CHAPTER 3

A MODEL FOR TEACHING RATIO AND PROPORTION USING AUTHENTIC INVESTIGATIVE ACTIVITIES

The model presented below is the basis used for constructing an instructional unit on the topic of ratio and proportion, whether for pre-service mathematics teachers or for in-service mathematics teachers participating in a professional development course.

This model reflects the authors’ theoretical perspective on the method of teaching ratio and proportion, a method that can, in their opinion, lead to a deeper understanding of the concepts, when those concepts are based on sound mathematical and psychological/didactic principles. In accordance with this rational, the core of the model is based on a process of experimentation, solving authentic investigative activities, during which students are exposed to the concepts while attempting to develop their awareness of proportional reasoning abilities. Additionally, theoretical and practical knowledge are merged, as practical knowledge combined with tools to integrate between that and the theoretical, will allow pre-service teachers to build on that theoretical knowledge and to use it as a conceptual framework for their professional knowledge (Leinhardt, Young, & Merriman, 1995; Ball & Cohen, 1999; Even & Ball, 2009).

BACKGROUND

Following a number of studies that demonstrated the difficulties that mathematics teachers in the elementary and middle schools had in understanding and teaching ratio and proportion, it seemed imperative to develop a teaching model to rectify this problem (Keret, 1999; Ben-Chaim, Ilany, & Keret, 2002; Berk et al., 2009).

An experimental teaching model was developed and employed in three research projects that were carried out in two teaching colleges in Israel over the course of three years (2000-2003). In all three studies, the model was used as a basis for a course conducted to pre-service teachers in training to teach mathematics. The studies assessed changes in their mathematical and pedagogic/didactic knowledge of ratio and proportion, along with changes in attitude towards the importance of the topic, difficulties they anticipated in teaching it and confidence in their ability to teach the topic in elementary and middle school after participating in the course.

The results of the studies indicate that a course on ratio and proportion based on our model allowing exposure to and practice in authentic investigative activities, combined with theoretical and practical knowledge produces teachers who
successfully solve the questions in the diagnostic questionnaire, and are able to suggest more methods for solving the problems, along with providing high-quality explanations for those methods. In addition, there was a remarkable improvement in their attitude to the topic from all standpoints (Ben-Chaim, Ilany, & Keret, 2002; Keret, Ben-Chaim, & Ilany, 2003; Ilany, Keret, & Ben-Chaim, 2004).

THE COMPONENTS OF THE TEACHING MODEL

The model has four interactive components. The main component, the core of the model, is the authentic investigative activities. Around this core are three supporting components: the first (Unit 1) gives a general description of the structure of the activities; the second (Unit 2) describes the structure of the didactic element, and the third (Unit 3) presents evaluation tools for use in the course. By keeping in mind the information in each of these units, the instructor can organize the presentation of the activities to advantage. In addition, there is a fifth component involving basic mathematical concepts (fractions, percentages, scale, etc.) which the instructor must consider when preparing the lesson.

Figure 1. Teaching Model Using Authentic Investigative Activities for Teaching Ratio and Proportion