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OBE FORMATIVE ASSESSMENT AS A TOOL TO IMPROVE LEARNER THROUGHPUT

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INTRODUCTION AND PERSPECTIVES

According to data for 2005 retrieved from the South African Department of Education internet site, 3574.5 learners were registered nationally for ND in the Chemical Engineering Technology field, while 278.33 diplomas were issued, which translates into a graduation rate (throughput ratio) of 8%. This can be compared to a 100% pass rate, where the graduation rate is 33%.

The SA YEARBOOK 2007/08 | EDUCATION contains the National Curriculum Statement (NCS) for schools, which is built on a number of principles including Outcomes Based Education (OBE). In 2008, school pupils are expected to write the National Senior Certificate examination. Although the National Plan for Higher Education (2001) does not mention OBE, academics in higher education institutions have been required to convert their study guides to OBE format and some (including the author) have received training in OBE to become assessors.

A preliminary study was performed at UJ in 2006 to gauge whether OBE methods could be implemented for large groups of learners. A test had been written that most learners found challenging, leading to a high failure rate. A supplementary assessment strategy based on OBE Formative Assessment was conceptualised to allow learners to improve their marks. The main findings of the preliminary study were that a large number of learners could be accommodated in the Formative Assessments and that the learners (and lecturer) were very positive about the process.

PURPOSE

Following the positive results of the preliminary study, it was realized that the OBE Formative Assessment strategy was potentially practicable and effective in ensuring that learners achieved the necessary standard of understanding. It was reasoned that this would lead to a significant increase in pass rate and distinctions.

LITERATURE REVIEW

According to Wikipedia, the free encyclopaedia on the WEB, OBE is a learner-centred learning philosophy that focuses on empirically measuring learner performance, which are called outcomes. Cowie and Bell ^[1] define Formative Assessment as the bidirectional process between teacher and learner to enhance, recognise and respond to the learning.

Letseka and Maile ^[2] contend that the graduation rate in South African universities is among the lowest in the world, and can be improved by support of poor learners and counteracting poverty and inequality.

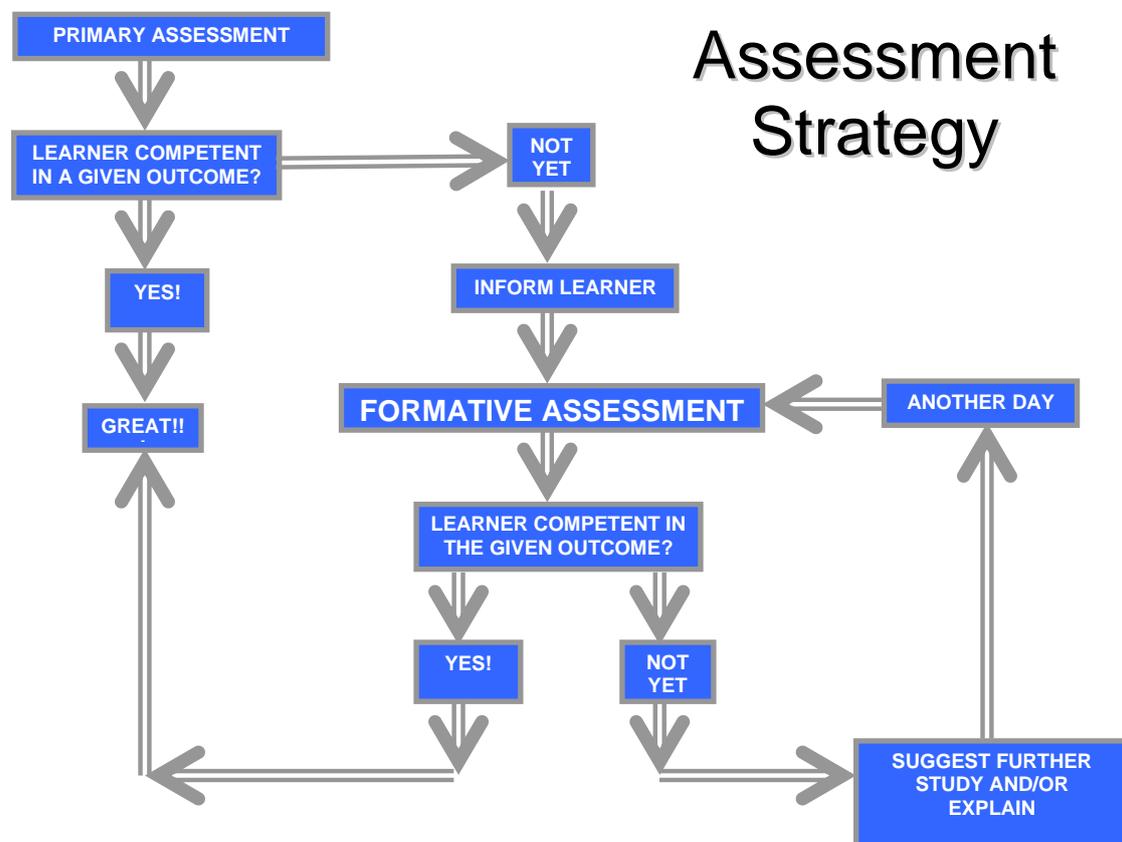
In the national plan for Higher Education in South Africa (2001), the Ministry of Education announced its intention to take steps at both the institutional and national levels to address the inefficiencies in the graduate outputs of the

higher education system. For this purpose, benchmark values for graduation rates have been set for the institutions to aspire to.

It is the author's contention that, in OBE, learners need to become competent in the outcomes of a course, no matter how long it takes. And that Formative Assessment can be the means by which the learners become competent. This in turn would allow the benchmark values to be achieved.

METHODOLOGY

An assessment strategy was conceptualized and a preliminary study (on a voluntary basis) was performed before implementation to ensure that an untried system was not put into practise without knowing the outcome:



The primary assessment was a standard test, while the Formative Assessment was conducted informally in the lecturer's office. If the learner was not competent in an outcome, (s)he had to come back on another day for a repetition of the assessment. The delay is meant to allow the learned skills to become part of long-term memory. In the preliminary study, total competence could be achieved for large numbers of learners, who were awarded a 50% mark for the test. The learners were also overwhelmingly in favour of the procedure employed.

The exercise was repeated for a following test as well, but here most failing learners did not volunteer, probably as they had already qualified to write the

exam. This indicated that, in order for the procedure to be implemented successfully, it had to be made compulsory. This was done by making it an entrance requirement to the exam (Summative Assessment) that followed. Management was informed and consulted on this matter and the necessary changes were made to the study guide.

At the beginning of the next semester, the learners were informed about the new procedure and the positive feedback received from the preceding peers. The belief that every one of them was going to pass the course was expressed. This was done in order to increase their enthusiasm for the Formative Assessment strategy.

In order to not overload the learners and lecturer time-wise, lectures were condensed - by half in some cases.

Multiple opportunities were set up for the Formative Assessments, and no limit was imposed on the number of times a learner could be assessed for a given outcome. This ensured that struggling but willing learners could also qualify for and perform in the summative assessment (exam).

In addition to awarding 50% to failing learners after successful completion of the Formative Assessment process, those that passed the test were awarded 75% (i.e. the Formative Assessment acted as a supplementary for a distinction) or 100% if they got a distinction. This provided some additional incentive to do well in the test and to partake in the Formative Assessment process. Hence the more academically able learners also benefitted from the procedure.

Towards the end of a semester, lists were published stating whether the learners qualified to write the exams (i.e. they finished the Formative Assessments) or not yet. The lists were updated on a regular basis so that the learners that were not yet competent could observe the increasing trend of qualifying learners and become more motivated to finish their own Formative Assessment. Learners that were falling behind in their Formative Assessments were identified and contacted to provide further encouragement. The stipulation that the Formative Assessment had to be completed before qualifying for the exam was rigorously applied.

Learners that failed the exam but qualified to write the supplementary exam were invited to discuss their performance in the exam and were encouraged to study for and pass the supplementary exam.

RESULTS AND CONCLUSIONS

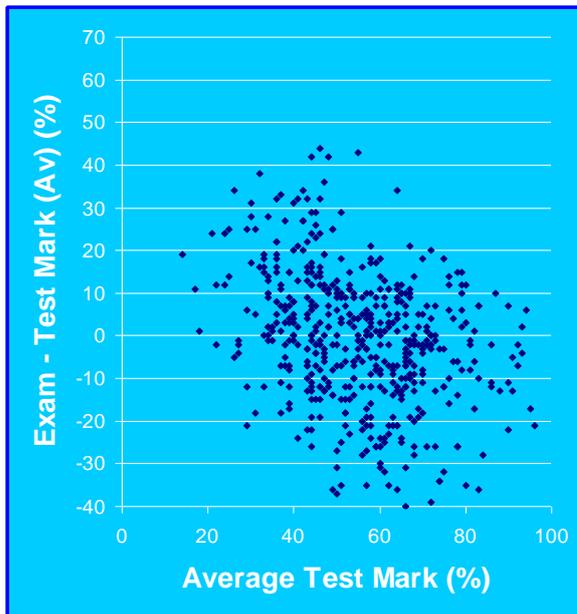


Figure 1 Mark improvements in three semesters before OBE

In Figure 1, the difference in the exam mark and the average test mark is plotted against the average test mark for each learner in the three semesters before OBE implementation. It can be seen that there is a lot of scatter in the data. The clear top right and bottom left can be explained by considering that if a learner has a high test mark, the scope for improvement is limited, while the opposite holds for a low test mark. On average, the difference

between exam and test marks before OBE is -0.5%; which is not really significant.

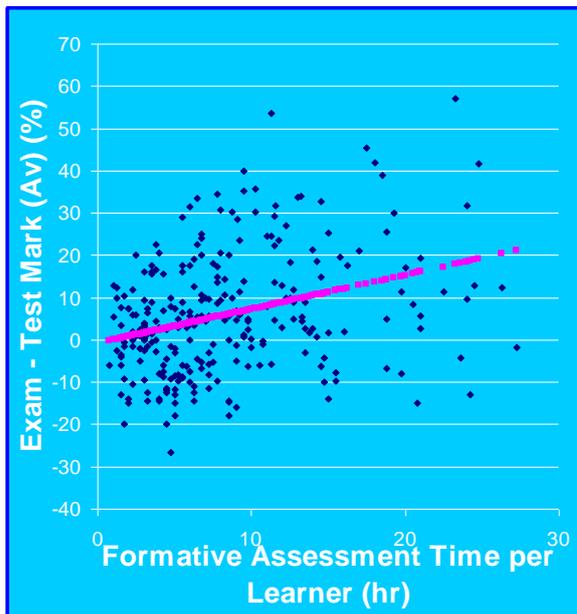


Figure 2 Mark improvements in three semesters with OBE

In Figure 2, the difference in the exam mark and the average test mark (before adjustment) is plotted against the Formative Assessment time for each learner for the three semesters with OBE implementation. It can be seen that there is a lot of scatter in the data, however there is an increasing trend. Linear regression was used to draw a line through the data points, and this indicates that for each 10 hours of

Formative Assessment undergone by a learner, the mark improvement is 8% on average. This line also passes close to the origin as expected. In all but one case, the drop in marks from the test to the exam is limited to -20%, whereas it can be seen that before OBE (Figure 1) a sizeable fraction of the learners experienced a drop of more than 20%.

| | Before OBE | With OBE |
|-----------------------------------|------------|----------|
| ● Pass Rate (Registered Learners) | 67% | 84% |
| ● Distinctions | 10% | 28% |
| ● Semester Mark-Exam Mark | 3.4% | 5.8% |
| ● Test Mark | 55% | 58% |

**Table 1
Comparative Data**

Average results from the three semesters before and the three semesters with OBE are given in Table 1. There is a significant increase in pass rate and distinctions, as was expected.

The semester mark before OBE typically was higher than the exam mark. This was also true with OBE, only more so by 2.6%. This is not thought to be significant, as it only increases the final marks by 1%. This is evidence that the marks awarded for the tests after completion of Formative Assessment (50%, 75% and 100%) are reasonable and justified.

The tests are written before Formative Assessment, and here it can be seen that there is a small increase in the average test mark before and after OBE. A factor that could increase this mark is an increasing trend in academic ability of learners accepted into the program. Perhaps learners are also more motivated due to the whole OBE Formative Assessment strategy. A factor that that would limit the increase in this mark is the shorter lecturing contact time that was introduced at the same time as the OBE based strategy.

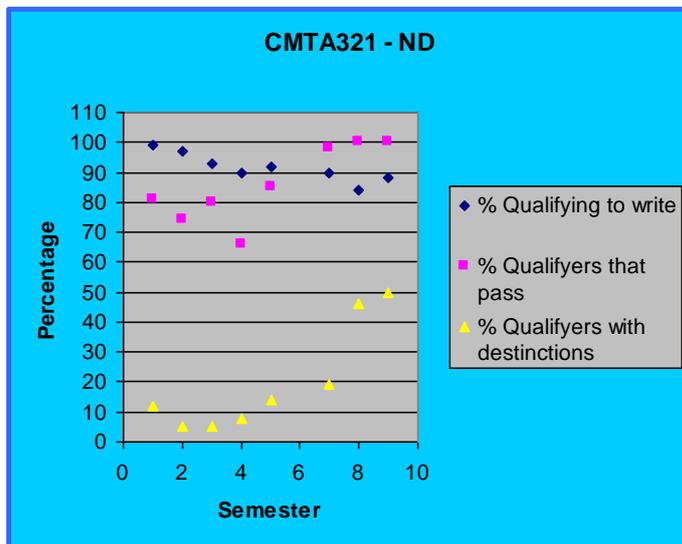


Figure 3 Longer Term History of Learner Performance in a Subject. OBE from Semester 7

The effect of the OBE strategy on the results obtained from a single ND course is given in Figure 3. Here it can be seen that almost all learners that complete the Formative Assessments pass the course. This result is

mirrored in all the courses with Formative Assessment. There is a small decrease in the fraction of registered learners that qualify, probably due to the increased demand placed on the learners to complete the Formative Assessment process.

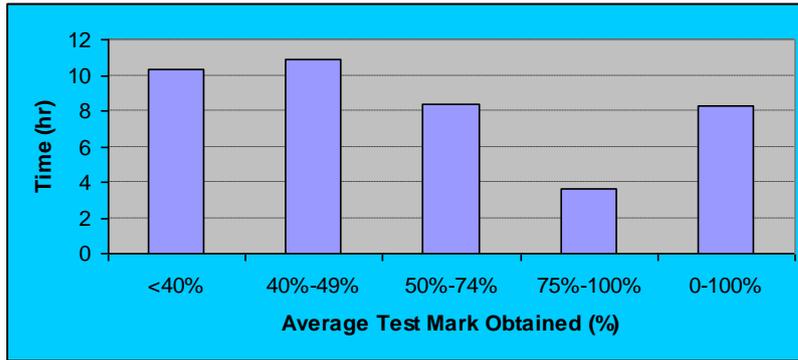


Figure 4
Average Time spent on Formative Assessment by a Learner

In Figure 4, it can be seen that the average time spent by a learner

in Formative Assessment is eight hours. This is compensated for by the decrease in lecturing time, which is about 12 hours.

Struggling learners (those that fail their tests on average) spend about 10 hours on Formative Assessment, while academically able learners (those that achieve distinctions) spend less time (< 4 hours). From Figure 1, struggling learners can spend up to 25 hours on the Formative Assessment per subject, and academically able learners can spend as little as 1 hour on Formative Assessment. The strategy has found favour with the learners. An open-ended question at the end of one of the learner surveys provided some feedback on the new method (see the Appendix).

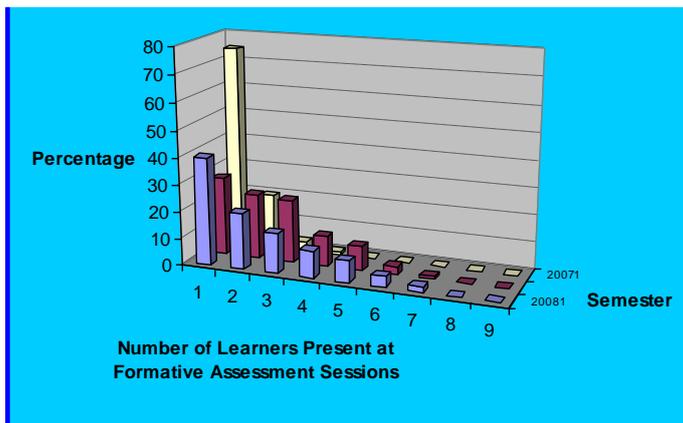


Figure 5 Number of Learners Present at Formative Assessment Sessions

In the first semester of OBE, most Formative Assessment sessions were held with one learner at a time. However, it was soon realized that it was possible and more

practical to allow more than one learner at a time. The average number of learners in a session was 2.5 for the last two semesters. In general, it has been found practical to handle four learners at a time. While feedback is given to one learner, the other three can be busy solving problems. Once the number 6 is exceeded, however, some of the learners may be idle and have to wait before feedback can be given to them, with a concomitant increase in pressure on the lecturer.

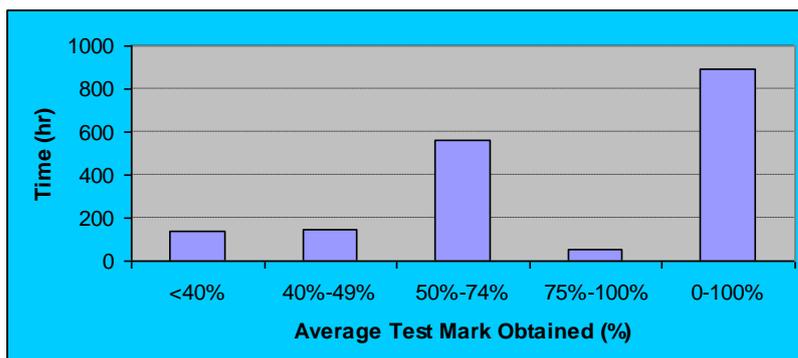


Figure 6 Total Time Spent by Lecturer on Formative Assessment in 3 Semesters for 2.5 Learners at a time

A total of 900 hours was spent by the lecturer on Formative Assessment. Of this time, 1/3 was spent on struggling learners, who make up about 25% of the registered learner body. The increase in proportionate effort does not appear to be so high as to justify more stringent entrance requirements.

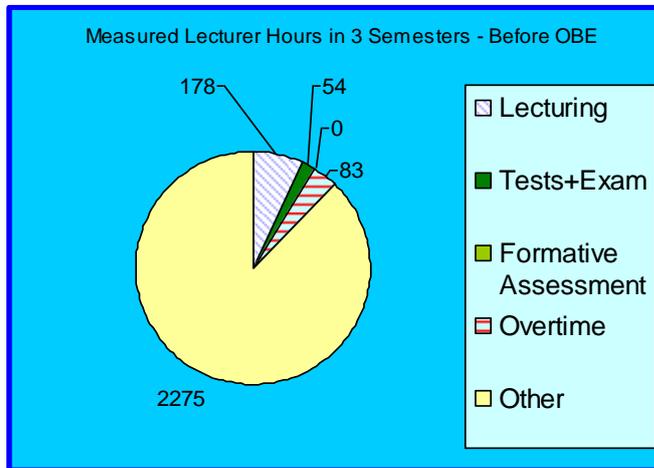


Figure 7 Distribution of Lecturer Working Hours Before OBE

From Figure 7, it can be seen that about 9% of the lecturer's time was spent interacting directly with learners in lectures, tests and exams. The values are the number of hours. Overtime is the time spent in excess of 8 hours per working day. The "Other"

time is time spent on academic administration, preparation and marking of assessments, preparation of lectures, learner projects, post-graduate learners etc. No time was spent on Formative Assessment, and the time spent on consultation with learners was minimal.

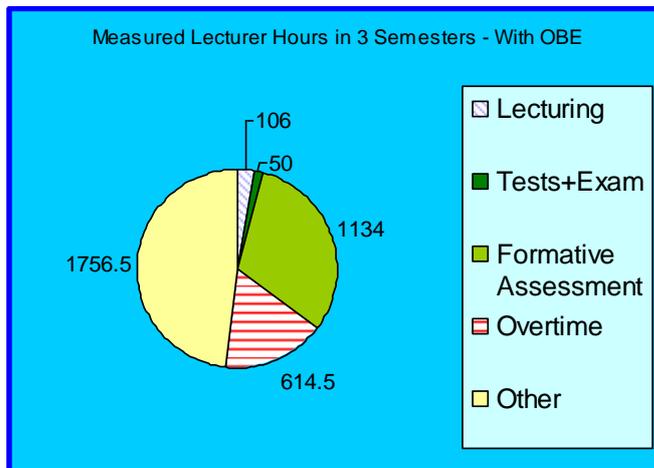


Figure 8 Distribution of Lecturer Working Hours With OBE

Due to the large number of learners, the Formative Assessment had a significant effect on the workload of the lecturer, leading to an increase in overtime. This effect was counteracted to some extent by spending less time on the "Other" activities.

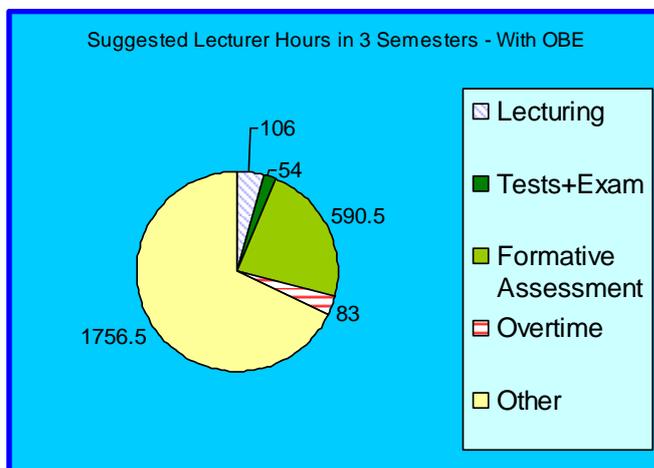


Figure 9 Suggested Distribution of Lecturer Working Hours With OBE

In Figure 9, it is suggested to reduce the overtime to levels before OBE while keeping the time spent on "Other" activities, lectures and assessments the same. This leads to time available

for Formative Assessment to be reduced to 590.5 hours per 3 semesters. This means 3 times more direct interaction with learners than without OBE.

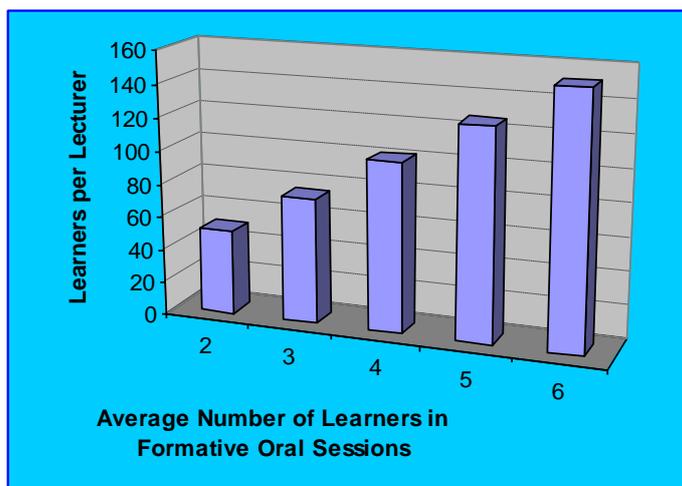


Figure 9 Number of Learners that can be handled by a lecturer for the Suggested Distribution of Lecturer Working Hours

The more learners that can be handled in a Formative Assessment session, the more learners can be handled by a lecturer. Presently, the average number is about 2.5, i.e.

from Figure 9, two groups of 30 learners each can be handled by a lecturer. However, it has been found that up to 4 learners can comfortably be handled at a time, and this would increase the group sizes to 50 each. To achieve this, the logistics of organising Formative Assessments would need to be improved. The number or length of Formative Assessment Sessions would have to be reduced while putting measures in place to ensure that more learners are present, e.g. by awarding marks for learners that honour appointments, or by delaying marking of subsequent tests until such time that learners have completed the previous test's Formative Assessments.

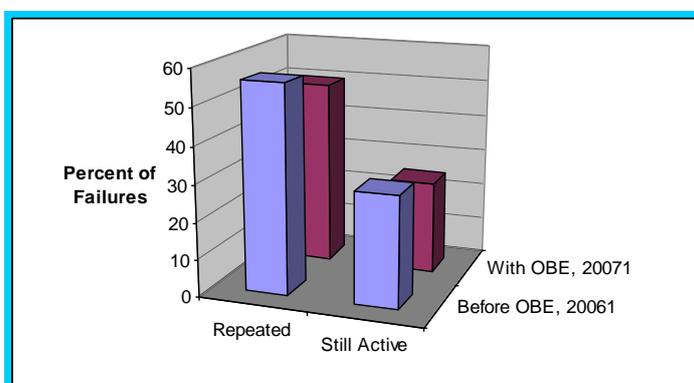


Figure 10 Percentage of Learners that Repeated their Course (CMTA321) after Failing, and Those that are Currently Registered for Chemical Engineering

From Figure 10, it can be seen that about 50% of learners repeated the course (CMTA321 – ND),

regardless whether OBE was practised or not.

In order to gauge the effect of increased pass rate (84% with OBE vs 67% before OBE), a simple model was set up. The percentage of learners that passed a semester in the first two years was assumed to be the same as the pass rate for a single subject (84% vs 67%). 50% of the failing learners were assumed to repeat the course in the following semester (see Figure 10). All learners were assumed to pass the two semesters of practical training in the final third year (P1 and P2).

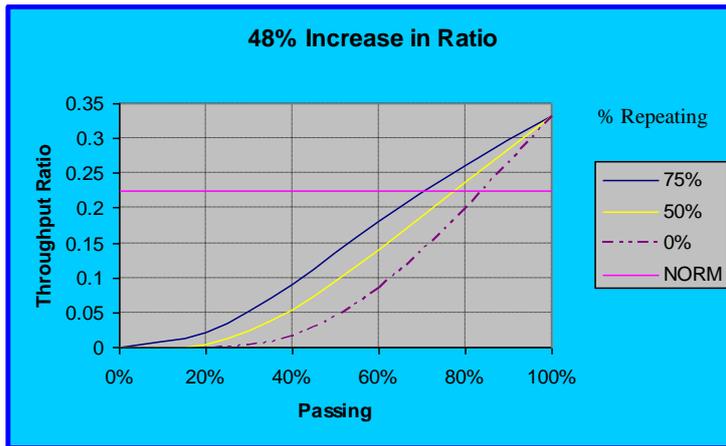


Figure 11 Effect of Pass Rate on Throughput Ratio

The throughput ratio is equal to number of diplomats divided by the number of learners registered for the year. In Figure 11, this ratio is given for different percentages of learners

repeating the course. For 50% repeating, the ratio is increased from 0.176 to 0.261, a 48% increase. This is above the benchmark 22.5% set by the Ministry of Education. It can be seen that, according to the model, this ratio could be increased further if learners can be more motivated to repeat if they fail.

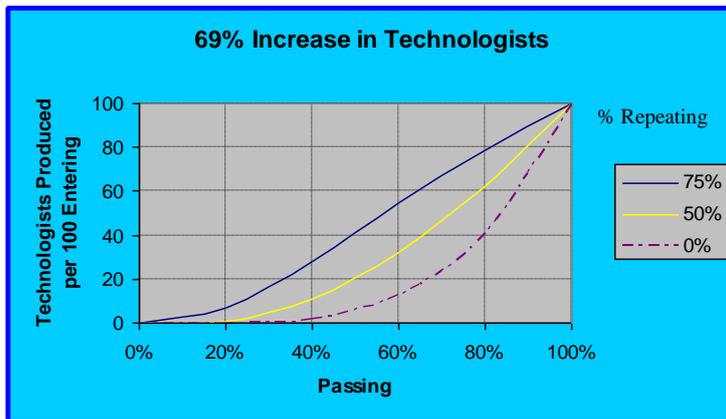


Figure 12 Effect of Pass Rate on the Number of Technologists Produced

From this figure, it can be seen that the number of learners receiving their National Diploma is increased from 42 to 71 per 100 entering, a 69%

increase. Again, this number can be increased if more failing learners can be motivated to repeat the semester. Assuming a constant percentage, the number of distinctions is increased from 4 to 20, a 500% increase, giving an indication of the increase in education quality.

A rough economic assessment was conducted based on the following assumptions:

| | | | | | | | | | |
|----------------------------|-----|------------------------------|----------|------------------|-----------|-------------|-----------|-----------|-----------|
| Subsidy: | | Correction factor 2006->2008 | 1.099678 | | | | | | |
| Learners/Lecturer: | | 100 (L/L ratio) | | | | | | | |
| Research Grant: | | 89353 per lecturer | | Weighing Factor: | | 0.5 (Tech.) | | | |
| Teaching Output: | | 14000 per diplomate | | Weighing Factor: | | 1 (3yr ND) | | | |
| Teaching Develop: | | 12200 per diplomate | | Weighing Factor: | | 1 (3yr ND) | | | |
| Norm Diplomate/Registered: | | 22.50% | | | | | | | |
| Teaching Input: | | 7856 per reg. learner | | Weighing Factor: | | 2.5 | | | |
| Learner Fees: | | 1400 per sem. course | | | | | | | |
| | | | | | | | | | Lecturers |
| | | | | | | | | | Group |
| | | | | | | | | | 100 |
| %Pass | S1 | S2 | S3 | S4 | P1/P2/Dip | Norm | Size (Av) | L/L ratio | |
| 67% | 120 | 96 | 77 | 62 | 42 | 54 | 89 | 11 | |
| 84% | 109 | 100 | 92 | 84 | 71 | 61 | 96 | 12 | |

These assumption lead to the following income in Rmil per 100 learners entering:

| | Research | Teaching | Teaching | Teaching | Learner | Total |
|-------|----------|----------|----------|----------|---------|--------|
| | Output | Output | Develop | Input | Fees | Income |
| %Pass | Grant | Grant | Grant | Grant | | |
| 67% | 0.49 | 0.59 | 0.15 | 3.49 | 3.33 | 8.05 |
| 84% | 0.54 | 0.99 | 0 | 3.78 | 3.83 | 9.14 |

Table 2 Income Based on the Model

The increased teaching output grant due to a higher pass rate is partially offset by the Teaching Development Grant. However, for each 10% increase in pass rate there is an 8% increase in income. The incomes calculated are within the ballpark, but still need to be confirmed.

IMPLICATIONS

- Further work
 - Another lecturer is implementing Formative Assessment as well in order to confirm the effectiveness of the method.
 - The number of learners per Formative Assessment session needs to be increased.
 - Wider application of the strategy is proposed, bearing in mind that the degree to which lecturers are encouraged to adopt the strategy should be balanced by considerations of academic freedom. If the interaction with learners is increased three-fold, it could be proposed that any method would be as effective. However, OBE Formative Assessment provides a systematic and effective way to ensure that all learners do become competent in all Outcomes.
- Formative Assessment will address learner retention and throughput, providing that adequate resources are allocated to limit the number of learners to 100 or less per lecturer. It significantly increases the quality of education as measured by the number of distinctions.
- Formative Assessment finds favour with learners.
- In the National Plan for Higher Education in South Africa, one of the key outcomes is increased graduate outputs. This could be achieved using Formative Assessment to ensure that the limited supply of learners exiting the school system with the necessary proficiency in maths and science is utilized fully. This will find favour with the Ministry of Education.
- Due to the better results, and the increased interaction with learners, the author has decided to adopt Formative Assessment on a permanent basis. **This** is education.

REFERENCES

1. Cowie, B., & Bell, B. (1999), A model of Formative Assessment in science education, *Assessment in Education*, 6: 101-116
2. Moeketsi Letseka and Simeon Maile (2008) High university drop-out rates: a threat to South Africa's future, *HSRC Policy Brief*

APPENDIX

TE REPORT FOR CMTA321 (2008, first Semester)

QUESTION 13:

- Sometimes he is difficult during oral tests, but up to so far everything is in order
- I think Dr Huberts is my best lecture so far in my S3 level, I would really appreciate to continue with him in S4.(3)
- Makes learning Chem Tech a pleasure.
- Dr Huberts makes the students repeat orals that they are finished with.
- If I pass or fail it is my responsibility. The orals are not really needed. They should be optional not compulsory. The memorandum should be explained with full steps not short cuts.
- Teaching method is fine its just that we need a reference for the lectures so that we can exercises at our own time.
- From my side I benefited a lot from Dr Huberts. The way he assess us is brilliant e.g after each and every test we do the orals, which help us to understand the material well. I wish all the other lecturers can do the same to enhance the process of the students.
- Not many lectures give us time to prepare or to understand a Chapter like Dr Huberts with his orals.
- Dr Huberts has presented this course in a clear and concise matter. With this I have gained mountainous confidence in this module.
- Lecturer is very helpful, hope the OBE system he uses will be used by other lecturers as the system helps to make sure that the learner is competent in all the learning modules. Thanks Dr Huberts.
- The lectures are normally too long and no breaks are taken during the lecturing. By the time he finishes lecturing everybody (well almost everybody) is exhausted.
- Dr R Huberts is an asset to the University. He gives his all.
- He is organized and effective. (3)
- He makes sure we all understand the subject.(2)
- The oral is good for understanding and correcting the mistakes in the tests. The involvement of students is very good.
- He is friendly and encourages students. (2)
- The lecturer is always available to help students and also takes time to explain until the students are satisfied.