Bridging between the dynamics of biological discoveries and high-school biology education

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Since biology is one of the most dynamic research fields within the natural sciences, the gap between the accumulated knowledge in biology, and the knowledge that is taught in schools, increases rapidly with time. Our long-term objective is to develop means to bridge between the dynamics of biological discoveries and the biology teachers and students. Members of the group are involved in all of the facets required to promote our major objective, including curriculum development and implementation of the curricula via numerous teachers’ workshops and in-school activities, as well as the research that nourishes all of our efforts.

The use of adapted primary literature for learning biology in senior-high school

The group issued a curriculum in developmental biology and a curriculum in biotechnology which are based on scientific research articles that were adapted to the knowledge level of high-school biology students. We hypothesized that learning using primary literature may be a way of developing a capacity for scientific ways of thinking among students. We found that learning through adapted primary literature provided a stimulus for question-asking by high-school students. The questions asked by these students exhibited higher thinking levels and uniqueness than the control group studying using a conventional program. We also observed that mere reading of adapted primary literature by high-school students resulted in superficial comprehension. However, when students were asked to answer questions about the text, deeper comprehension evolved. In addition, we examined the possible benefits of learning using adapted primary literature versus secondary literature, particularly with respect to their influence on the creation and formation of scientific literacy. We found that students who read adapted primary literature demonstrated better inquiry skills, whereas secondary literature readers comprehended the text better and their attitudes towards the reading task were less negative. A curriculum guide, which accompanies the adapted primary literature curriculum and contains authentic teaching episodes and a vast spectrum of questions and activities to be edited by the teachers, was designed on a CD-ROM. The curriculum guide was found to be effective in both educating and emancipating the implementing teachers.

The living cell as a longitudinal axis

The group developed learning materials about the living cell for the junior-high school population. In developing the new materials, we addressed the well-documented difficulties of most 7th- to 9th-graders in comprehending the concept of a living cell. It has been shown that students have difficulty understanding the microscopic-macroscopic relationships in living organisms, and the fact that as diverse as they may be in structure and function, cells are indeed the basic elements of all living organisms. To address these difficulties, we developed a strategy whereby the topic of the living cell is introduced together with the biological processes which are studied at a more concrete level in junior-high school, rather than as an independent topic, as is common practice worldwide. We are currently investigating the practical aspects of implementing this strategy in junior-high schools in Israel. We examined the pedagogical content knowledge of junior-high school teachers about the living cell topic. The majority of the teachers teach solely at the cellular-level at 7th-8th grades, while giving relatively minor attention to the possibility of simultaneously relating to several organizational levels. Such links were found to be created by the teachers only at 9th grade during the instruction of genetics, suggesting that the longitudinal axis model is not yet enacted in the educational system in Israel.

Deciphering the secrets of the genome through a computerized learning environment in bioinformatics

We have developed an internet-based learning unit in bioinformatics which includes related interactive activities, based on genome databases. In it, we adopted some of the strategies employed by molecular biologists today, in order to teach high-school biology
majors basic ideas in genetics. The unit includes interactive problem-solving activities that are based on human-genome databases and search engines. The environment is aimed at giving high-school biology students a feel for how scientists work in the field, as it exposes them to some of the tools and resources currently available in experimental molecular biology. We were able to show that learning through the bioinformatics environment promotes construction of new knowledge structures and influences students’ acquisition of a deeper and multidimensional understanding of the genetics domain. In addition, learning through this environment influences students’ comprehension of the practices and scientific ways of thinking.

Identifying students’ self-generated interests in science and technology

Our group has initiated a pioneering effort to probe K-12 students’ self-generated interests in science and technology using science and technology-related questions submitted by children, from Israel as well as from other countries, to a series of television programs and internet sites. One example from this research, shown in Figure 1, is the relative interest in zoology decreases with age, as the interest in human biology increases (p<0.0001). Our attempts to identify children’s self-generated interests may constitute an empirical database for identifying contexts, which might be more relevant to the interests and experiences of students. We can subsequently use this information for designing learning and teaching materials which are aligned with students’ interests.

Modern experiments in molecular biology for the high-school biology population

Most high schools are not equipped with the modern facilities that would enable carrying out laboratory experiments in molecular biology. We, therefore, recently designed and enacted modern experiments in molecular biology that can be carried out by high-school biology students and teachers in the laboratories of the Davidson Institute of Science Education, in the framework of The Center for Inquiry Labs, Nechmad project (in collaboration with the Davidson Institute).

We have also recently developed animations, as an additional attempt to bring modern molecular biology techniques into the high-school biology classroom. The animations are aimed to accompany our adapted primary literature based curriculum in biotechnology, as well as a newly developed unit in genetic engineering for high-school biotechnology majors.

Selected publications


Selected learning materials (in Hebrew)


Acknowledgements

Supported by grants from The Amos de-Shalit Israeli Science Teaching Center.