome Weight |
|--|--------------------|--------------------------------|----------------------------------|----------------|
| <b>Outcome A</b>   |                    |                                |                                  | <b>25%</b>     |
| Assessment 1   | Writing assessment | Problem Solving and Derivation | 70% Exemption<br>0.7Max1+0.3Max2 |                |
| Assessment 2   | Practical          | Problem Solving and Derivation |                                  |                |
| Assessment 3   | Writing assessment | Problem Solving and Derivation |                                  |                |
| <b>Outcome B</b>   |                    |                                |                                  | <b>25%</b>     |
| Assessment 1   | Writing assessment | Problem Solving and Derivation | 70% Exemption<br>0.7Max1+0.3Max2 |                |
| Assessment 2   | Practical          | Problem Solving and Derivation |                                  |                |
| Assessment 3   | Writing assessment | Problem Solving and Derivation |                                  |                |
| <b>Outcome C</b>   |                    |                                |                                  | <b>25%</b>     |
| Assessment 1   | Writing assessment | Problem Solving and Derivation | 70% Exemption<br>0.7Max1+0.3Max2 |                |
| Assessment 2   | Practical          | Problem Solving and Derivation |                                  |                |
| Assessment 3   | Writing assessment | Problem Solving and Derivation |                                  |                |
| <b>Outcome D</b>   |                    |                                |                                  | <b>25%</b>     |
| Practicals: Reports and Matlab programming                     |                    |                                |                                  |                |
| <b>Final Mark</b>  |                    |                                |                                  |                |
| <b>Average (Outcome A + Outcome B + Outcome C + Outcome D)</b> |                    |                                |                                  | <b>100%</b>    |

Table 1: Structure for Assessments used for SST3A11 Module

| Assessments  | Kind of Assessment | Assessment Details             | Assessment Weight | Outcome Weight |
|--|--------------------|--------------------------------|-------------------|----------------|
| <b>Outcome A</b>                                   |                    |                                |                   | <b>33%</b>     |
| Assessment 1                                       | Writing assessment | Multiple-Choice + Theory       | 30%               |                |
| Assessment 2                                       | Practical          | Report + Demonstration         | 30%               |                |
| Assessment 3                                       | Writing assessment | Problem Solving and Derivation | 40%               |                |
| <b>Outcome B</b>                                   |                    |                                |                   | <b>33%</b>     |
| Assessment 1                                       | Writing assessment | Multiple-Choice + Theory       | 30%               |                |
| Assessment 2                                       | Practical          | Report + Demonstration         | 30%               |                |
| Assessment 3                                       | Writing assessment | Problem Solving and Derivation | 40%               |                |
| <b>Outcome C</b>                                   |                    |                                |                   | <b>33%</b>     |
| Assessment 1                                       | Writing assessment | Multiple-Choice + Theory       | 30%               |                |
| Assessment 2                                       | Practical          | Report + Demonstration         | 30%               |                |
| Assessment 3                                       | Writing assessment | Problem Solving and Derivation | 40%               |                |
| <b>Final Mark</b>                                  |                    |                                |                   |                |
| <b>Average (Outcome A + Outcome B + Outcome C)</b> |                    |                                |                   | <b>100%</b>    |

Table 2: Structure for Assessments used for SIG3B01 Module

| Assessments   | Kind of Assessment | Assessment Details             | Assessment Weight | Outcome Weight |
|---|--------------------|--------------------------------|-------------------|----------------|
| <b>Outcome A</b>  |                    |                                |                   | <b>35%</b>     |
| Assessment 1  | Test               | Quiz                           | 20%               |                |
| Assessment 2  | Test               | Multiple-Choice + Theory       | 30%               |                |
| Assessment 3  | Test               | Problem Solving and Derivation | 50%               |                |
| <b>Outcome B</b>  |                    |                                |                   | <b>35%</b>     |
| Assessment 1  | Test               | Quiz                           | 20%               |                |
| Assessment 2  | Test               | Multiple-Choice + Theory       | 30%               |                |
| Assessment 3  | Test               | Problem Solving and Derivation | 50%               |                |
| <b>Practical</b>  |                    |                                |                   | <b>30%</b>     |
| <b>Practical</b>  | <b>Project</b>     | Report                         | 30%               |                |
|   |                    | Hardware implementation        | 70%               |                |
| <b>Final Mark</b>                                       |                    |                                |                   |                |
| <b>0.35*Outcome A + 0.35*Outcome B + 0.3* Practical</b> |                    |                                |                   | <b>100%</b>    |

Table 3: Structure for Assessments used for TEL3B01 Module

industry, demonstrating our students' capabilities to pass all the knowledge areas in each module.

Students have three assessment opportunities to pass the outcome. During the course of the semester three smaller formative assessments were given for each out-come. To pass an outcome a student has to achieve a 50% mark in two of the assessment opportunities or a 70% mark in one of the opportunities. The philosophy was that the student could fail one opportunity and use the experience gained from that opportunity to pass subsequent assessments. The 70% threshold was instituted to allow students that have mastered a given outcomes knowledge to be able to demonstrate their knowledge once and then be able to focus on the remaining work [1].

Personally I started using the outcome-based assessments since 2011. In 2015 I had the opportunity to lecture three courses to third-year students, Signal and Systems (SST3A11) in the first semester and two other modules in the second semester, Digital Signal Processing (SIG3B01) and Telecommunications (TEL3B01).

After almost five years of using the outcome-based assessments, I decided in 2015 to evaluate this assessment scheme and to develop another assessment scheme using different assessments styles. This was to avoid the heavy load caused by the outcome-based assessment and the type of questions offered to students.

In my first semester course, Signal and Systems, I applied the departmental assessment module, considering the practicals as an outcome on their own. The scheme of calculating my students' marks is depicted in the table shown in Table 1. It can be seen that students have three outcomes and practicals, where three assessment opportunities are offered to students with same way and type of questions, the problem solving and derivation.

In the second semester for my SIG3B01 module, I applied a different assessment scheme from the one used with SST3A11 module. In this case I retained the three assessment opportunities to meet the ECSA requirements but this time I considered the practicals as one of the assessments. This reason for dropping the number of assessments was that they usually create a heavy load on students and affect their results and therefore the throughput rate. Another modification was to give different varieties of assessments that did not focus only on one type of assessment, as in the previous scheme, as problem solving and derivation. I introduced a multiple-choice type of assessment to cater for all different students' choices. This choice of assessment was fair for students who are not comfortable with problem solving as the only type of assessment. Since different types of questions require different time allocations, I adjusted the percentage of each assessment mark to the final mark. The final students' marks are calculated as shown in Table 2.

In the case of TEL3B01 module I kept the same assessment style for SIG3B01 but moved the practicals on their own - not as in the case of SST3A11 - but to the form of a small project that contributed a certain percentage to the final mark of the module. The idea behind this was to give a chance to students

to do a separate project and submit it at the end of the semester and to take advantage of the practical allocated time to do revision or any kind of homework. As a result of this new model and to be consistent with the ECSA's assessment requirement, a third assessment was required. Thus, I introduced the quiz assessment which carried a lower percentage to accommodate the rest of assessment types. The final students' marks are calculated as shown in Table 3.

A survey was conducted among my students to gauge their preferences and how comfortable they were with each of the assessment types. I preferred not to rely on the results only; I wanted them to express their views on this matter and to assist

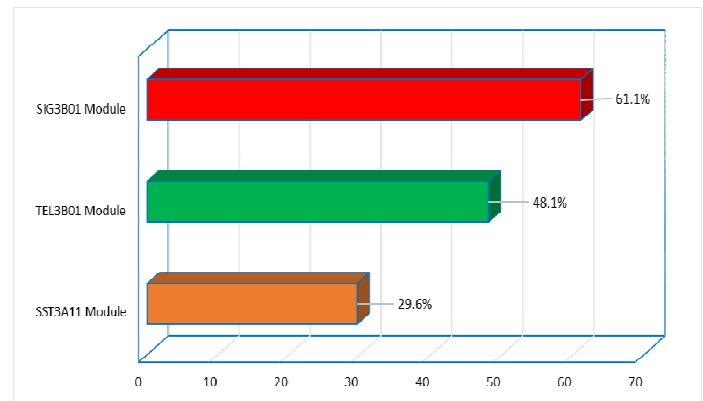


Figure 1: Students Evaluation of Modules Assessments Schemes

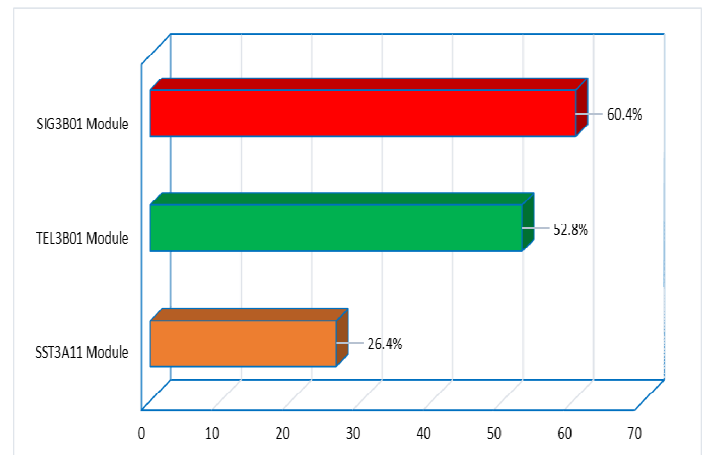


Figure 2: Students Preferences for the Assessments Schemes

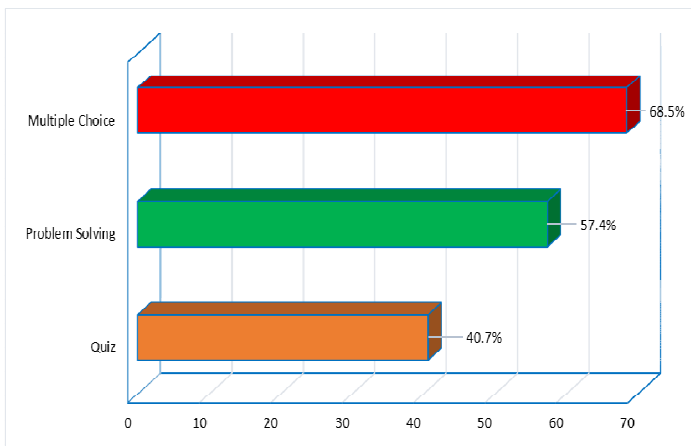


Figure 3: Students Preferences for the Kinds of Assessments

me in improving the proposed assessment schemes. Figures 1, 2 and 3 provide information on students choosing the right assessment scheme for their benefits and the type of scheme that helped improving their marks. It is clear that from Fig. 1, that students prefer the assessments tool used for SIG3B01 as the scheme that suits better the outcomes based assessment approach. From Fig. 2, it is clear that the assessment tool used with SIG3B01 is the one they feel more comfortable with.

Fig. 3 shows that multiple-choice assessment is the best choice for students which means that this assessment tool help them the most in getting better marks.

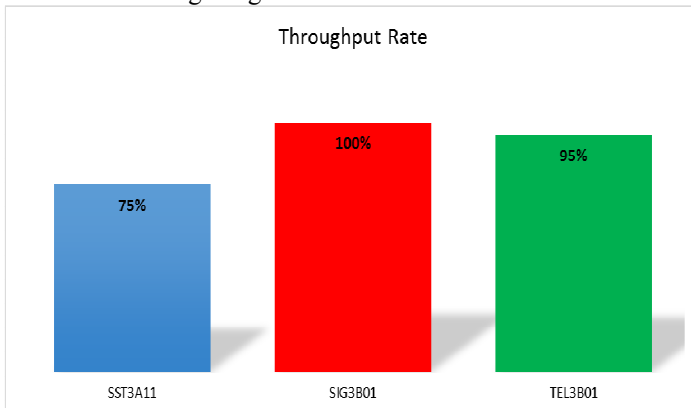


Figure 4: Throughput Rates of Different Modules

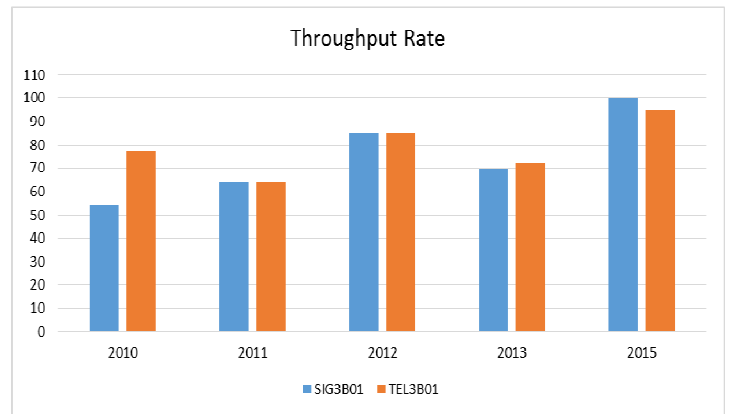


Figure 5: Throughput Rates from 2010 until 2015

### III. CONCLUSION

It is clear from the results presented in the previous results that outcome-based module for continuous assessments should have flexible assessments type as it was proved students prefer multiple-choice assessment and the use of practical as one of the three assessments. This helped off loading students with the number of assessments from each module.

The comparative results between my modules SST3A11, SIG3B01 and TEL3B01 lectured in 2015, show the proposed assessments schemes in 2015 is much better in improving the throughput of module than the classic assessment scheme used in previous years as presented in Figures 4 and 5.

### REFERENCES

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