

CONCEPTUAL MAPS AND PRESERVICE TEACHERS TRAINING

Angela Colli, Paola Rossi, Chiara Giordani and Carla Montagna
SILSIS, Pavia University, Italy
Email: luriboni@libero.it ,www-silsis.unipv.it

Abstract. Since 1999 Italian preservice teachers, after their degree, may attend a university course named SILSIS (scuola interuniversitaria per l'insegnamento secondario). In Pavia University future science teachers attend courses about pedagogy (Area 1) and about the teaching of scientific subjects (Area 2). They attend also practical teaching laboratories (Area 3) and they train in different schools (Area 4) to practice as teachers. Concept maps are useful tools for them: a) to determine "structural" concepts of the subject they are going to teach in their training in secondary schools, b) to detect students' misconceptions, c) to draw a route of their "teaching-learning itineraries".

1 Introduction

Since 1999 Italian preservice teachers, after their degree, may attend a university course named SILSIS (Scuola Interuniversitaria per l'Insegnamento Secondario). In Pavia University future science teachers attend courses about pedagogy (Area 1) and about the teaching of scientific subjects (Area 2). They attend also practical teaching laboratories (Area 3) and they train in different schools (Area 4) to practice as a teacher. This is a fundamental moment of their learning process because they can improve their theoretical and practical knowledge. This passage is also crucial because it represents the first real contact with the students and with the class environment.

Concept maps are very useful tools in preservice teachers' training for exploring students' prior knowledge, for building their own "journey" routes and for gathering and sharing information.

2 A constructivist approach

In all SILSIS courses we adopt a constructive method based on Ausubel's theory, which emphasizes the difference between meaningful and rote learning. We believe that students aren't "vessels to fill" with a lot of notions, but they can produce their own knowledge with an active process. Knowledge structures are stored in semantic maps that, like nets, are built and rebuilt every time students learn new concepts. Novak described concept mapping as a "major methodological tool of Ausubel's Assimilation Theory of meaningful learning". We think that traditional model of teacher lecturing and student listening and memorizing is obsolete and that it is necessary to replace it with models of instruction recognizing that learners must be engaged in their own meaning making activities. Preservice teachers are aware that their future role will be the one of a "coach" who facilitates the process of learners' meaning making. The difference between teaching and learning is not so wide as we might think.

Preservice teachers training looks like an adventure journey. We know where we want to go (to build meaningful learning of a specific topic), but what about the route? A first map can help future teachers to find their own way ((Figure 1). Before starting we have to determine the structural concepts of the topic we choose: if the students do not have them, they cannot learn meaningfully. Student may have misconceptions, obstacles in the way toward meaningful learning. It is important for the teacher to know them and to choose strategies to overcome them. Some questions about every day life with open answers may be useful to detect students' misconceptions. Concept maps are useful, too, and may be built with the students in a class discussion or can be obtained by the teacher reading the answers to open questions.

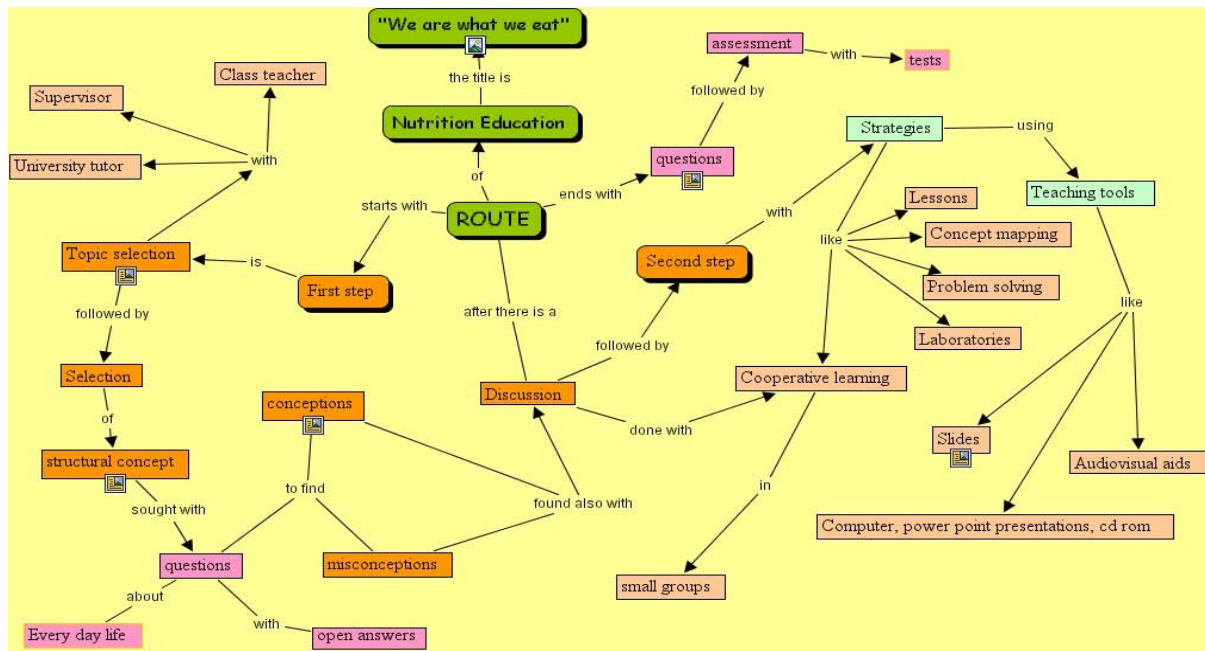


Figure 1. Map built by Carla Montagna to teach about nutrition (We are what we eat) in a class of a technical school (ITG Faravelli) in Stradella (Pavia-Italy), in the academic year 2003-2004.

2.1 Maps as journey routes

Preservice teachers construct concept maps identifying and defining structural concepts and graphically representing interrelationships among them: the result represents a spatial organization of their knowledge about curriculum and pedagogy. The map is of great value to the teacher and to the learner. In Pavia SILSIS preservice teachers build their own maps using the last version of CmapTools, a software developed by the Institute for Human and Machine Cognition. Every preservice teacher makes a map of his own “route” with links to resources: texts, images, web addresses, other maps (Figure 1). Every “route” map has links to one or two maps about structural concepts of the topic chosen for training. (Figure 2 and 3).

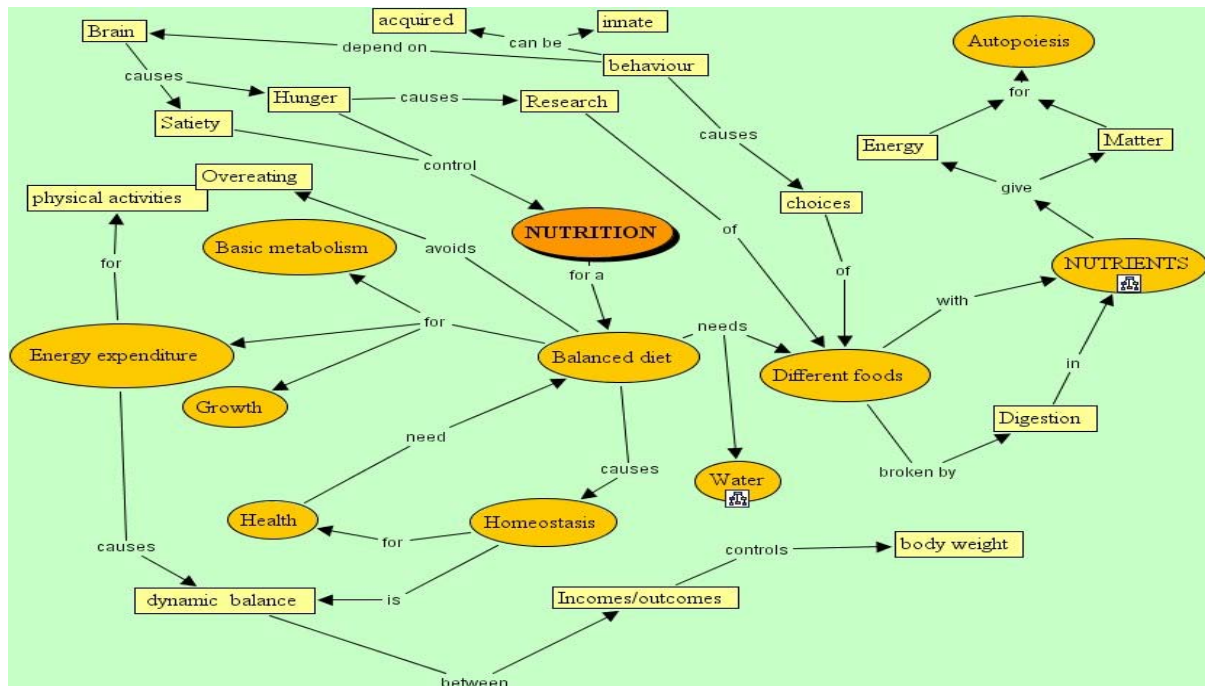


Figure 2. Map of “strucral concepts” used by Carla Montagna to teach about “Nutrition” (We what we eat) in a class of a tecnical school (ITG Faravelli) in Stradella (Pavia-Italy) in the accademic year 2003-2004

The journey (Figure 1) starts with a first step: the teacher selects the topic (Nutrition Education), the title (“We are what we eat) and the related structural concepts. A “questionario” (questions with open answers) and a discussion are useful to look for misconceptions. In a second stage the teacher practises different strategies (lessons, mapping, cooperative learning, laboratories, problem solving) to overcome misconceptions and to help student to learn. In the end the answers to the same questions of the beginning and a summative assessment will show changes in students’ knowledge. Some structural concepts are linked to other maps built with students to overcome their misconceptions (Figure 2). Carla Montagna noticed that her students didn’t recognize the importance of water in human body and in nutrition, so she built a new map about “water” with them (Figure 3). Maps can be a successful strategy in the learning process of the adults, too. The preservice teacher Chiara Giordani trained in a prison with adult learners, men and women separately. Her topic was “Sexual Education”: she used maps to detect and to overcome “common sense” ideas and stereotypes about human reproduction (Figure 4).

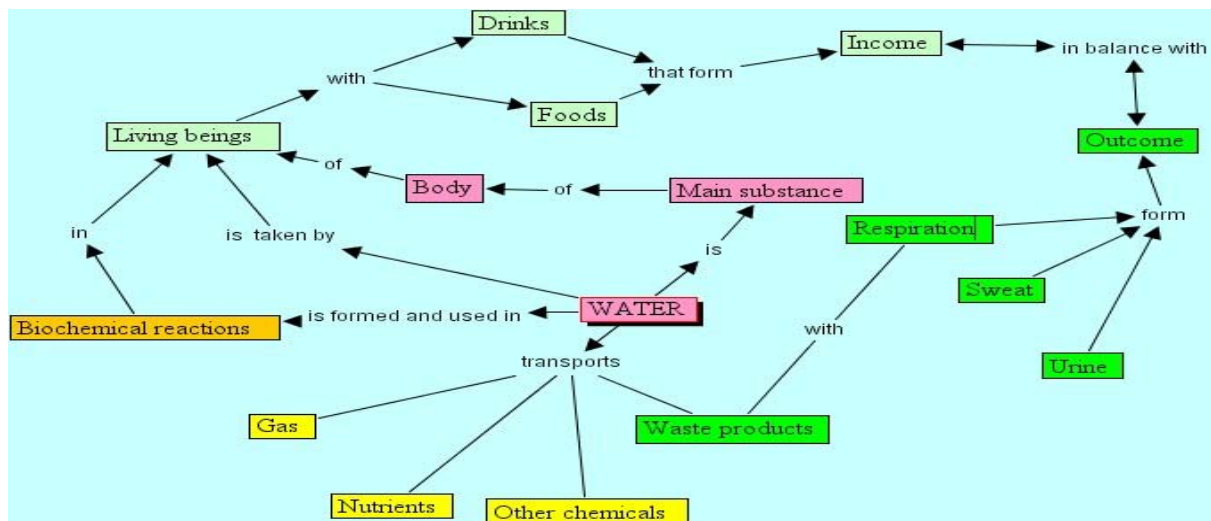


Figure 3. Map about “water” built by Carla Montagna in order to overlap students’ misconceptions in a class of a technical school (ITG Faravelli) in Stradella (Pavia-Italy) in the academic year 2003-2004

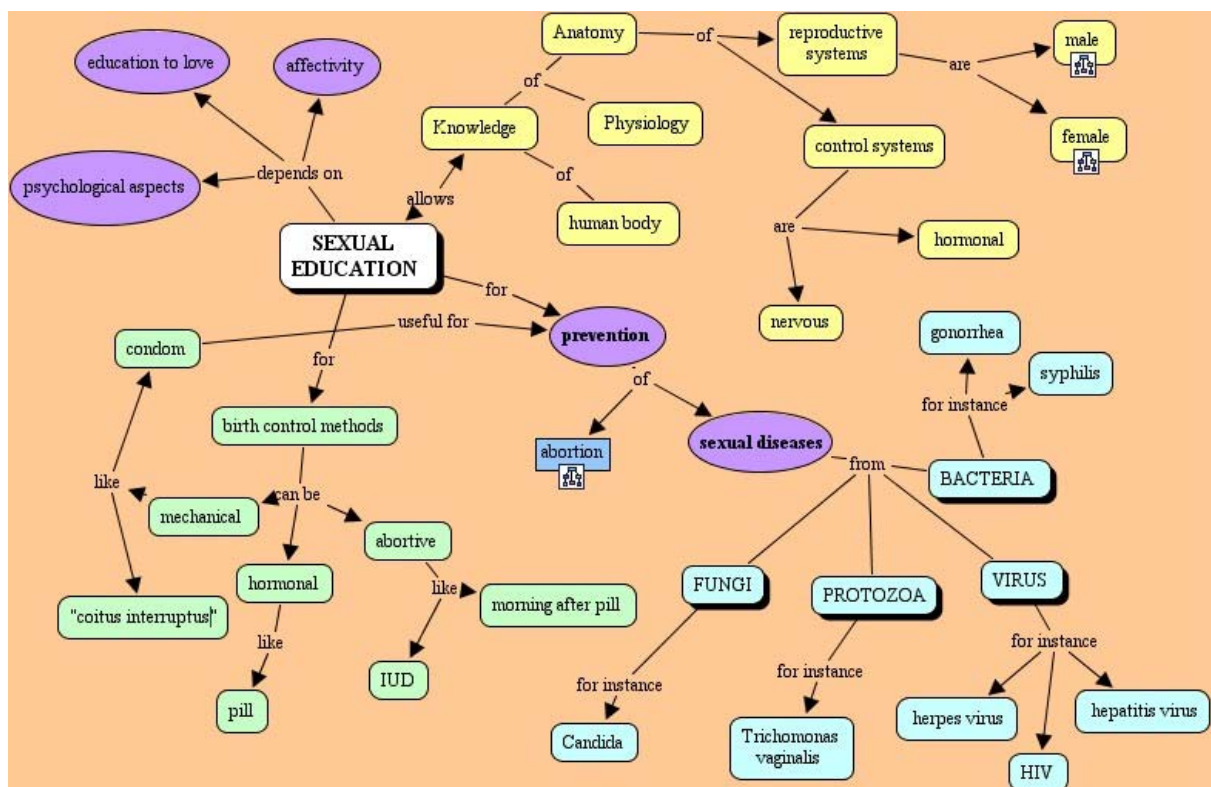


Figure 4. Map built by Chiara Giordani about “Sexual Education” in a prison with adult learners, men and women separately, in the academic year 2003-2004

2.1.1 Cyclic or hierarchic maps

“The Cyclic CMap is considered to be an appropriate tool for representing knowledge of functional or dynamic relationships between concepts. The Concept Map (CMap), on the other hand, is viewed as an appropriate tool for representing hierarchical or static knowledge. The two maps complement each other and collectively they capture a larger domain of knowledge, thus forming a more effective knowledge representation tool.” (Safayeni, Derbentseva & Cañas, 2003). Preservice teachers of Pavia University built both kinds of maps: cyclic and hierarchic. Relationships between concepts in natural science are sometimes static (anatomy), sometimes dynamic (physiology, ecology). Most of our maps can be considered a hybrid of a CMap and a Cyclic Map.

Our work is in progress; the teaching-learning journey never ends: new students, new concepts, new maps wait for us.

3 Summary

In the courses for natural science preservice teachers in Pavia University we adopt a constructive method based on Ausubel’s theory, which emphasizes the difference between meaningful and rote learning. Concept maps are useful tools for preservice teachers: a) to determine “structural” concepts of the topic they are going to teach in their training in secondary schools, b) to discover student misconceptions, c) to draw a route of their “teaching-learning itineraries”.

4 Acknowledgements

We thank all natural science preservice teachers of Pavia University in the academic year 2003-2004.

5 References

- Colli, Angela (2001). *Possono le nuove tecnologie rendere significativo l’insegnamento delle scienze*. Atti del Convegno Ted, Genova 12-14 febbraio 2001, 418-422.
- Colli, Angela (2003). *Le TIC nella formazione dei futuri insegnanti di Scienze*. Didamatica 2003, Genova 27-28 febbraio 2003, 416-421.
- Ferry, B., Hedberg, J., & Harper, B. (1998). How do preservice teachers use Concept Maps to organize their curriculum content knowledge. *Journal of Interactive Learning Research*, 9(1), 83-104.
- Kinchin, I. M. (2000a). Using Concept Maps to reveal understanding. A two-tier analysis. *School Science Review*, 81, 41 - 46.
- Kinchin, I. M. (2000b). Concept Mapping in biology. *Journal of Biological Education*, 34 (2), 61- 68.
- Novak, J. D., & Gowin, D. B. (1984). *Learning How to Learn*. New York: Cambridge University Press.
- Novak, J. D. (2001). *L’apprendimento significativo*. Trento: Erickson.
- Pearsall, N. R., Skipper, J., & Mintzes, J. (1997). Knowledge restructuring in the life sciences: a longitudinal study of conceptual change in biology. *Science Education*, 81(2), 193-215.
- Novak, J. (2002). Mappe ipermediali per apprendere. *Informatica & Scuola*, 10 (2), 22-24.
- Safayeni, F., , N. Derbentseva, A. J. Cañas. *Concept Maps. A Theoretical Note on Concepts and the Need for Cyclic Concept Maps*, accepted for publication, *Journal of Research in Science Teaching* (2004). <http://cmap.ihmc.us/Publications/ResearchPapers/Cyclic%20Concept%20Maps.pdf>.