

Certainty-Based Marking (CBM)

-webcast 19 Feb 2008

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Useful knowledge needs reliable foundations.

A student's ability to identify the reliability of an answer is integral to the assessment of knowledge and reasoning.

To encourage critical thinking, CBM must reward both :
(i) confidence in correct answers, and
(ii) honest identification of uncertainty.

- In self-assessment, CBM aids learning by encouraging reflection about the basis and relationships of ideas.*
- In exams, it rewards students who can distinguish uncertain and reliable answers.*
- CBM should become a major plank of educational testing, especially with automated marking.*

What is CBM ?

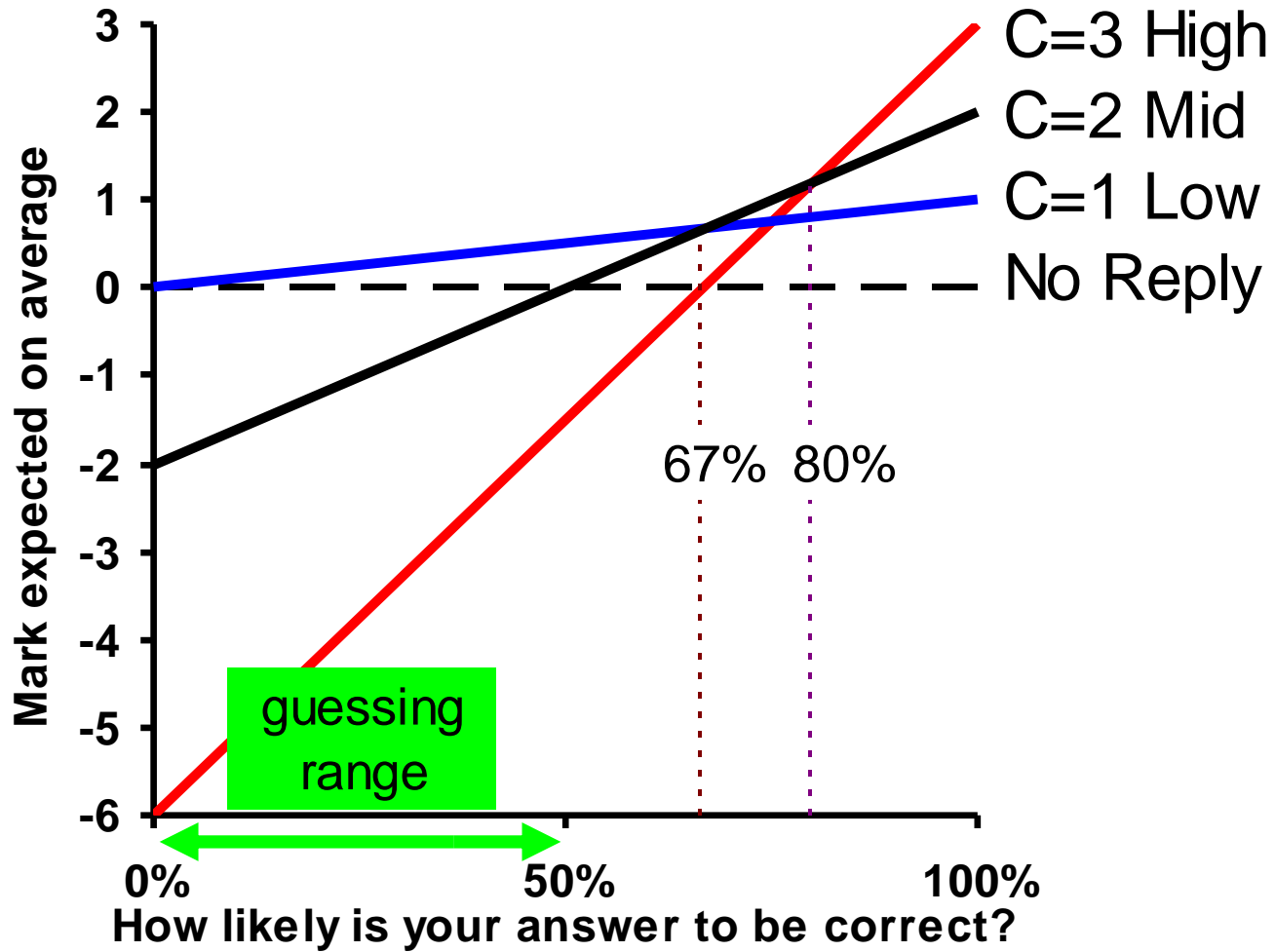
Each answer is marked according to the student's certainty that their answer is correct.

Degree of Certainty :	C=1 (low)	C=2 (mid)	C=3 (high)	No Reply
Mark if correct:	1	2	3	0
Penalty if wrong:	0	- 2	- 6	0

If you're sure, obviously you're best with C=3, but you must convince yourself there is a low risk of a penalty.

If unsure, you gain by acknowledging this, with C=1, and thus avoiding the risk of a penalty.

Which Certainty Level is Best?



Qu. 3: In a cold winter, the coldest place in a pond is at the bottom.

TRUE (or YES)

FALSE (or NO)

No Reply

Certainty:

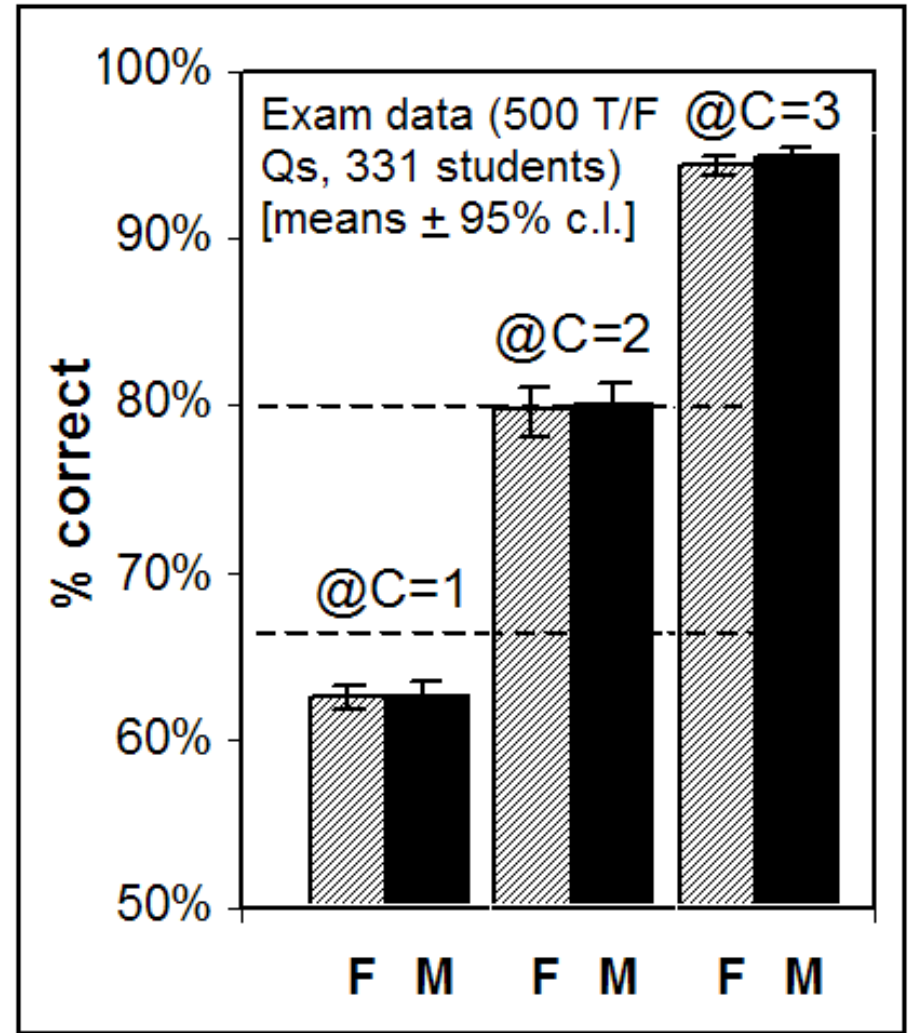
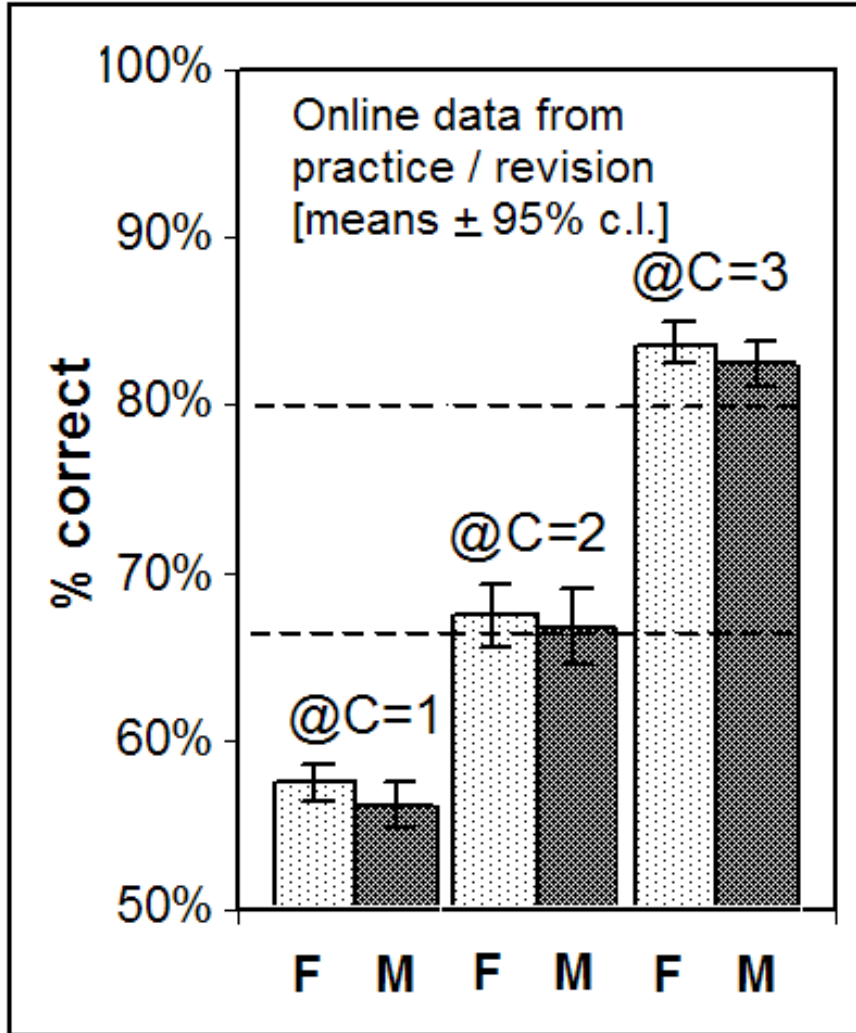
C=1 (low)

C=2 (mid)

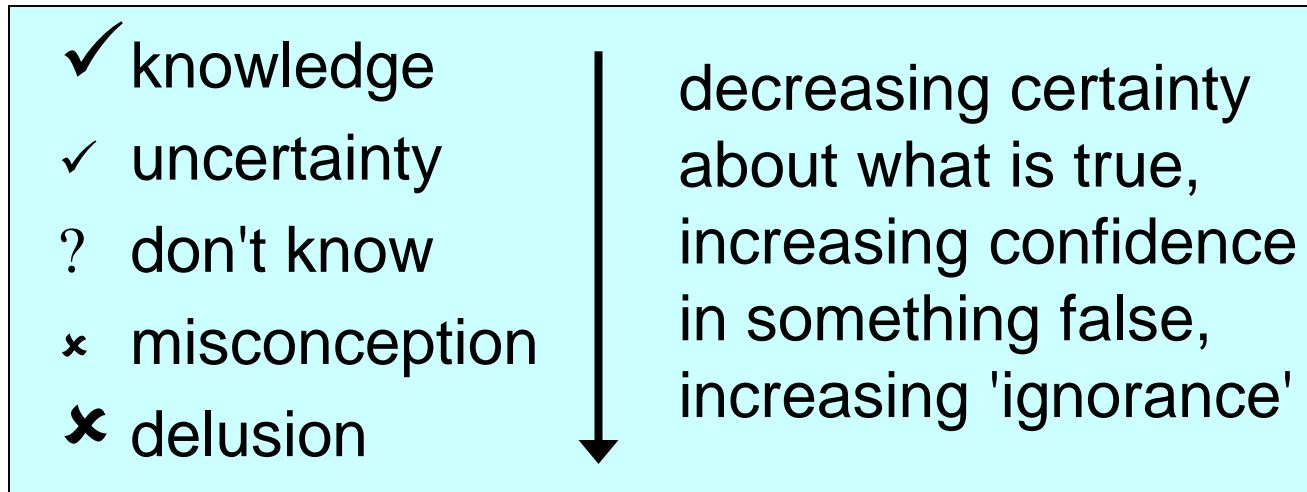
C=3 (high)

Certainty	Low (C=1)	Mid (C=2)	High (C=3)	No reply
Mark if Correct	1	2	3	(0)
Mark if Incorrect	0	-2	-6	(0)

How well do students discriminate reliability ?



Ordinary ways we think about Knowledge



Knowledge is a function of confidence (certainty, or degree of belief)

The only anchor point is the top: total knowledge or zero ignorance

There are states a lot worse than acknowledged ignorance

"It ain't what you don't know that gets you into trouble.
It's what you know for sure that just ain't so."

- attributed to Mark Twain

[Al Gore - An Inconvenient Truth]

DATE: _____ TEST: _____

SURNAME: _____

FIRST NAMES: _____

MARKING INSTRUCTIONS
 Use PENCIL only to mark your choice. Thus:
 Erase COMPLETELY if you make corrections.
 Do NOT cross out mistakes or use ticks or circles.
 Write your name, etc. in the boxes above.
 Do NOT write elsewhere on the card.
 Mark ONE answer ONLY for each response on the test.
 Mark your certainty (C=1,2 or 3). Marks are treated as: 2
 Correct answers get 1, 2 or 3 marks; Incorrect 0, -2 or -4.
 Blanks get the average mark for a random guess at C=1.
 Use C=1 if Probability correct < 67%, C=2 if it is > 80%.

PART 1. TRUE / FALSE QUESTIONS

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OMR Cards from Speedwell Computing Services

PART 1. TRUE / FALSE QUESTIONS

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not sure	sure	very sure
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PART 2. SBA (Single Best Answer) or EMQ Questions

21	A <input type="checkbox"/> B <input type="checkbox"/> C <input type="checkbox"/> D <input type="checkbox"/> E <input type="checkbox"/> F <input type="checkbox"/> G <input type="checkbox"/> H <input type="checkbox"/> I <input type="checkbox"/> J <input type="checkbox"/> K <input type="checkbox"/> L	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3
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PART 2. SBA (Single Best Answer) or EMQ Questions

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not sure	sure	very sure
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Students adopt certainty-based marking very easily

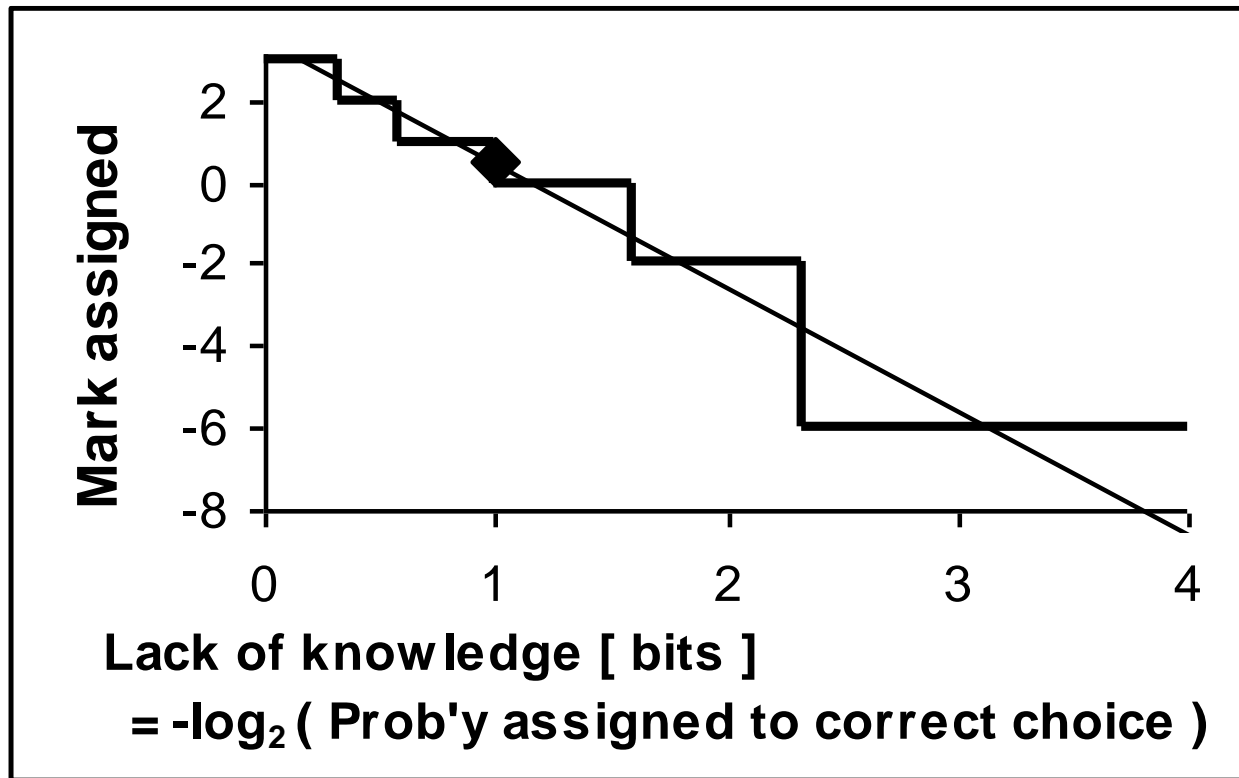
Principles that students seem readily to understand :-

- You must know the reliability of your knowledge to use it
- confident errors are serious, requiring attention to explanations
- expressing uncertainty when you are uncertain is a **good thing**
- confidence is about understanding things, not about personality
- if over- or under-confident, you must recalibrate with practice
- reflection is an essential study habit

In evaluation surveys, a majority of students have always said they like CBM, finding it useful and fair.

Early on they asked to include it in exams, and recently at UCL they voted 52% : 30% to retain it.

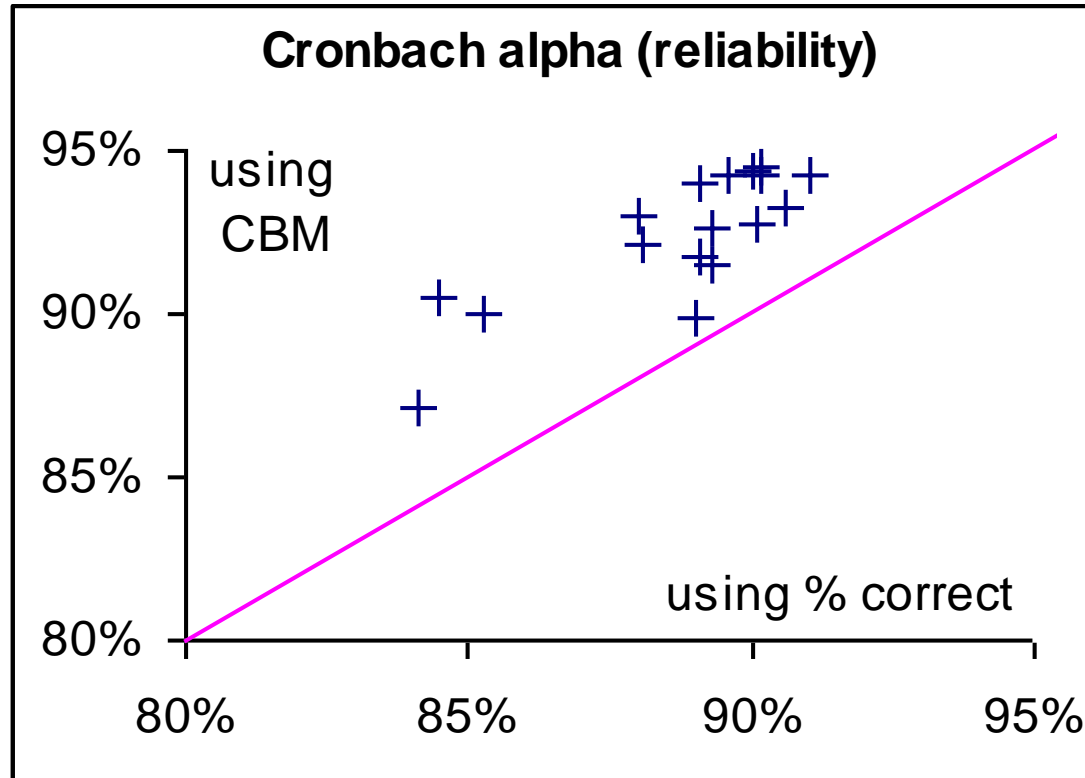
CBM quite closely follows the ideal ignorance measure



**The student loses about 3 marks per 'bit' of ignorance
- up to a maximum of 3 bits**

CBM increases the reliability of exam data with True/False Questions

'Reliability' indicates to what extent a score measures something about the student's ability, as opposed to 'luck' or chance.



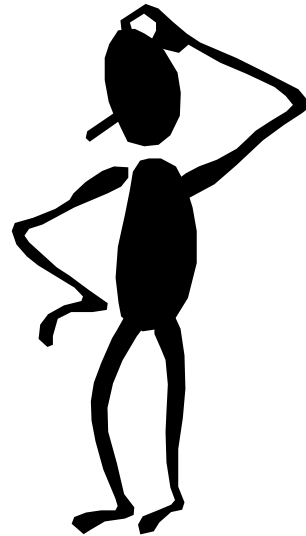
To achieve these increases using only % correct would have required on average 58% more questions.

A few of the names associated with confidence testing in education

- Andrew Ahlgren
- Jim Bruno
- Confucius
- Robert Ebel
- Jack (I.J.) Good
- Kate Hevner
- Darwin Hunt
- Dieudonné Leclercq
- Emir Shuford
- Mark Twain

We fail if we mark a lucky guess as if it were knowledge.

We fail if we mark delusion as no worse than ignorance.



www.ucl.ac.uk/lapt

Some Questions about CBM !

- Are there problems using it?
- Why doesn't my VLE support CBM?
- Do students need practice?
- Isn't computer marked assessment just factual?
- Does CBM increase retention?
- Do I need new questions?
- What are the best Q types?
- What about school education?
- Is it relevant to my subject, where opinions differ?
- Isn't it bad to encourage guessing?
- What if my only assessments are exams?
- How do I convince an exam board?
- Isn't it right/wrong that really matters?

Lessons from experience with CBM

- Practice is needed before use in exams
- Exams should re-use questions from an open database only very sparingly
- Over-confidence and diffidence are both unhealthy traits that can be moderated by practice to achieve good calibration
- With multi-option questions, students tend (at least initially) to over-estimate reliability
- Standard setting - it is easy (but important!) to scale CBM marks to match familiar scales based on number correct.

How did CBM in London begin?

In 1994, through collaboration of physiology depts, to improve online self-assessment (LAPT: London Agreed Protocol for Teaching).

Automated marking is forced on us through pressures on time. CBM was an attempt to improve it: make it more like face-to-face assessment, gain more information, and stimulate deeper learning.

CBM in exams? In 2001, students & staff at UCL opted for CBM for Yr 1,2 medical exams as more fair and motivating than 'number correct' or ± 1 negative marking.

Fairness: a lucky hunch is not the same as a justified correct answer. Confident errors are worse than acknowledgement of uncertainty. In 2006, UCL medical students voted 52%:30% to retain CBM.

Is there experience elsewhere?

Much research (mainly <1970) has shown the value of related (though usually more complex) mark schemes. UCL and Imperial College London are probably the largest current users of CBM.

CBM increases both retention of test material and reliability of exam data. Possible reasons for poor uptake are inertia, poor comprehension and vested interest in retaining existing commercial systems.

Why CBM?

- Get students to think more
- Reward recognition of uncertainty
- Highlight misconceptions
- Engage students more - game element of CBM
- Encourage criticism of Qs (intolerance of ambiguity or looseness)
 - NB Answers must be definitely right or wrong, not matters of opinion
- In general: enhance self-assessment as a learning experience

***NB None of the above require much if any practice with CBM.
The following do require practice :***

- More searching diagnostic data
- More valid and reliable assessment data

(But NB with CBM you never lose conventional assessment data.)