The Diagnostic Assessment of Scientific Literacy

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Framework for diagnostic assessment

The aims of science education are clearly reflected in the elements of the models created for the interpretation of scientific literacy (see e. g. Holbrook & Rannikmae, 2009) and in the theoretical frameworks of international assessments (OECD-PISA 2007): applying scientific knowledge in real-life situations, knowledge about the nature and methods of science, scientific investigation and attitudes towards science. One of the prerequisites to achieving the goals of effective science instruction is the regular collection of information on students' knowledge and the development of their thinking, and based on the results, assisting learning through special programs and individualized tasks.

Within the framework of the 'Developing Diagnostic Assessments' project of the Center for Research on Learning and Instruction of the University of Szeged the construction of a diagnostic assessment system of scientific knowledge is currently in progress, together with the development of a content framework of diagnostic assessments and the development of an item bank related to it. The content framework (Korom, B. Németh, Nagy & Csapó, 2012) covers three dimensions (thinking, application, and disciplinary), each of which describes the fields of assessment in three age groups (grades 1-2, 3-4, 5-6) and in three content fields (Physical Systems, Living Systems, Earth and Space). The three dimensions correspond to the three main objectives of science education: fostering thinking, application of knowledge and acquisition of disciplinary knowledge (Csapó, 2004).

Thinking dimension

The psychological dimension examines whether learning science improves general cognitive skills (e.g. analogical, deductive, probabilistic and proportional reasoning) and scientific thinking including IBL skills (e.g. formulation of research questions and hypothesis, prediction, designing experiments, identifying variables, collecting data, interpretation and explanation of results).

Application dimension

The application dimension is organized along the social expectations of learning and places the emphasis on the social usability of knowledge, its applicability in different contexts, knowledge transfer and the ability to create links between science, technology, society and the environment. The dimension examines the application of knowledge in everyday situations (personal, social, global contexts).

Disciplinary dimension

The disciplinary dimension gives priority to professional factors; it examines how well the students acquired the different subject matters of the science subjects (Physics, Chemistry, Biology, Geography) relative to the curricular standards in the well-known contexts of school activities.

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Computer-based diagnostic items developed in the eDia system

Within the framework of the project we have developed a system eDia (Electronic Diagnostic Assessment) suitable for online assessment. The test items follow the principles of the framework and make use of the opportunities provided by computer-based assessments. The type and appearance of the items and the mode of responding are varied. There is also opportunity to watch short videos and simulations. The item bank consists of items that are balanced along a number of different parameters, out of which the ones suited to a given assessment aim can be selected to construct a test for a specific purpose.

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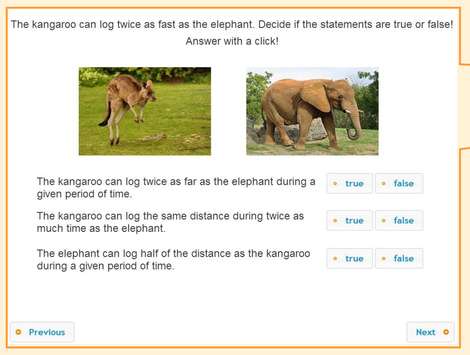
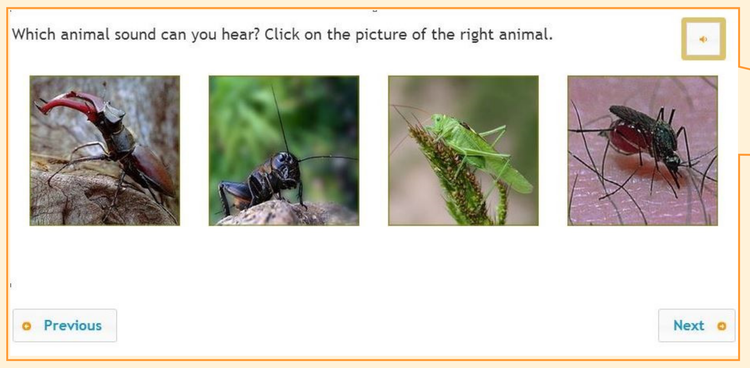
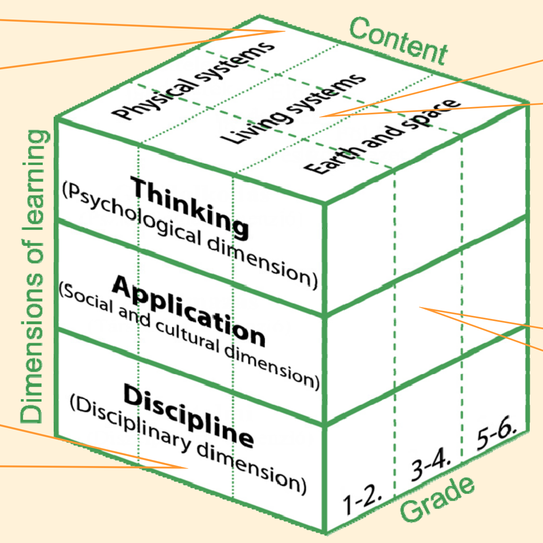
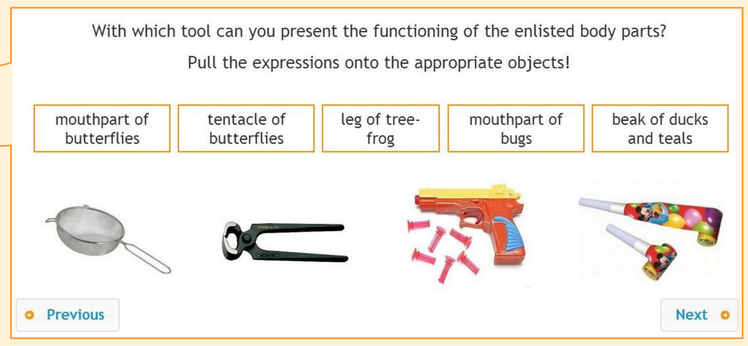
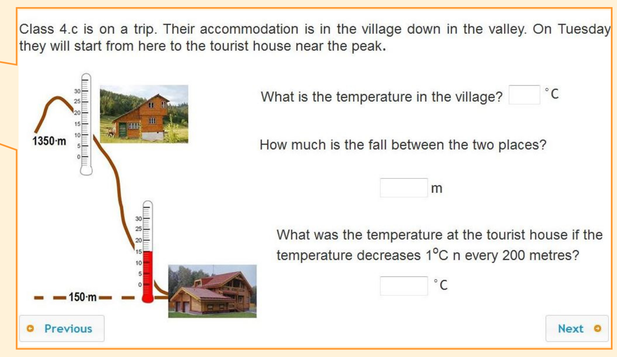


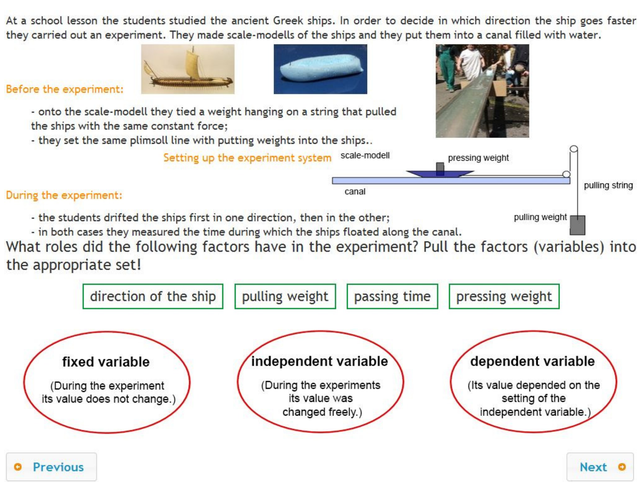








Sample tasks to assess IBL skills



The task assesses the ability to identify variables in 5th-6th grades. Students have to recognize the three basic types of experimental variables, decide what can change freely, what shows a value depending on the change and what factors need to be held constant for precise measurement.

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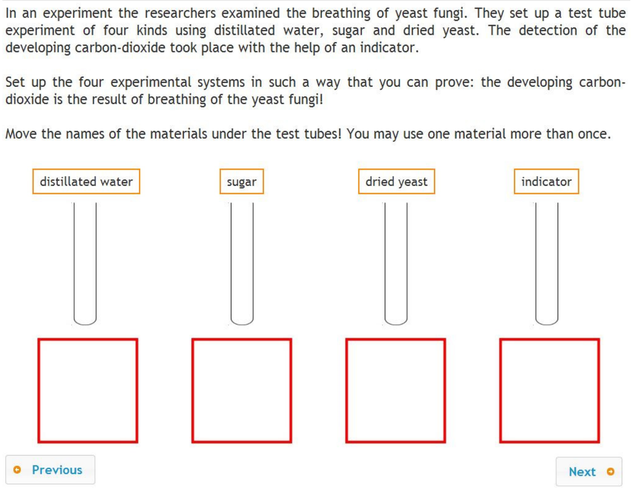
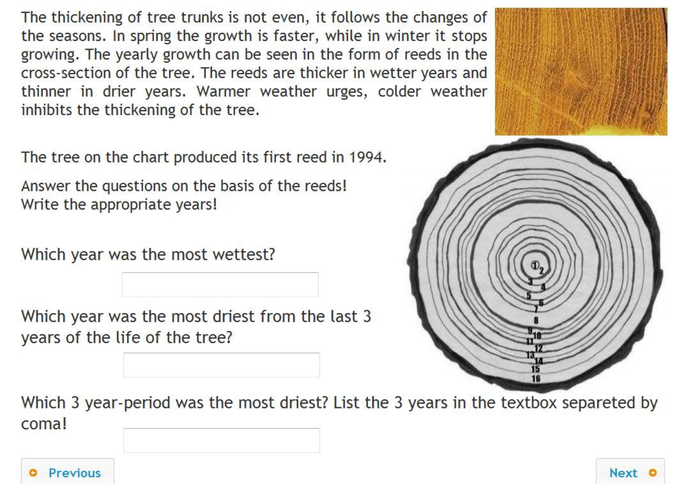


The task assesses students' ability to design an experiment. A given set of materials are to be put into four test tubes in such a way that the four combinations be suitable for examining the research question. The students have to recognize the role of solvent and indicator, set up separately and together the living sample and the mixtures containing the nutrient, and set up a blind test. The scheme to be recognized is the logical principle of one/ other/ both/ neither.



The task assesses students' skill of making inferences based on a given factor (amount of precipitation). The ability to judge the reliability of the inference could be tested with further questions, since the students have to realize that in this task other growth factors cannot be taken into account.

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