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Bridging Expert and Novice Knowledge through the Collaborative Construction of Concept Maps in a Higher Education Learning Environment in Theoretical & Computational Physical Chemistry

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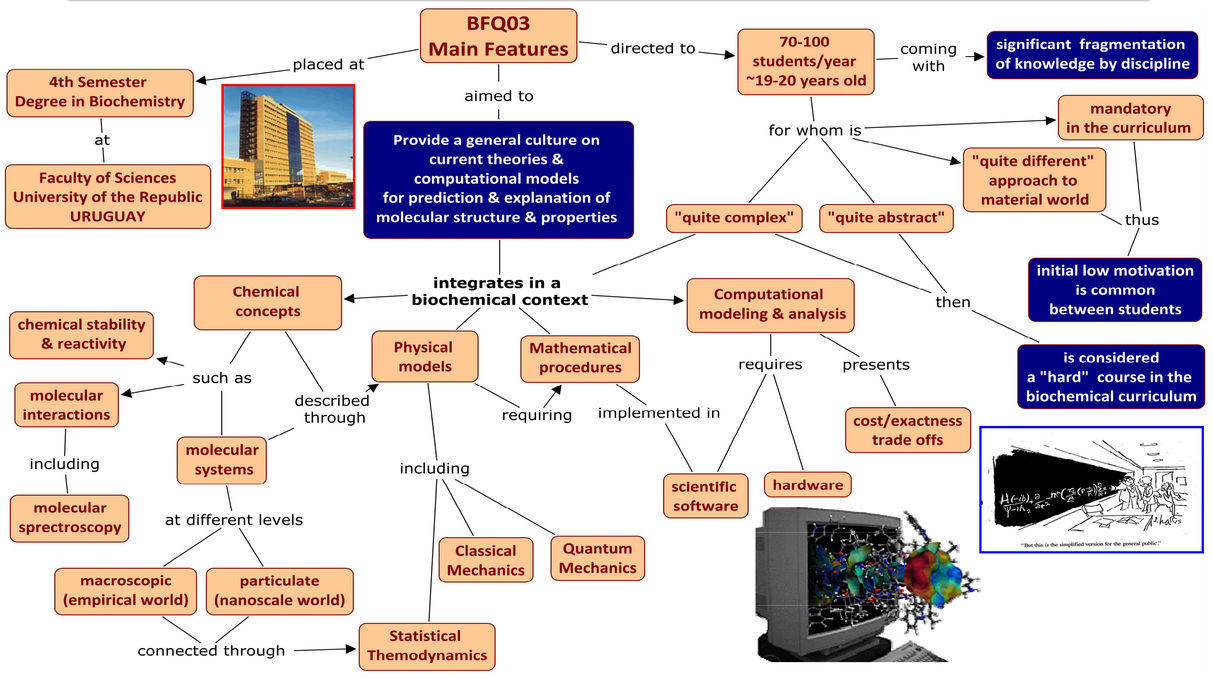
Abstract

We present here the results of a decade of experience **(2000-2010)** using *Concept Maps (CM)* to support teaching and learning processes of topics on *Theoretical and Computational Physical Chemistry* (*FQM-BFQ03*) in the context of a *Biochemistry Degree* at the Faculty of Sciences, University of the Republic, Uruguay.

CMs are incorporated to the instructional design of this introductory-level course as a central tool for promoting week after week the construction of deep understanding, well organized by concept's hierarchy and linked in a way connected to the student's biochemical background. The proposed strategy has been successful in enabling to approach student's novice knowledge to scientific expert knowledge, aimed to facilitate the process of constructing significant meanings with a good integration and balance between quite abstract and complex aspects on theories and models on molecular structure and physicochemical properties and a computational practice in molecular modeling labs. This constitutes one of the features of the course most appreciated by the students.

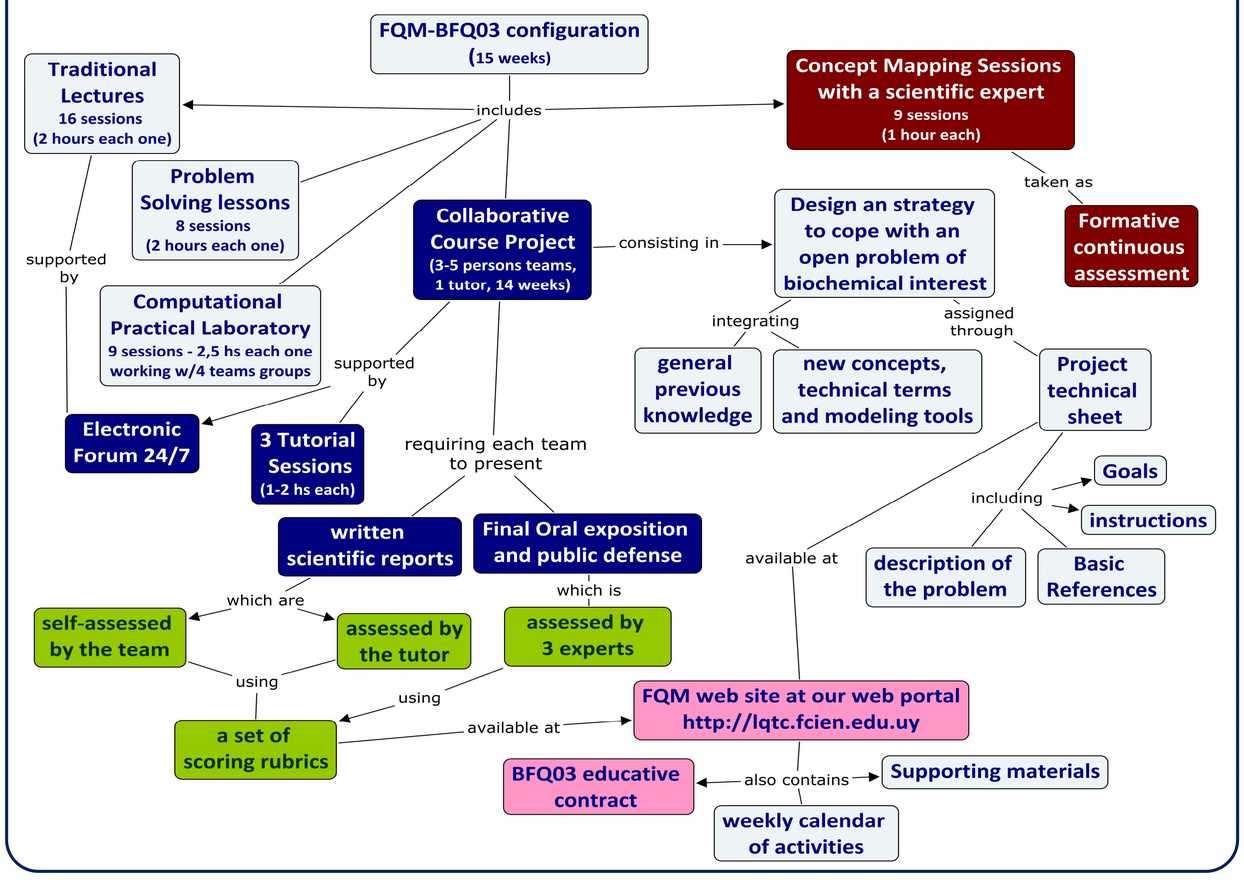
Along these years, the collaborative construction of *CMs* in the classroom -lesson by lesson- actively guided and supported in all the instances by the head of the academic area (who provides instant feedback in a personalized way quite infrequent within similar introductory populated contexts at our University) has also become the most relevant tool employed to follow step by step the academic progress of our 70-100 students.

FQM-BFQ03: The Scenario for Concept Mapping

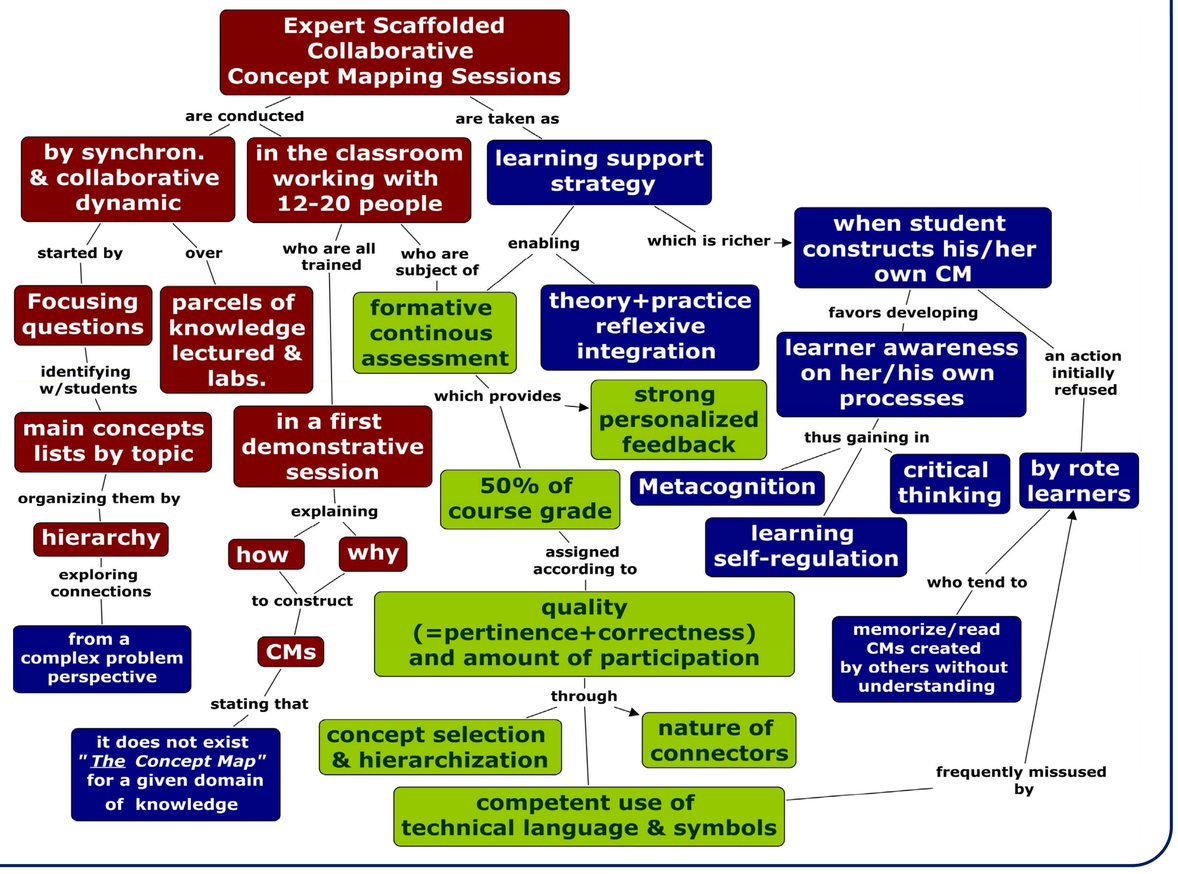


Collaborative competences (Johnson *et al*., 1999) and development of written & oral scientific communication skills are also transversal goals of the course.

Didactic Configuration & Learning Environment Design



The 9 Expert Scaffold Concept Mapping Sessions



Conclusions

Two dimensions and kinds of quantitative information sources were considered (**academic performance records** and **student satisfaction surveys**) have been taken into account in order to evaluate the results of this experience **along a 10 year period and ~1.000 students received in FQM-BFQ03**.

- **Academic performance = # of students approving FQM** have been continuously placed at the **92-95% range** (which is considerably higher than the international standards for university courses of similar degree of complexity) with an **average proficiency of 60% at the starting cohorts** which has been shifting towards higher mean performances (**65-74% after formally introducing CM sessions in 2001** and **currently placed at 75-82%** after introduction of CM construction training sessions in 2004 and improvements in PBL related activities in 2007).

- **Student satisfaction =** more than **85% considers that the CMs weakly sessions help them to better understand and to integrate the considerable amount of new knowledge introduced in the course.** Around **half of each cohort pre-constructs their own maps when no grading rewards the work** (the percentage is higher when grading CMs applies) **more than 90% of them thought this work contributed to a better awareness on their learning process as well as the use of rubrics and self-assessment**. The whole system of continuing formative assessment receives more than 80% agreement (rote learners express preferences towards summative tests assessment by multiple choice).

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