VRUNDA PRABHU, HAIYUE JIN AND ROBERTO CATANUTO

3.5. USE OF CONCEPT MAPS IN CLASSROOM RESEARCH

INTRODUCTION

Concept map approach is a highly effective tool for the development and assessment of student conceptual understanding of mathematics and as such it belongs to the category of Stenhouse TR acts (Chapter 1.1). Teaching-research expands the utility of concept mapping to teacher's own reflection upon the coherence of the curriculum; Chapter 3.7 describes its use by a teacher-researcher as a guide in the formulation of a coherent curriculum out of the prescribed topics of remedial mathematics course, Chapter 3.6 is a full scope description of concept maps as assessment tool, while Chapter 3.8 describes use of concept maps by the teacher as the tool of finding the "common denominator" between the theme of the class and student interests.

Concept map is a graphical representation of knowledge and its construction within a particular domain. It is a network consisting of nodes and labelled lines. Nodes contain concepts, usually in boxes or circles. The relationships between concepts are indicated by connecting line segments or arrows. The labels in the lines are called linking phrases, and indicate how joined concepts are related. The linked concepts together with labels indicating the connecting phrases form a meaningfull statement. Together, this whole network of concepts and linking phrases represent student schema of knowledge relatively to the main concept to be understood mastered. Contemporary interest in concept maps dates to the work of Novak who saw them primarily as the assessment tools (Novak & Gowin, 1984). Concept maps have been extensively used in science education (Horton et al., 1993) but their usage in mathematics education has only slowly been acquiring momentum. Important in this respect was the use of concept maps in the context of modelling by Clark and Lesh (2003). The authors point out to the dual role of the concept maps as an education act and as a research act:

> using concept maps as a model-eliciting activity for teachers not only allowed teachers a tool to make sense of their own thinking but it was [also] purposeful in that teachers were designing concept maps to serve as curricular guides for student model-eliciting problems.

B. Czarnocha et al. (Eds.), The Creative Enterprise of Mathematics Teaching Research, 199–247.

More complete approach to the assessment of student teachers' knowledge using concept maps has been investigated by Afamasaga-Fuata'l (2009). He points out to the role of refinements through iteration in student teachers' construction of their concept maps confirming the central role of iteration in the TR/NYCity model, which has been pointed out in Chapters 1.1 and 4.3. Chapter 5.1 by Vrunda Prabhu develops and provides examples of artefact generalization through its iterated refinements with different cohorts of students. A concept map can address either an individual concept, a group of concepts or the conceptual organization of a thematic unit of the curriculum.

The concept map as the scaffolding guide both for a teacher and for a student has been one of central aspects of concept mapping for Prabhu. It guided the pathway of questions and hints which can be used by the teacher in facilitating student discovery of a particular connection between relevant concepts.She demonstrates importance of concept maps:

- as a means by which to provide students a snapshot of the big picture;
- as a way for teacher-researchers to design the problems in the instructional sequence; the structure of the concept map representation of the schema outlines the pedagogical design that will be implemented in the course;
- as an environment within which analysis of word meanings can begin and progress toward a shared understanding (Bruner, 1990).

Prabhu central interest here is in the facilitation of construction of students' schema of thinking by using the concepts maps of the full course as well as concept maps of the particular concepts. She guided herself in this work by the concept of Zone of Proximal Development created by the scientific concepts of the course concept map and the spontaneous concepts of students (Vygotsky, 1987).

The same concept maps can be also be used as a complete classroom or homework exercise in formulation of the full schema. Students might get a concept map either with empty concept boxes with individual relationships between concepts indicated or with concepts indicated but missing the relational phrases. Their task is then to find the missing concepts in the first case, and missing relationships – in the second case. The third exercise in this series might be the construction of the full concept map from a given list of concepts (Chapter 3.7). Chapter 3.7 gives a full description of the concept map as the assessment tool together with the method of assessing and grading them. The author of this chapter, Haiyue Jin, a Chinese educator from Nanging Normal University educated in Singapore has been specially invited to present the knowledge of a Singapure school of concept mapping initiated by Wong, K.Y. It is interesting to note the responses of students of the experimental cohort to the questions of the Attitude Towards Concept Map questionnaire designed by Jin and administered to all students in the cohort:

1. In which aspect do you think concept mapping is helpful?
2. Can you summarize your major achievement during this concept mapping period?

Students found that concept mapping was beneficial for review, memorization, problem solving and understanding. Aside from its use as an assessment technique, students found, responding to the question 2, that concept mapping helped with conceptual learning. They also reported that they better understood particular concepts when they were placed in a larger picture. In the discussion of results Jin comes to the realization on the basis of these student responses that concept mapping can also serve as the instructional tool during a regular class. Her results confirm our own understanding of concept maps as Stenhouse TR acts (Chapter 1.1).

Chapter 3.8 by the teacher-researcher Roberto Catanuto from a school in Switzerland presents newly formulated technique of using concept maps as medium for the "dialogue" between the teacher and students leading, in a three iterations, to the discovery of a common aspect "common denominator" between student life interests and the mathematical topic or theme of the class curriculum. Catanuto asks a central question, how can educator build an effective connection between the topic of the curriculum and interests and attitudes of students. The same question has been addressed, albeit differently, by several authors in this volume. Prabhu addresess it in Chapter 2.1 via imbedding relevant mathematics in a dramatical scene while Stoppel in Chapter 4.9. who searched, in the calculus context, for a proper modelling approach to fit student inclinations and interests finds mathematical exhibition organized by ministry of education to be the medium creating the necessary connection.

Robert Catanuto addresses it through "communication" between two concept maps. The steps described by the author bear certain analogy to the construction of the bisociative framework, consisting of MH (Mind Home) of a student representing students interests and attitudes, and of the Topic Concept Map (TCM) created by the teacher. Iterated extentions of each of the concept maps are aimed at finding the conceptual connections between the topic to be taught and the student interests, that is the "hidden analogy" introduced in Chapter 1.2.

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