COURSEWORK ASSESSMENT AND CONTROL: THEIR ROLE IN BETTER RESULTS

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Abstract *¾ It is generally accepted that students who conduct themselves well in class and do all their coursework do better than those with a more relaxed attitude towards their work. At the beginning of a course many lecturers therefore urge their students to work hard, and to be attentive but more often than not this advice is ignored. For courses with large classes, the lecturer faces a formidable task; students are often reduced to registration numbers. In this paper the authors report on a strategy adopted for coursework and tests during the first semester of year 2001 / 2002 in the department of Electrical Engineering at the University of Zimbabwe. The strategy consisted of slightly increased coursework load for students with very strict marking and monitoring regime. Weak students were followed up and students were made to be constantly aware of their coursework performance. The weaker or defaulting students were given chances to submit remedial work to the satisfaction of the lecturer. The 2001/2002 end-of-semester results are compared with those of previous years and they show a significant improvement. The authors report that although very positive results were obtained, the work- load on the lecturers increases considerably and discuss what alternatives there are.*

Index Terms ¾ Coursework Assessment Methodology, Student Evaluation, Teaching of Electrical Engineering, African Universities.

INTRODUCTION

For its nearly 20 years of existence, the Department of Electrical Engineering at the UZ although the biggest in the Faculty of Engineering has been small compared to others in the region. However, this scenario altered radically in the last two years. Whilst before, the average first year intake was 40, the intake is now nearly double this number (the increased intake is still small compared to that in South Africa (200 in some South African Universities). This scenario has also been observed in some Western Countries, for example in Norway *by* Odegard, Engan, and Rettedal [1]. For the University of Zimbabwe the selection criteria is based on Cambridge Examination 'A' level points. Also, in the past, only applicants with 12 or more 'A' level points (e.g. grades A, B, C or B, B, B) from 3 eligible subjects stood a good chance of entry, the entry points have been lowered and those with 8 or 9 are now also being considered. Two or three (5-8%) of the first year students are admitted on the basis of a mature entry scheme which aims to give opportunities to those applicants with alternative qualifications, for example a recognized diploma together with industrial experience. The increased numbers of students admitted into Engineering is now stressing the facilities and resources and the University is still to come to grips with the increased intake policy in terms of providing the necessary teaching equipment, lecture halls laboratory space and teaching staff. The first year curriculum is largely common among civil, electrical, geo-informatics & survey, mechanical, metallurgy and mining students. In the first year students study mathematics, computer science, electrical principles, communication skills, engineering drawing, engineering materials, and mechanics. Students should pass at least seven of these eight subjects before proceeding to the second year. The failed subject has to be passed in the next examination for that subject before he or she is allowed to proceed to the 3rd year. In the second year student will formally belong to specific departments. For those registered in Electrical Engineering, they will take 8 courses of which 6 are offered by the depabtment and 2, Mathematics and either Thermo Fluids or Applied Mechanics are offered by the departments of Mathematics and Mechanical Engineering respectively. *As a result of the increased intake, the Electrical Machines course (EE202) which had been taken by about 110 students annually, from Electrical, Mechanical, Mining and Agricultural Engineering, will now be taken by over 150 students*. It is with this in mind that the Author decided to introduce a strategy of teaching in which course-work and continuous played a major part. That students benefit from course-work, is not disputed and by some extrapolation the more the better. At the University of Zimbabwe, however, the Engineering students and those in Medicine are widely believed to carry the biggest workload and therefore, when it comes to the allocation of coursework, one has to introduce balance. In the following section the rationale adopted will be given.

MONITORED COURSEWORK AND TESTS

Like in many other Universities, the student's learning experience consists of a combination of examinations and coursework. The weighting of these often depends on the University / Department concerned but often reflects the

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importance attached to each of these components. Often however this also reflects the amount of effort put into the course by both students and lecturers. For the EE 202, course, there was a deliberate initiative to have students learn through doing and through interaction with the lecturer and themselves. The effectiveness of learning by doing is very well illustrated by DALE's[1] cone of learning, shown in Figure 1 which show that the closer the student is to the real thing the better.

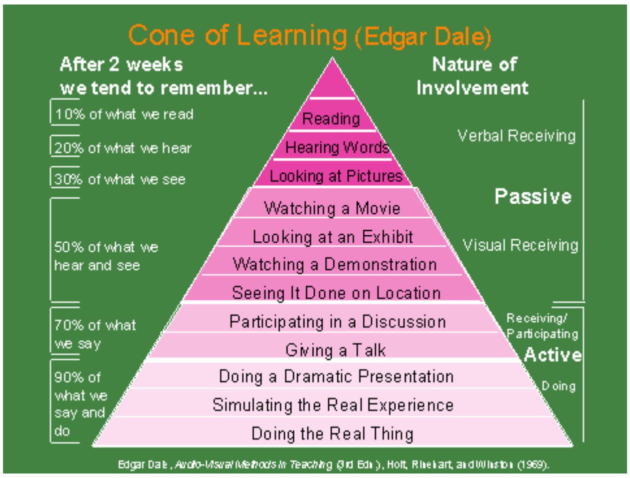

Figure 1, DALE's Cone of Learning

For the EE202 class the following activities were deemed to form the coursework element:

1. Assignments
2. In-class tasks
3. Laboratories
4. Tests

- The assignments were given at the end of each topic and usually were a combination of a numerical problem, a design exercise or a technical 'essay'. The completed assignments had to be submitted within a stipulated time with severe penalties for late submissions.

- The in-class tasks consisted of either one student attempting to solve a problem on the board or a group of students trying to solve the more complex tasks.

- The laboratories consisted of setting up test equipment, and carrying out the experiments as directed and according to a given format. Due to shortage of equipment the students have been working as part of a large group often exceeding 10 in number. This is obviously unacceptable and it is expected that the experiments will be done more or less as an individual effort in the coming years.

- The tests administered in very strict manner, similar to official university examinations. This contrasts with group assignments where students are allowed to share information and have access to their textbooks and notes. Invigilation is strict and time limits must be adhered to.

All of the above techniques and procedures are common to many universities and many curricula. However two major interventions were part of the teaching strategy:

1. Even though, due to the large class size teaching assistants were used to mark certain assignments, the majority of the assignments were marked by the lecturer himself. This allowed the lecturer to identify the weak students and also instances of students trying to reproduce another student's work.

2. Once marked, those students with marks below set threshold were asked to re-submit their work. In general the re-submitted mark was not allowed to exceed 50%, but there were several instances where the resubmissions were of such outstanding quality that higher than 50% were awarded. *This was a departure from previous practice.*

3. Students with serious difficulties were called to see the lecturer with whom they had an opportunity to discuss their problems. They had the opportunity for a one-to-one instruction. Often these sessions resembled counselling sessions as in many cases the weak performance was attributable to factors outside the classroom such as lack of campus accommodation resulting in a student having to commute long distances to college on a daily basis. Financial difficulties and even illness of close relatives often impacted adversely on the performance of the student.

THE EE202 COURSE AND ITS CONTENT

The EE 202 (Electrical Machines) is deals with energy conversion and specifically covers basic principles of electromechanical energy conversion as well as the principle of operation, construction and design of key industrial and commercial machines, such as transformers, dc and ac motors as well as ac circuit measurements, some energy efficiency topics. There is now decreasing coverage of dc machines especially the generators and increasing coverage of ac machine theory, power electronics and actuators.

Increasingly there is treatment and attention to the operating and design aspects of common devices and systems, e.g. stepper motors that are found as part of computer components. A moderate amount of mathematics is required and we observe that inadequate knowledge in this area often retards the learning process. The next section gives the course outline of the EE202 course.

COURSE OUTLINE ELECTRICAL MACHINES

EE 202

Prerequisites:

- Mathematics MT101 & MT102, Electrical Principles EE101, **specifically**, complex (j) notation, manipulation of complex parameters of the type R+jX (i.e. addition, multiplication & division).

Introduction & Definition of Electrical Machines

- Brief review of the magnetic field effects on its environment and how motor, transformer and generator principles are based on these effects.

Transformers

- Construction of distribution and power transformers. Types of transformers. Construction methods: core & shell construction. The effect of construction on efficiency and costs. Principles of operation of single phase transformers. The emf equation and its role as a basis for transformer design. Derivation of the equivalent circuit of a single phase transformer. Transformers on no load and on load. Transformers regulation and efficiency and the use of phasors. Transformers testing. No load and short circuit tests. The meaning of percentage impedance and standard values for typical distribution transformers. Applications of transformers.

Induction Motors

- Construction of cage and wound rotor machines. Principles of operation of a squirrel cage induction motor (using the rotating field concept). Derivation of the single phase equivalent circuit of 3 phase cage motor, exact and simplified models. Induction motors under running conditions; torque vs slip characteristics. Conditions for maximum torque under running conditions. The influence of rotor resistance on starting and running torque. Testing of induction motors, the no load test. The locked rotor test. Determination of machine parameters from tests. Introduction to single phase motors. Applications of induction motors.

Direct Current (DC) Machines

- Construction of DC machines according to application and power levels. Importance of insulation in large dc machines. DC machine windings, lap & wave windings. Principles of operation of the dc generator. Circuit models of series, shunt and compound excited dc generators. Load characteristics of dc generators. Applications of dc generators. Principles of operation of dc motors, circuit models of series and shunt excited dc motors. DC motors under running conditions, torque speed characteristics. Starting of large dc motors. Speed control and protection of dc motors. Specific problems of dc machines, commutation and armature reaction. Compoles and interpoles. Motor efficiency.

COMPARISON OF RESULTS WITH PREVIOUS YEARS

In 1999, 120 students were part of the EE202 class and also took the examinations. The following table gives the total marks observed and the average mark.

TABLE 1
1999 Student Performance

	Course Work	Exam	Aggregate
Totals	7840	7057	7253
Averages	65	59	60

Pass Rate = 89%

In year 2000 the Author was on sabbatical and therefore it would be misleading (and perhaps unfair, because of the learning curve process involved in the teaching classes for the first time).

In 2001, 89 students were part of the EE202 class and also took the examinations. A number of students who had failed the year 2000 examination did not come to the class but attempted the examinations. Their results are not included in the analysis. The following table (Table 2) gives the total marks observed and the average mark.

TABLE 2
2000 Student Performance

	Course Work	Exam	Aggregate
Totals	5948	5970	5956
Averages %	67	67	67

Pass Rate = 93%

ANALYSIS OF THE RESULTS

Although the above results may perhaps not be very conclusive, the large number of students is persuasive enough to give credit to the system used in 2001, which resulted in an overall increase in the average mark as well as an increase in pass rate. There was also documented satisfaction on the part of the students. At the end of the course a student evaluation questionnaire was handed out. The format of the questionnaire is given in Table 3.

TABLE 3
Student Evaluation Form

University of Zimbabwe Department of Electrical Engineering	***Course Evaluation by students*** Course : EE 202 Lecturer : Dr E. Chikuni Student's Department: ________	*Student's Score*				
		1	2	3	4	5
General: Course Relevance to Career Goals						
The EE 202 Course is compulsory for most students taking it, would you have chosen it if was optional? (**1=NO, 5=Certainly**)						
1 Presentation ***Lecturer Attributes***						
The Lecturer was well prepared (**1=strongly disagree, 5=strongly agree**)						
The Lecturer was approachable (**1=strongly disagree, 5=strongly agree)**						
The Lecturer was interested in students (**1=strongly disagree, 5=strongly agree)**						
Knowledgeable in the subject area (**1=strongly disagree, 5 strongly agree)**						

TABLE 3 CONTINUED					
Industry Application					
Enough industry examples were given (**1=strongly disagree, 5=strongly agree)**					
Clarity of presentation					
New terms & concepts explained (**1=strongly disagree, 5=strongly agree)**					
Visual Aids used effectively (**1=strongly disagree, 5=strongly agree)**					
Clear Summary at the end (**1=strongly disagree, 5=strongly agree)**					
Audible & Fluent (**1=strongly disagree, 5=strongly agree)**					
The lecturers were within context of course (**1=strongly disagree, 5=strongly agree)**					
Objectives were clearly set (**1=strongly disagree, 5=strongly agree)**					
Key Points were clearly defined (**1=strongly disagree, 5=strongly agree)**					
New terms & concepts explained (**1=strongly disagree, 5=strongly agree)**					
Visual Aids used effectively (**1=strongly disagree, 5=strongly agree)**					
Clear Summary at the end (**1=strongly disagree, 5=strongly agree)**					
Audible & Fluent (**1=strongly disagree, 5=strongly agree)**					
Stimulation of Lecture					
Lecturer was enthusiastic on topic (**1=strongly disagree, 5=strongly agree**)					
Lecturer was able to hold students' attention (**1=strongly disagree, 5=strongly agree**)					
Encouraged Questions (**1=strongly disagree, 5=strongly agree**)					
Questions Answered Clearly (**1=strongly disagree, 5=strongly agree**)					
Supporting Material					
Reading lists, models & references were adequate (**1=strongly disagree, 5=strongly agree)**					
2 Course Assessment					
Set appropriate assignments, tests and exams & there was a fair mix between them (**1=strongly disagree, 5=strongly agree)**					
I was given opportunity to give best performance (**1=strongly disagree, 5=strongly agree)**					
Tutorials were very useful (**1=strongly disagree, 5=strongly agree)**					
3 Student's Comments					

The following table (Table 4) gives the average scores by the 36 respondents in each category:

TABLE 4
STUDENT EVALUATION OF EE 202

Resp	Rel	Lect	Appl.	Clar	Stim	Refs	Ass	Tot	%
R1/36	4	20	4	32	20	5	15	100	95%
R2/36	5	18	2	34	18	2	15	94	90%
R3/36	3	19	5	32	13	3	6	81	77%
R4/36	5	20	5	32	19	3	15	99	94%
R5/36	5	15	4	31	16	3	13	87	83%
R6/36	4	18	2	26	13	1	12	76	72%
R7/36	5	20	5	35	20	5	15	105	100%
R8/36	3	20	3	31	18	5	15	95	90%
R9/36	5	19	3	31	16	3	12	89	85%
R10/36	5	16	4	27	19	2	13	86	82%
R11/36	3	20	4	33	19	3	15	97	92%
R12/36	5	20	5	30	19	5	15	99	94%
R13/36	5	20	5	35	20	5	15	105	100%
R14/36	5	20	5	35	20	5	15	105	100%
R15/36	5	19	5	33	20	4	15	101	96%
R16/36	5	15	3	31	11	5	15	85	81%
R17/36	5	20	4	35	20	3	15	102	97%
R18/36	5	20	3	30	14	3	11	86	82%
R19/36	5	20	5	35	20	4	15	104	99%
R20/36	5	20	5	35	20	5	15	105	100%
R21/36	5	20	3	30	18	2	13	91	87%
R22/36	5	18	3	32	19	4	14	95	90%
R23/36	5	20	3	23	20	1	11	83	79%
R24/36	5	19	3	23	17	4	11	82	78%
R25/36	1	20	5	35	20	4	15	100	95%
R26/36	3	17	4	31	16	2	14	87	83%
R27/36	3	17	3	23	8	1	11	66	63%
R28/36	5	16	3	23	12	3	6	68	65%
R29/36	1	20	4	21	14	3	8	71	68%
R30/36	5	18	2	30	17	2	15	89	85%
R31/36	3	9	5	22	16	5	10	70	67%
R32/36	5	16	3	35	20	2	15	96	91%
R33/36	3	19	4	34	19	3	13	95	90%
R34/36	5	20	5	31	18	5	12	96	91%
R35/36	4	20	5	25	16	4	9	83	79%
R36/36	5	20	3	29	18	2	11	88	84%
Totals	155	668	139	1090	623	121	465	3261	3106
Ave	4.31	18.56	3.86	30.28	17.31	3.36	12.92	90.58	86.27
%	86%	93%	77%	87%	87%	67%	86%	91%	86%

Table 5 gives a summary of the evaluation in the form of attributes and scores awarded by all students for each.

TABLE 5

SUMMARY OF SCORES

Attribute	% Average
Relevance to Career Goals	86
Lecturer Performance	93
Industry Application	77
Clarity of Presentation	87
Stimulation of Lecture	87
Supporting Material	67
Course Assessment	86

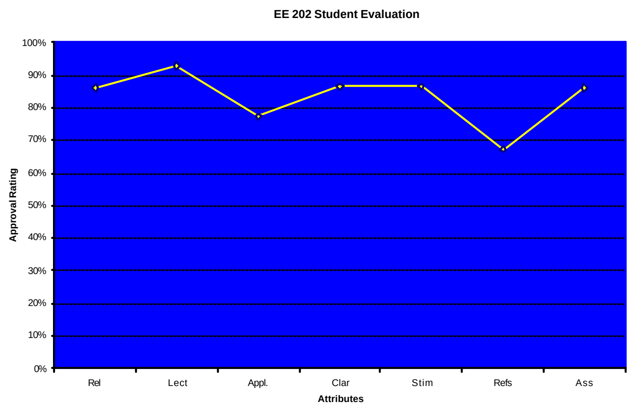

Figure 2

Three main findings were arrived at from the questionnaire:

1. An approval rating averaging 93% for overall lecturer performance
2. The lowest rating was 67%, on provision of course material. This confirms a problem typical of many universities in developing countries. It is clear that this problem needs to be addressed with greater vigour in the coming semester.
3. An overall average score of 91%.

It is to be acknowledged that the new methodology has only been operation for one semester and therefore cannot be entirely conclusive. However, it is an encouraging start. The comments from the students were quite encouraging. Among the comments were:

- Class examples and assignments were useful
- Important material was covered during lectures
- Tests helped us to prepare for exams
- Labs were stressful and time consuming
- The lecturer is excellent
- The University needs to compliment the lecturer's efforts by beefing up the library
- The one hour periods did not do justice to the course, improvement on visuals will help to understand applications taught.

Figure 3: A part of the EE 202-2001 Class

CONCLUSIONS

The information arising from the examination results indicates that positive outcomes can be arrived at through increased coursework for students and more interaction between the lecturer and the student. Also, it was clear that some students benefit from re-working their assignments and tests. Unfortunately this translates into increased workload for the lecturer and therefore some mechanisms must be put in place to lighten the burden. It is hoped that with the increasing availability of educational software tools, many of the tasks can be automated. It was clear from the student questionnaire that there was not enough reference or handout material and this was a concern for a very significant number of students. Clearly there will be more effort to ensure the availability of support material. At present the shortage of hard currency in Zimbabwe has meant that the student has to rely more on the lecture's notes. A future project will be the writing of a local textbook for the course that will be available in local currency at a reduced cost.

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