

# **Characterization of the living cell conceptions and aspects of macro-micro thinking of Junior-High school graduates in Israel**

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## Abstract

The cell is the smallest structural and functional unit of all living organisms. Understanding some of the cells' functions is considered essential for understanding the functioning of multicellular organisms. However, the cell topic was reported as difficult for students to comprehend, and many of them do not develop a coherent understanding of the cell as 'the basic unit of life'. A decade has passed since the change in the Israeli Science and Technology curriculum for grades 7-9 with regard to the cell topic. One of the changes in the new curriculum was the recommendation to teach the cell topic 'longitudinally' in conjugation with other study contents. This recommendation provides an opportunity to form meaningful relationships between biological phenomena at the macro-level and their cellular explanations. These kind of explanations can help students acquire a coherent understanding in biology. In this research I focused on a characterization of the living cell conceptions of junior-high school graduates, who studied the cell topic 'longitudinally' according to the new Science and Technology curriculum. In addition, aspects of students' macro-micro thinking and the type of relations they make along various organizational levels in biology were also characterized. This research is based on the constructivist theory, according to which, understanding is accomplished by an active reconstruction of information by the learner, and therefore his/her prior knowledge is essential to this process. Both quantitative and qualitative methods were used.

Even though a decade had passed since the change in the Science and Technology curriculum for grades 7-9, many gaps were identified in students' knowledge about the cell topic, and also a variety of misconceptions were found among the students' population with regard to the cell topic. Moreover, it was found that students are aware that the cell is the basic building block of all organisms, but are lacking the understanding of the cell as a functional unit in multicellular organisms. These findings point to a gap between the 'intended curriculum' and the 'attained curriculum' of the cell topic. The research findings regarding the macro-micro thinking of students show that they answer questions about a

biological phenomena at the organizational level in which the question was asked, and tend to explain their answer mainly at the macro level. In addition, I found that the connections and the relations that students are making between levels of organization are mostly constructive, and the minority are functional relations. These findings strengthen previous reports that students see the cell as a constructive unit of organisms, but not as a functional unit.

Other findings in this research were obtained using the 'Repertory grid' technique, which I found as a unique, interesting and informative method for examining students' ways of thinking and their thinking patterns, which can also enable to uncover students' misconceptions. In addition, some patterns or "rules", which could help to interpret the students' grids and their meanings, were also found. These findings can assist other researchers who may choose to use this method in the same context.

Recognizing students' conceptions and ways of thinking, regarding the cell topic, as reported in this research, adds another level of understanding to some previously reported students' misconceptions about the cell topic. It may also assist in finding suitable ways for teaching and assessing this topic in junior-high school.