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DEVELOPMENT OF CONCEPTUAL STRUCTURES: CREATIVE LEARNING ENVIRONMENT

Vrunda Prabhu, Bronx Community College, City University of New York
Peter Barbatis, Palm Beach State College
James Watson, Bronx Community College, City University of New York
Email: Vrunda.prabhu@bcc.cuny.edu

Abstract. The present article draws from Teaching-Research Experiments using the TR-NYC methodology of Teaching Research. TR-NYC started as a methodology for the improvement of learning of mathematics. The maps described in the present submission serve different roles in the mathematics classroom – design of instructional material and design of learning environments. Concept maps serve the purpose of guiding the teaching-research work in the form of (i) design of instructional material, (ii) preparing instructional material directly used by learners to make sense of learning, (iii) exploring components and connections between them in the design of new instructional environments, (iv) designing learning environments.

1 Introduction

Concept mapping as ongoing active meaning-making, occurs in the teaching-research process. Teaching Research TR-NYC model (Czarnocha, Prabhu, 2006) is the process of teaching with simultaneous attention to its impact on learning, with the goal of improvement of the learning. The method of teaching is for the most part by the Discovery method (Mahavier, 1999). This means that the instructional team must engage in exploring deeper connections based on students' questioning during the process of teaching. The concept maps thus continue to evolve over the cycles of the teaching-research experiments. In this article two types of concept maps, those that are at the beginning stages and those that have evolved over many teaching-research cycles, are discussed. Both types contain much learning for the seasoned as well as new teacher-researchers, in developing their own practice, bringing about improvement of learning and contributing to the knowledge of the profession. Conceptual structures thus develop as the teaching research investigations cycle over specific learning difficulties in the course of one semester, and over semesters. The structures develop use for locales beyond the particular place of origin.

2 Concept Map evolved over teaching research cycles

Consider the map of the teaching-research (TR-NYC model) cycle below. The looping nature, characteristic in the learning of the teaching-research team occurs as the cycle repeats over a conceptual difficulty and as the cycle repeats over semesters over courses taught. In either case, the concept maps being utilized undergo revision from the learning that occurred during the teaching research process. The revision is largely driven by the questions of the students, and thus the concept maps even though made by the instructional team, portray the learning of the classroom.

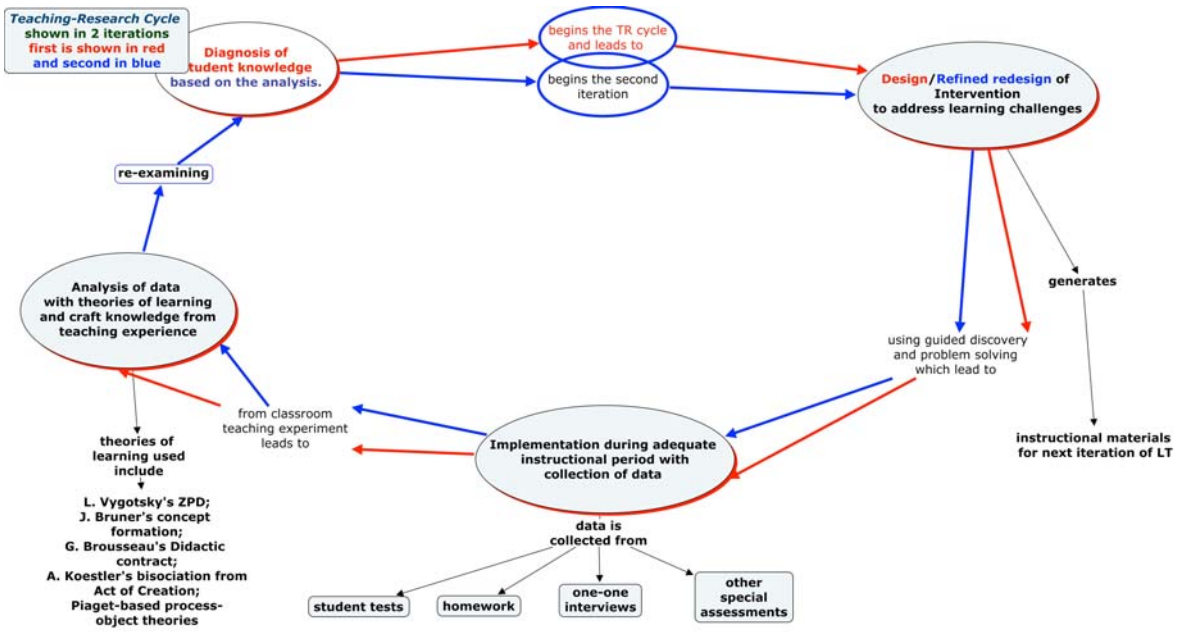

Figure 1. Teaching-Research Cycle TR-NYC model.

One such concept map being presented below is called *Story of Number*, being used in classes of Arithmetic and Elementary Algebra in the community colleges of the City University of New York. Note, that the dates on the concept map indicate the last date of when the concept map needed to be modified based on the needs in the classroom. The concept map is of general interest to persons involved in the teaching of Arithmetic concepts. The Discovery and Teaching Research approach necessitate that the most clear path be found and that this path be guided by investigation of the roots of the mathematical concepts in question to facilitate the exposition to start from basic building blocks. Concept maps allow to isolate the essential features of the schema in question with a possibility to identify learning trajectories. Making sense is achieved by developing the connections between concepts.

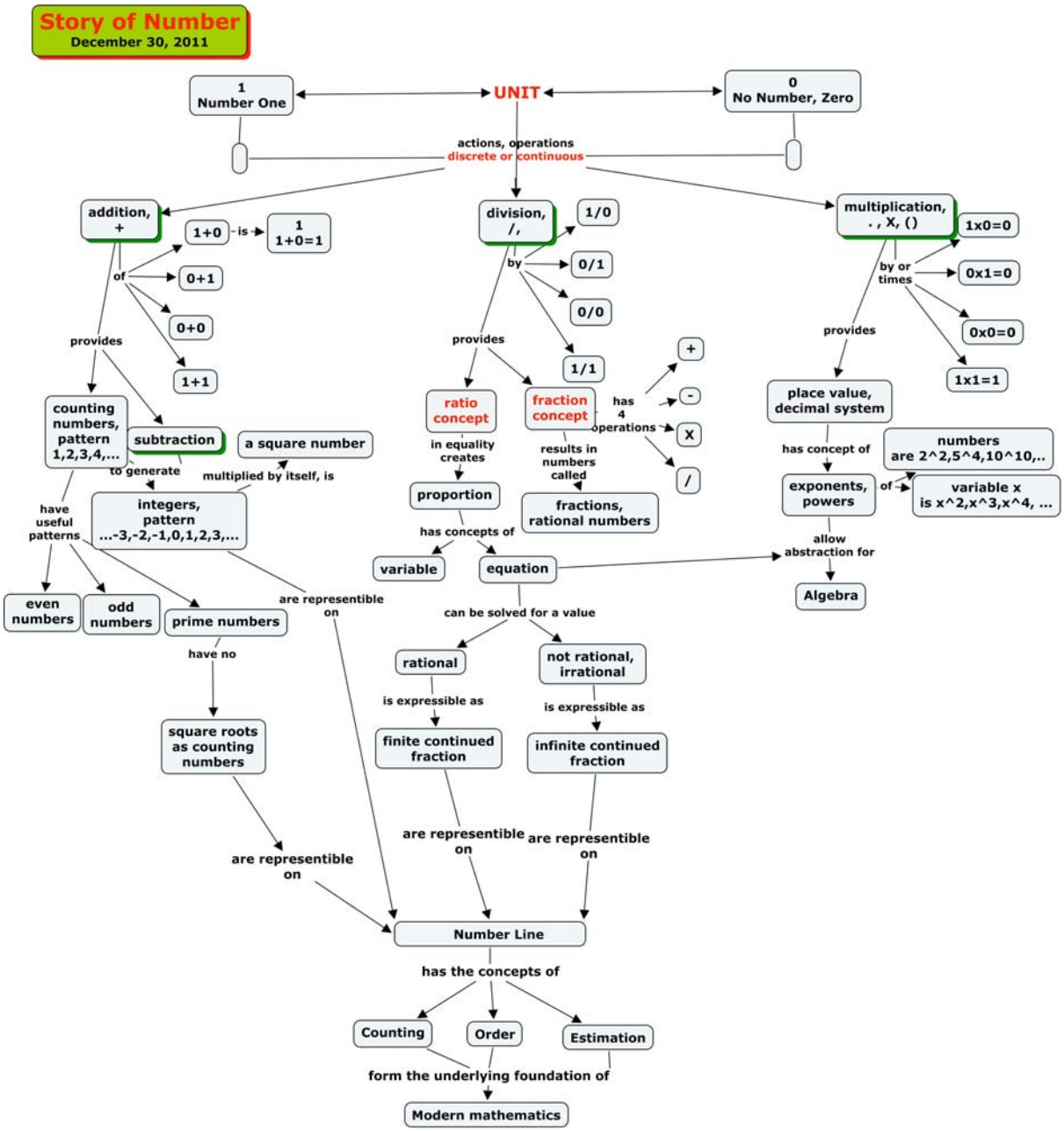

Figure 2. Story of Number.

Note that the concept map, when it evolves over several teaching research cycles, such as the one above, connects concepts from two perspectives: on the one hand, it provides the teacher-researcher in the classroom, a navigational direction and assists in the selection or design of instructional problems; on the other hand it aligns

this teaching of basic mathematics with the mathematical structure of the real number line, and thus creates instructional possibility at the basic level in accordance with mathematical sophistication that may not yet be within the means of learners, directly.

The above concept map is part of the larger learning environment created by the teaching research team. The design of the creative learning environment can be seen below through the way the concept map assists in this process. The needs of the classroom and the materials used for the purpose are detailed in the concept map shown next. This concept map is at the early stages of the design of the learning environment and hence is to be considered as one at the beginning of the evolutionary process. The above concept map is part of a series of concept maps for Arithmetic, Algebra and Statistics, all falling in the general theme of making sense of number.

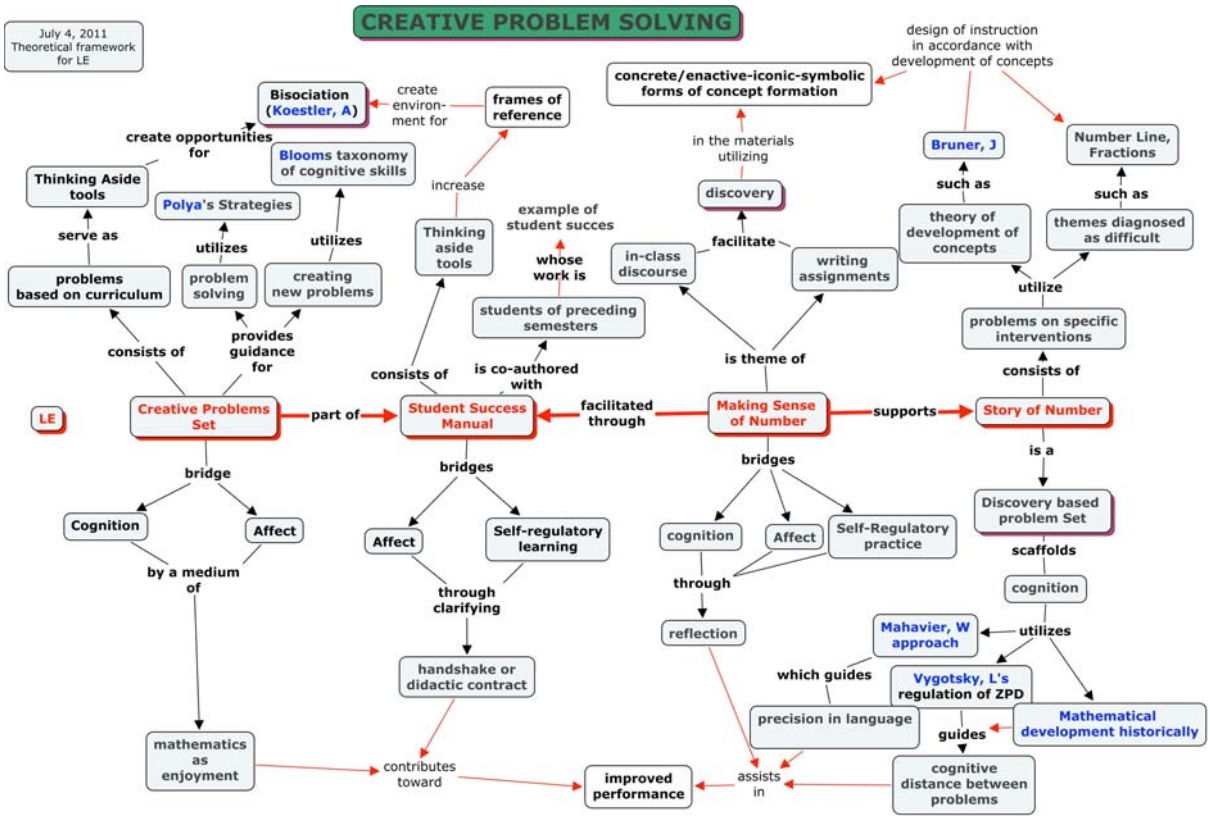

Figure 3: Initial design of the learning environment

Over the period of several teaching research cycles, a concept map such as the one above undergoes several revisions. The components which occur profusely in the above representation, acquire coherence in grouped categories, and the dispersed nature of the concept map changes as shown in the revised map below.

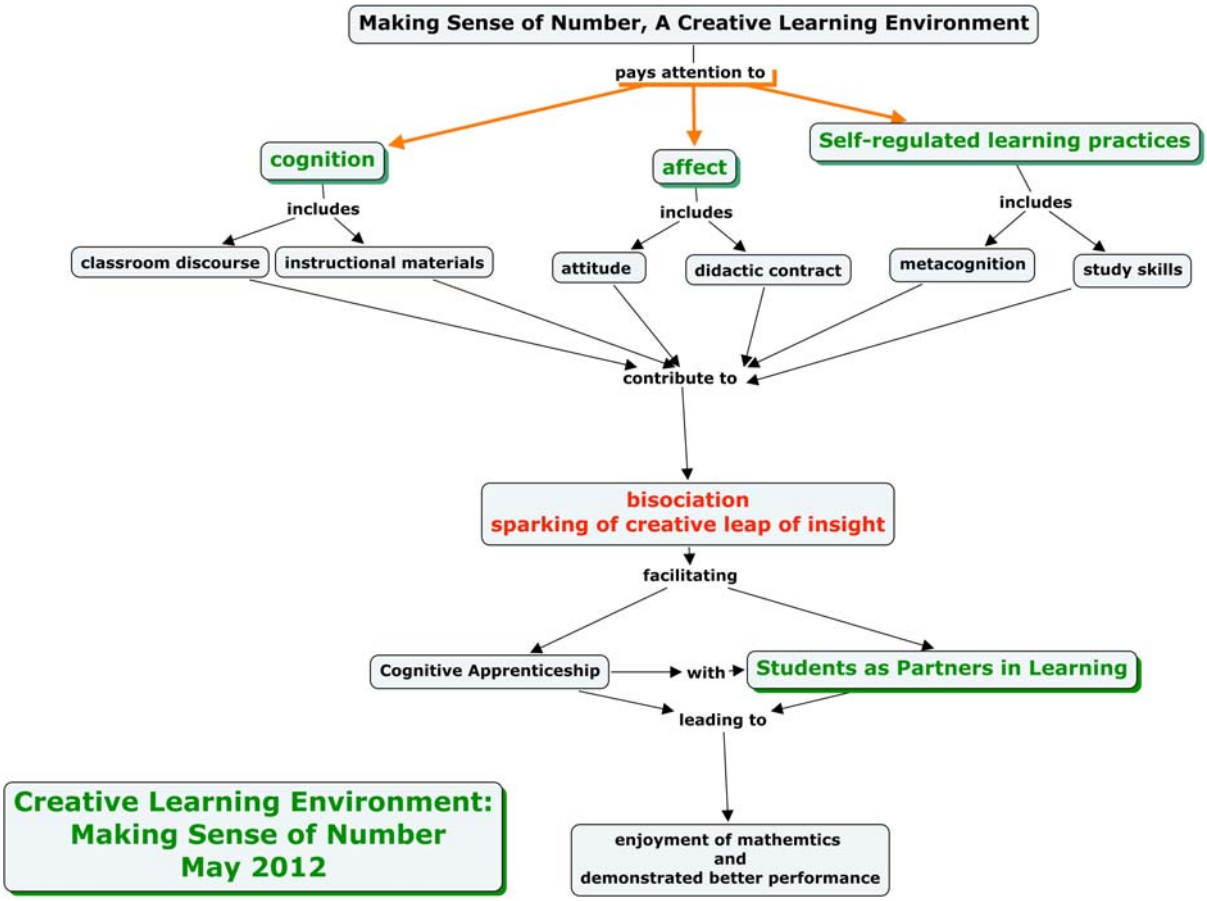

Figure 4: Evolving Design of the Creative Learning Environment

3 Summary

The use of concept maps in our teaching research work is multifaceted. It serves to organize knowledge and knowledge structures. Over a period of several teaching research cycles, the concept maps provide grounds for developing and connecting conceptual structures and allow for expansion into areas not formerly seen as intersecting with academic work. An example of developing and connecting conceptual structures can be seen in the concept map of *Story of Number*, where topics from Basic Mathematics and Modern Mathematics find connections and ways to enhance teaching, while simultaneously investigating the foundations of Modern mathematics. An example of expansion into new areas of thinking is demonstrated by the interdisciplinary nature of the concept maps involved in the design of learning environments. Conceptual structures develop that connect learning of mathematics in the classroom with learning of mathematics in general, outside the formal learning environment. By integrating concept maps with triptychs designed as instructional tools, the creativity of learners sparks bisociation (Koestler, 1964), generating new interest in learning. Since, Spring 2012, the teaching-research experiments, have begun integrating triptychs with concept maps in the classes of Arithmetic, Algebra and Statistics in the facilitation of the creative learning environment.

References

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Mahavier, W.S. (199) "What Is The Moore Method?" *Primus*, vol. 9 : 339-254.