**Abstract**

The upcoming challenges of the twenty-first century require the blazing of a new trail in the teaching of science and technology, encouraging the training of the scientists and engineers of the future and based on the standards included in NGSS (Next Generation Science Standards, 2013).[[1]](#footnote-1) Science teaching is facing multiple challenges as a result of technology and the explosion of knowledge and channels of communication. Accordingly, the education system must adapt itself in these directions and equip its graduates with the skills needed for optimal functioning in the twenty-first century. This direction requires the updating of existing curricula to reflect the latest standards and content in science, as well as the inculcation of advanced technological means in teaching-learning-evaluation processes (NRC, 2013; STL, 2017). The standards included in the NGSS document reaffirm the assertion that research and metacognitive guidance lead to the discovery of new knowledge and contribute to the development of scientific literacy. Studies have shown that metacognitive guidance that constitutes the peak of higher-order thinking promotes meaningful study and understanding among students, develops scientific research skills, and improves the students’ motivation and attitudes regarding science studies. Accordingly, metacognitive guidance forms an integral part of teaching, learning, and evaluation processes in science classes. This study examined the impact of metacognitive guidance on the indices of knowledge of scientific content, research skills, and motivation and attitudes toward science studies among junior-high school students in laboratory environments. The study included the operation and evaluation of a study unit on the subject of photosynthesis in plants.

In order to examine the effectiveness of the metacognitive guidance, a research framework was developed including two groups: The trial group, which undertook research learning in the laboratory with metacognitive guidance, and a control group that undertook laboratory learning without meta-cognitive guidance. The study was undertaken in a sample of 124 students in the 9th grade aged 15-17.

The study included three key stages in both groups: A. Pre-learning; B. Implementation of the intervention plan; C. Post-learning. In the pre-learning stage, the study examined the aspects of: the students’ scientific knowledge about plants and their motivation and attitudes toward science studies. This examination was undertaken in order to enable the gauging of the changes caused through the implementation of the study unit. The intervention plan included teaching a study unit entitled Photosynthesis in Plants. During the program, research skills were examined. After the learning, the three indices mentioned above were examined: the students’ scientific knowledge about plants and processes in living organisms, such as photosynthesis in plans; scientific research skills; and the students’ motivation and attitudes toward science studies In addition to these indices, the study also examined meta-cognitive knowledge in the trial group only, before and after learning.

The findings show that in the trial group, a strong improvement was seen after learning by comparison to the control group in the three indices examined: the level of knowledge of the scientific content, the level of research skills, and students’ attitudes motivation and attitudes toward science studies following metacognitive guidance. In addition, the study examined the characteristics of metacognitive knowledge after the provision of metacognitive guidance for the students.

**The Impact of Metacognitive Guidance**

**Scientific Content, Research Skills, and Motivation**

**toward Science Skills**

**in a Laboratory Environment**

**Final Research Project for a Master’s Degree**

**in Science Education**

**Hemdat Hadarom College for Education**

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1. From: <http://www.nextscience.org> [↑](#footnote-ref-1)