

THE ROLE OF CONTEXT IN LEARNING BEGINNING ALGEBRA

Michal Tabach

Alex Friedlander

Department of Science Teaching, Weizmann Institute of Science, Israel

A context-based approach has both immediate, and more general advantages:

- It facilitates learning processes by providing a real or concrete meaning to an otherwise, abstract concept or algorithm.
- It provides points of reference – models that allow students to refer back at a more advanced stage of learning, when work is performed at a more abstract level.
- It raises student motivation and willingness to get engaged in learning.
- It emphasizes the potential of using algebraic models and skills in other fields.

Our experience shows that learning beginning algebra in context promotes a distinction between constant numbers and variables, and a better understanding of algebraic concepts and properties, such as lack of closure of algebraic expressions, and of equivalence of algebraic expressions.

The *Match Towers* problem situation belongs to a sequence of activities that form the core of the beginning algebra course in the *Compu-Math* materials for 13-year-old students (Hershkowitz et al., 2002).

The main task in this activity is to analyze the patterns of two sequences of “match towers” (Fig. 1). The first stages of the activity are:

- finding the number of matches for some specific cases (the tenth tower, for example),
- generalizing for the number of matches in the n -th “tower”,
- using and analyzing this generalization (for example, finding the place of the “tower” made of 40 matches).

In *Match Towers* and other similar activities, the students are involved in processes of generalization and as a result, they must consider **the meaning and notation of a variable** (in this case, the sequence place value), an expression (the changing number of matches) and a constant quantity. In our case, the obvious difference between the two sequences is in the towers’ constant base in the first sequence, as opposed to their changing base in the second. Thus, the context of the problem situation allows for a visual representation of a varying quantity -- such as the number of matches in some parts of the towers (for example, their vertical walls and horizontal ceilings), as opposed to the constant base (of 2 matches) for the towers in the second sequence. As a result, these quantities must be represented in different ways -- the first as an expression ($3n$) and the second as a number (2).

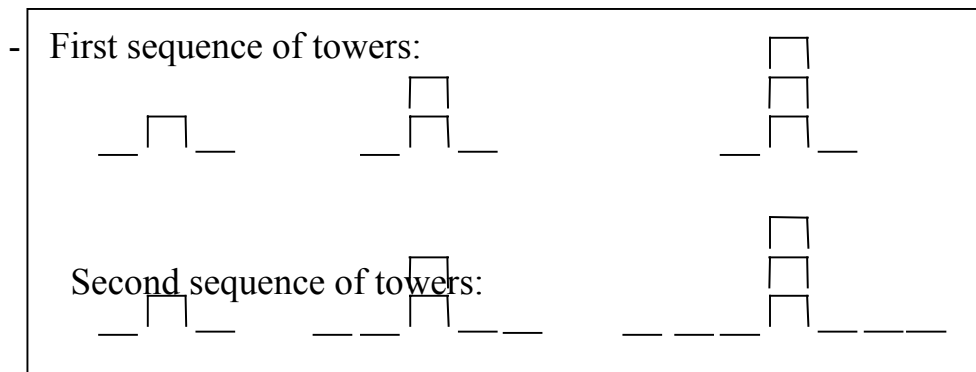


Figure 1. The *Match Towers* problem situation.

Classroom observations showed that attaching a visual, or other real meaning to algebraic terms, as a result of generalizing or modeling an authentic problem situation, is also effective in understanding the **lack closure of unlike terms**. As mentioned before, in the *Match Towers* activity, each term is given a visual meaning of a changing or constant quantity. As a result, the addition of like terms or the lack of closure for unlike terms are given a visual interpretation and understood in an intuitive way.

In a context-based approach, **the concept of equivalence** is raised by the natural need to compare different models that were designed by students to describe the same situation – and not by the arbitrary requirement to simplify abstract expressions presented by the teacher. Moreover, the meaningful interpretations, which are attached to each component of an expression and to the comparison of two expressions allow for a better understanding of the equivalence concept. In many context-based activities, an expression or another algebraic object reflects a method of modeling.

To conclude, we claim that learning beginning algebra at an almost exclusively abstract, symbolic level can cause many cognitive and affective difficulties. We claim that the provision of contextual meanings to algebraic objects, concepts and operations must occur already at the initial stages and accompany the whole process of learning – rather than presenting these meanings at more advanced stages, as possible applications. Our experience with developing a context-based algebra curriculum shows that this approach provides an important bridge between arithmetic and algebra and allows for a meaningful learning of algebraic concepts.

Reference

Hershkowitz, R., Dreyfus, T., Ben-Zvi, D., Friedlander, A., Hadas, N., Resnick, T. & Tabach, M. (2002). Mathematics curriculum development for computerized environments: A designer-researcher-teacher-learner activity. In L. English (Ed.) *Handbook of International Research in Mathematics Education* (pp. 657-694). Mahwah, NJ: Lawrence Erlbaum.