

Fostering metacognitive engagement with CBM for competence-based programs

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Prior thoughts, prior literature

What is CBM? (Leclercq, 1983; Gardner-Medwin, 2006)

- *Confidence*-based marking
- *Certainty*-based marking



—————→ **Self-assessment & Self-competence**

By the turning of centuries we find an increasing number of ‘narrow-studies’ that report implementations of CBM with more or less respect of the original idea.

See for example studies at H.E.:

- Law & Economics (Lotito et al. 2014, 2017)
- Law (Wong & Rojas-Mora, 2020)
- Engineering (Yuen-Reed & Reed, 2015)
- Neuroscience (Barr & Burke, 2013)
- Medicine (Schoendorfer & Emmett, 2012; Smrkolj et al. 2022)
- Informatics (Cisar et al. 2009)

See e.g. studies at H.S.:

- Mathematics (Foster, 2016)
- Physics (Clark, 2020 (Doctoral Dissertation))

Gardner-Medwin, A. (2006). Confidence-based Marking: towards deeper learning and better exams. In Bryan, C. & Clegg, K. (eds) *Innovative assessment in Higher Education*. pp.141-149. Routledge.

Context & Purpose

Master for Secondary Teacher Education as a valid context for CBM with **formative** purposes

- Big aim: *Lifelong Learning / SRL competence development*
- CBM algorithm on M.Ch.knowledge-tests as a means to challenge self-competence, provoke and foster SRL
- CBM offers controlled context for the training of risky professional decisions

¿Qué es la **lactosa**?

Seleccione una:

- a. Una proteína.
- b. Un lípido.
- c. Un azúcar.
- d. Una vitamina.

Grado de certeza : OC=1 (No está seguro: >67%) OC=2 (Seguro a medias: >67%) OC=3 (Bastante seguro: >80%)

CBM algorithm	if right	if wrong
High confidence	+3	-6
Middle confidence	+2	-2
Low confidence	+1	0

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The image shows a screenshot of a multiple-choice question about lactose. The question is in Spanish: "¿Qué es la lactosa?". There are four options: a. Una proteína, b. Un lípido, c. Un azúcar, and d. Una vitamina. Below the options is a "Sin respuesta" button. At the bottom, there is a "Grado de certeza" section with three radio buttons: OC=1 (No está seguro: >67%), OC=2 (Seguro a medias: >67%), and OC=3 (Bastante seguro: >80%). The OC=1 and OC=2 options are circled in blue. A table titled "CBM algorithm" is overlaid on the right side of the screenshot. The table has three columns: "CBM algorithm", "if right", and "if wrong". The rows are "High confidence", "Middle confidence", and "Low confidence". The values are: High confidence (+3 if right, -6 if wrong), Middle confidence (+2 if right, -2 if wrong), and Low confidence (+1 if right, 0 if wrong). Blue arrows point from the circled OC=1 and OC=2 options to the corresponding rows in the table.

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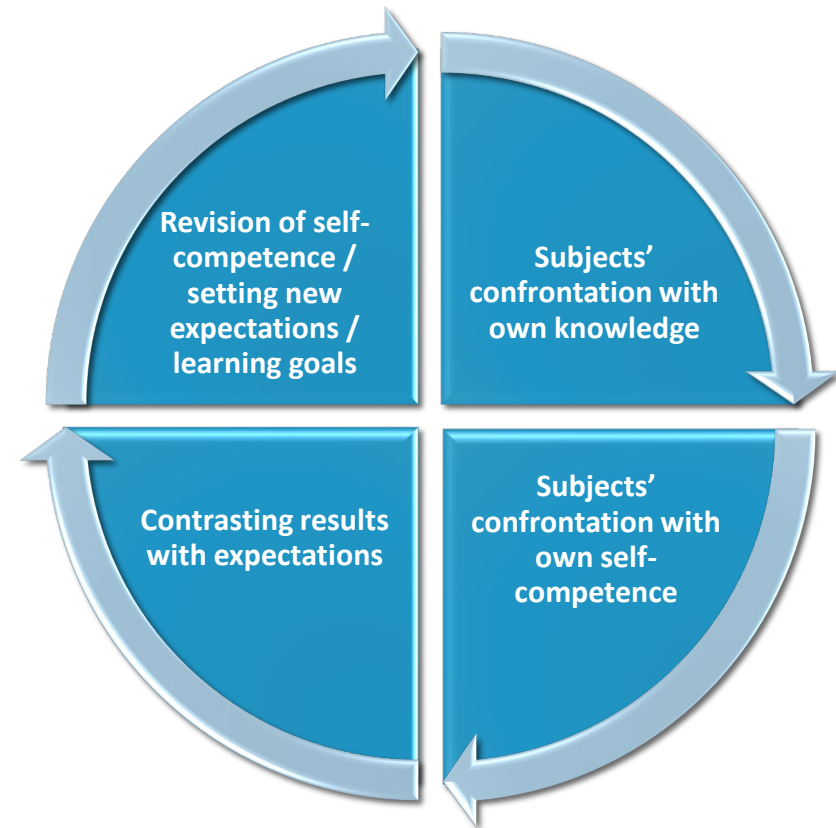
CBM algorithm	if right	if wrong
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Middle confidence	+2	-2
Low confidence	+1	0

Arrows indicate the mapping from confidence levels to the table: High confidence to +3 and -6, Middle confidence to +2 and -2, and Low confidence to +1 and 0.

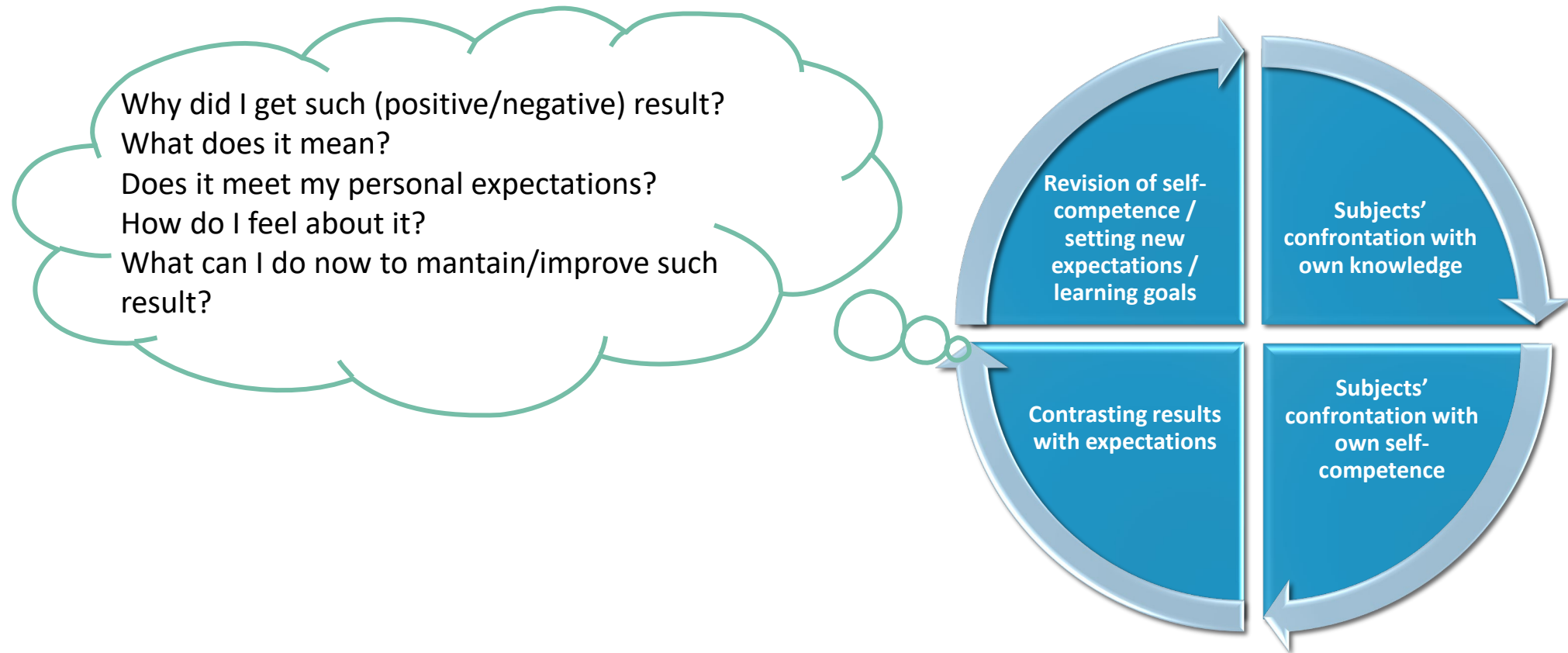
Score range for 10 items:
[-60,+30]

Gardner-Medwin, A. (2006). Confidence-based Marking: towards deeper learning and better exams. In Bryan, C. & Clegg, K. (eds) *Innovative assessment in Higher Education*. pp.141-149. Routledge.

Why/How does CBM connect with SRL?



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DESIGN

12 weeks, 20 sessions

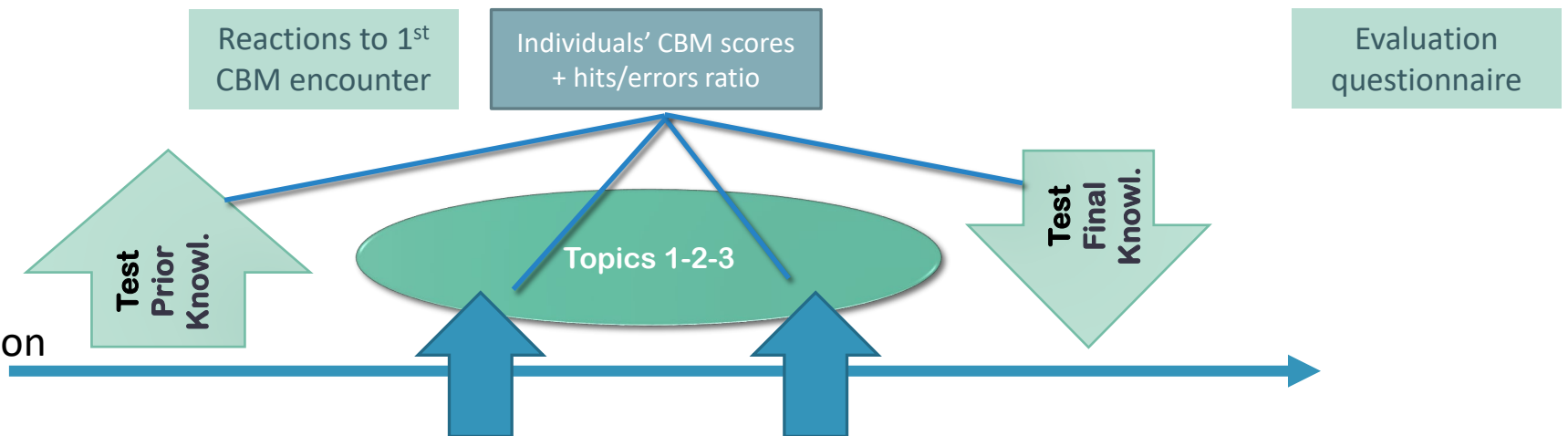
Control group NO CBM



Group **initial-final** intervention



Group **double rehearsal** intervention



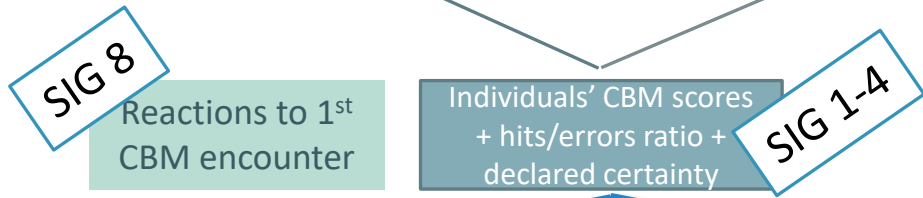
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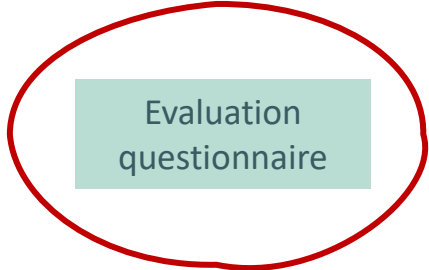
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Group **initial-final** intervention



Reactions to 1st CBM encounter



Group **double rehearsal** intervention



Research questions

Is CBM an appropriate assessment instrument for Teacher Education?

How do prospective secondary teachers in different curricular areas react to CBM?

How do they evaluate the experience?

Participants

N = 275 students at Master for Secondary Teacher Education (Universidad de Barcelona)

n = 125 voluntarily respond final evaluation questionnaire (45%)

Men **40%** ; Women **60%**

Graduates **74%** ; Post-graduates **26%**

Curricular area: Soc.Sci. **32%** ; Nat.Sci. **30%** ; other areas (Phys.Ed.; Voc.Ed.; Music; Arts) **38%**

Non-working stud. **32%** ; part-time working stud. **32%** ; full-time working stud. **35%**

Initial-final intervention group (n=183 // 80 → 43.7%)

Men **39%** ; Women **61%**

Graduates **72%** ; Post-graduates **27%**

Curricular area: SS **21%** ; NS **35%** ; other areas **44%**

Non-working **36%** ; part-time **31%** ; full-time **32%**

Double rehearsal intervention group (n = 92 // 45 → 48.9%)

Men **42%** ; Women **58%**

Graduates **76%** ; Post-graduates **24%**

Curricular area: SS **51%** ; NS **22%** ; other areas **26%**

Non-working **27%** ; part-time **33%** ; full-time **40%**

Method

Data collection

Students' demographic conditions:

1. Sex
2. Age (<25 / >25)
3. Prior education (bachelor/post-graduate (master/PhD)
4. Job situation (unemployed/part-time/full-time)

Students' response attempts to CBM items within:

1. Initial-final intervention
2. Double rehearsal intervention

Final questionnaire on students' evaluation of experience (scores 1-10)

Analysis

Contrast of hits/errors at initial and final test

Contrast of declared self-competence at initial and final test

Contrast of hits/errors ratio * declared self-competence at initial and final test

Initial questionnaire with first reactions to CBM

*Descriptive analysis of final questionnaire, regarding demographic conditions * intervention*

Some preliminary results: evaluation of the CBM-program

Overall **positive evaluation** of the CBM experience

- Women at MI show better evaluation $t(123) = 1.876$, $p = .03$; highest evaluation $M 6.85 / SD 2.38$

Students in the **DR** group reported a **decreased difficulty in evaluating self-confidence** by the end of the module and **increased satisfaction with the CBM results**, as a self-assessment opportunity

- Self-confidence evaluation (difficulty 1-10): MI > M 4.49 / SD 2.54; SI > M 5.43 / SD 2.6; $t(123) = 1.949$, $p = .026$; low-moderate effect size Hedges' $g = 0.364$
- Satisfaction with final learning results (satisfaction 1-10) MI > M 6.69 / SD 2.22; SI > M 5.85 / SD 2.04; $t(123) = 2.133$, $p = .017$; low-moderate effect size Hedges' $g = 0.398$

The experience with CBM reveals SRL-related actions as a primarily **individual (intimate) activity**, despite instructors' efforts in provoking collaborative debate situations in class

- Item "CBM-tests were useful to contrast ideas with classmates": SI > M 4.08 / SD 2.58; MI > M 3.89 / SD 2.42 [$p = 0.0001$]
- Item "CBM-tests were useful to contrast ideas with classmates": Women > M 4.03 / SD 2.55; Men > M 4.16 / SD 2.65 --- [$p = 0.007$ for women]

Stress related to the CBM experience was **higher for women than for men**, particularly in the **IF** group

- Women SI > M 6.14 / SD 2.75; Women MI > M 4.46 / SD 2.72 // Men SI > M 4.32 / SD 3.28; Men MI > M 4.68 / SD 2.5 --- [$p = .018$]

Thank you! Time for questions!

Ana Remesal

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