



## Experiences of Assessment using Multiple-Choice Questions on a first year module in Electrical Engineering

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## Structure of presentation

1. Multiple Choice Questions (MCQ's) - rationale
2. How MCQ's have been used
3. Discussion of pedagogical issues
4. Conclusions

### 1. Multiple-Choice Questions (MCQ's)

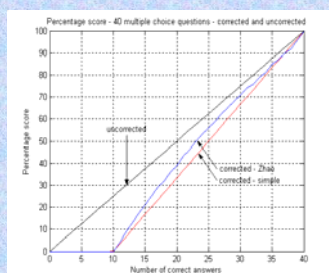
- Efficient means of knowledge assessment (particularly in well defined subjects that do not change with time).
- Good for assessing a large number of candidates.
- Widely used assessment methodology - aptitude tests in first and second level education, entrance examinations (e.g. some parts of the TOEFL test).
- Used less in assessment at third level, except in some knowledge based disciplines such as medicine.
- MCQ's are a feature of companion websites for some textbooks; the questions allow students to think conceptually about the material presented and provide students with extra practice on a wide array of problems. See [http://wps.prenhall.com/esm\\_dorf\\_modctrlsys\\_10](http://wps.prenhall.com/esm_dorf_modctrlsys_10)

### Multiple-Choice Questions - continued

- Multiple choice questions can have two choices of answers (true/false), though, more commonly, four choices of answers are available.
- It is recognised that raw scores from these tests should not be used directly. Why?  
*In a test with four choice-questions, a student may know the answers for 20% of the questions and guess the answers correctly for one quarter of the rest of the questions, passing the examination.*
- Scaling may be done using a probabilistic approach (Zhao, 2005, 2006) or a simpler approach (which employs negative marking). The scientifically sound probabilistic approach suggests that the optimum number of choice of answers for questions is 4. In addition, if the number of questions is greater than (8) (18) (48), there is less than (5%) (1%) (0.01%) probability of obtaining a scaled mark of 40% by pure guesswork.

### Multiple-Choice Questions - continued

- The author has written computer programmes to automate the tedious scaling process. The output of these programmes may be represented in graphical format e.g.

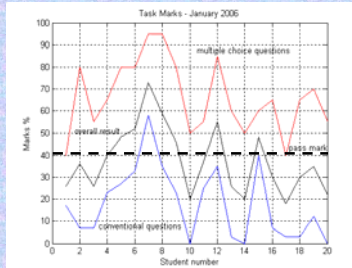


### Suitable module for use of MCQ's

- Many Level 7 programmes, particularly in their first year, are knowledge or fact-based.
- An example is the *Electrical Systems* module of the DT009 programme in Electrical and Control Engineering.
- In this module, students learn about basic electrical concepts (e.g. voltage) in simple DC and AC circuits.  
*The unit of voltage is*  
(a) ohm (b) watt (c) volt (d) farad
- Other concepts in the module (e.g. describing phenomena, solving problems) are less suitable for assessment using MCQ's.

## 2. How MCQ's have been used - 1

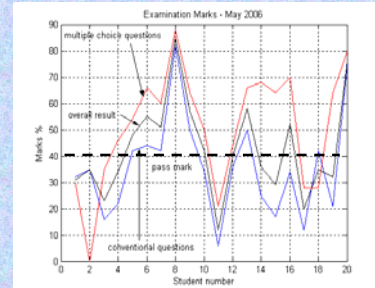
- In DT009 Year 1, the assessment for the module is composed of laboratory work (25%), terminal examination (50%) and one 'task' every semester (each task - 12.5%).
- 2005-6: The first task was a formal one-hour examination in January 2006. In this examination, 40% of the questions were in multiple-choice format (no scaling), with 60% of the examination being in a more conventional question format.



## How MCQ's have been used - 2

### 2006 Terminal exam:

- Q1 - a five-part obligatory question (conventional format);
- Two questions in multiple choice form (simple scaling used) and three conventional questions; do three of these five questions.



## 3. Discussion of pedagogical issues

- It is striking that, for all students who sat the assessments, the marks scored in the multiple-choice questions far exceeded the marks scored in more conventional engineering questions.
- This is particularly remarkable as the multiple-choice questions tested student knowledge of material covered in all of the module.
- The pedagogical rationale for the use of multiple-choice questions is pragmatic i.e. students perform better, on average, in answering such questions than in answering more conventional engineering examination questions.

Year	Median points level	Minimum points level
2006	275	115
2005	285	175
2004	315	160
2003	325	175
2002	340	140

Table 1: Selected data about student entry level

## 4. Conclusions

- MCQ's are most suitable for the assessment of knowledge, analytical ability, language proficiency and numerical skills involving a large number of candidates.
- Many Level 7 programmes (in particular) have learning outcomes that make MCQ's suitable as an assessment strategy (as part of a suite of assessment options).
- MCQ's tend to be student friendly.
- Exploration of the solutions of MCQ's assists students with monitoring of their own learning. The beneficial feedback given to the students is particularly important in the first year of the programme.
- MCQ's directly examine students in a broad range of basic ideas.
- A balanced use of assessment strategies is required to maintain educational standards in an era of mass higher education, in an environment where higher education institutions wish to increase retention rates on programmes and provide validation of student effort.