

Cellular aspects of the learning topics reproduction and heredity: identification of comprehension difficulties, development of learning materials and their evaluation.

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(in Hebrew)

The living cell is one of the learning topics which appear in the junior-high science and technology syllabus, as part of the subject "organisms: phenomena, structures and processes". From the scientific point of view, understanding the main principle that a living cell is the structural and functional unit in all living organisms, is essential for understanding all the biological processes that take place in our world. However, from the pedagogical point of view reports on research which was conducted among junior- and senior-high school students pointed to difficulties in the comprehension of the living cell concept and its involvement in the processes of reproduction and heredity. The functional aspects of the living cell and its relationships to the entire organism were particularly found to be difficult to comprehend.

Initially, I identified comprehension difficulties and misconceptions among junior-high school students in the topics reproduction and heredity and especially the relationships between the microscopic and the macroscopic levels. The comprehension difficulties and the misconceptions were identified using questionnaires which were administered to one hundred 9th grade students from three different schools in two different time points, one following the learning of the topic reproduction, and the other following learning the topic heredity. In addition, attitudes questionnaires were given to twenty two junior-high science and technology teachers, in order to reveal the most common difficulties in understanding and misconceptions among junior-high school students according to the teachers' opinion. Following the preliminary investigation I developed nine learning activities, that were integrated into the teaching sequence of the already available junior-high school learning materials, in the topics reproduction and heredity. Those activities attempted to overcome some of the comprehension difficulties and misconceptions and attempted to assimilate the scientific knowledge. The contribution of one learning activity ("The influence of the genetic variation on the offspring gender") was carried out using pre- and post-questionnaires which attempted to evaluate the knowledge and understanding of the genetic variation among gametes and their influence on the gender of the offspring. The questionnaires

were administered to 9th grade students from three different schools, before and after instruction. In addition, interviews were carried out with two junior-high science and technology teachers that taught the learning activity.

The results of the preliminary investigation showed that the students have difficulties in understanding the microscopic level in four main topics: the fertilization process and its products, the genetic variation and its influence on the phenotypic variation, the mitotic cell cycle and the meiotic cell cycle. It was found that the learning activity "The influence of the genetic variation on the offspring gender" contributed to students knowledge and understanding of the genetic differences of the gametes and their influence on the gender of the offspring. The learning activity reduced to some extent students' misconceptions and increased understanding of the microscopic level among students. The understanding of how the gender of the fetus is determined, what are the genetic variations among the sperm cells and the differences between a sperm cell and an oocyte were found to be improved. In the interviews, the two teachers emphasized that the learning activity "The influence of the genetic variation on the offspring gender" focused on the chromosomal level and on the differences between chromosomes. In addition, teachers said that the learning activity helped to make connections between students' prior knowledge and the new knowledge which is presented in the activity. Therefore, the newly developed learning activity may lead to a better understanding of the topic even after a long period of time. In addition, the two teachers noted that the learning activity encouraged the acquisition of thinking and learning skills, inquiry and problem solving skills and also contributed to the students' pleasure from the learning process.