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TEACHING IN BIOLOGICAL SCIENCES AT PRIMARY SCHOOLS IN SERBIA – AN APPLICATION OF THE *HANDS ON* METHOD

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ABSTRACT

The project Hands on has been implemented in Serbia since 2001 in order to uplift and revitalize teaching of the natural sciences in Primary Schools and enhance a personal engagement by the pupils in different topics. In 2003, the Serbian Ministry of Education decided to put forward an optional course “Hands on – Discovering the World”, for children from 6 to 8 years old. Resources related to the biology have been occurred through seven modules, as follows: Plants, Food and digestion, Five senses, Growing and aging, Ecosystems, Environment. Knowing that topics in systematic biology are usually considered difficult and demanding, here we present the new, interesting, simple and creative way to teach systematics and classification since the early age, based on the Hands on method. New module refers to the classification of living beings, when teachers encourage their pupils to observe similar attributes, arrange the hierarchy of nested groups and classify animals discovering the evolutionary relationships of taxa.

Keywords: *Hands on* method, biological sciences, Primary School

Introduction

Hands on method aims to stimulate and support inquiry based science education (IBSE) starting from the Primary School by experimentation based on scientific method. The program for inquiry-based science education (IBSE) was started and coordinated by the French Academy of Sciences with the support of the many official institutions. The Project called *La main à la pâte* (*Hands on* in English) developed in 1996, within the scope of the IBSE approach. Since it has been created, operation included a broad network of teachers, trainers and scientists through world-wide. Shortly after initiation, program has met a large interest outside of France. The well-known and most famous scientists, such as a Nobel laureate in physics Georges Charpac, are among those who assisted in the *Hands on*. This project aimed at renovating science education in elementary schools, allowing exchanges and enhancing the development of good practices: teacher's training, evaluation, on-line projects and dissemination.

Focusing on interdisciplinary activities, several projects have been developed, which involve hundreds of schools at international scale (according to International section *La main à la pâte*, (2, 4), at www.inrp.fr/lamap). Briefly, general philosophy of *Hands on* method can be present through the following: science as investigation; something pupils do, not something that is done for them; teacher helps pupils to build their own knowledge; action, experimentation, interrogation, collective reconstruction; deeper understanding an oral or written presentation. In other words, instead of the classical schemes of memorization and concentration on scientific concepts and formulas, the „learning by doing“ methodology insists on the appropriation of knowledge through the individual investigation and questioning attitude, leading the children to learn by experimenting in partnership with the teacher.

Hands on activities (*Ruka u testu* in Serbian) in Serbia launched in 2001 by the physicists from the Vinca Institute of Nuclear Sciences; *Hands on* was immediately supported by the Serbian Physics Society and was taken up by many teachers and public opinion.

The main forms of *Hands on* action in Serbia touch a wide range of fields. They are increasing social awareness of the issues connected with science education, organization and participation to conferences, congresses and seminars. During ten years of participation in *Hands on* program, Serbia has also become a natural intermediary for linking the cooperative activities and workshops of *La main à la pâte* to South-East Europe. The participants had different background and they hold different positions, as follows: academicians, university professors, science educators active in teacher's training, curriculum development and research. The proceedings of all these meetings can be found at the following address: <http://rukautestu.vinca.rs/handson/index.htm>.

Thanks to the numerous training workshops, the *Hands on* method rapidly become widely known among teachers in Serbia. During these trainings, teachers are placed in the same pedagogical situation as children, and implement an inquiry based science teaching in their classrooms later. To date, four international schools for Southeast Europe in our country have been done, during which participants shared results and educational, pedagogical and scientific resources. To now, training workshops for more than 2000 teachers were organized, including one exhibition *Sciences à l'école: quelle histoire!* It is important to note that program *Hands on* in Serbia was also supported by the Serbian Academy of Sciences and Arts, the Serbian Ministry of Science and Technological Development, the Serbian Ministry of Education.

In order to uplift and revitalize teaching of the biological sciences in the Primary School and enhance a personal engagement of pupils in different biology topics, we have organized several workshops for the pupils, and seminars for the teachers, applying the concept *Hands on* in Serbia.

Materials and Methods

Science education based on the principle of an inquiry type teaching involves several steps in achieving its goal: building hypotheses, experimentation, teamwork and written expressions. Led by the children in small groups, teacher above all, provides the answers related to the initial hypotheses. This approach involves questioning the pupils about the real world, phenomenon or object, living or non-living, natural or manufactured. Instead of replying

immediately, the teacher throws the question back to the class, "And you, what do you think about it?" The simple experiment (observation, manipulation or measurement) then begun. Finally, the children will be invited to express their thoughts (as short statements, writing in an experimental notebook) being thereby obliged to enrich their vocabulary and, hence, their syntax. However, such routine scenario may be interfering from one of its elements. It can happen, especially when pupils performed experiments with living things.

Here we will briefly present modules so far related to the biological science in Serbia, as well as describe the most recent one "*Classification of living beings*", which has already been implemented in practice. It will be presented on the website <http://rukautestu.vinca.rs/> soon. This is the result of cooperation between Serbian team and staffs from *La main à la pâte* in France. Modul *Classification of living beings* is inspired and formatted by the model proposed by Lecointre et al. (7).

Results and Discussion

Activities in Serbia

In 2003, the Serbian Ministry of Education decided to put forward an optional course "*Hands on – Discovering the World*", for children from 6 to 8 years old. Course lasts about thirty hours annually and gives Serbian children the opportunity to discover science through initiation into the experimental approach (1, 5). Several books and *Hands on* manuals for teachers and parents have been translated and published in Serbian. Some of them are: *La main à la pâte, Seeds of Science 1, 2, 3, 4 and 5, Teaching Science at School, Discovering the World at Nursery School, Europe, Land of Discoveries*. Several others are in preparation. Teachers can also find large amounts of resources on the Serbian website <http://rukautestu.vinca.rs>, inspired by the original French site *La main à la pâte* and under the auspices of the French Academy of Sciences, the Serbian Academy of Sciences and Arts and University of Belgrade (6). The site accommodates approximately 500 pages of resources intended for Serbian teachers. The website offers description of experimental activities (in physics, biology, ecology and other scientific objectives), as well as the extensive scientific documentation written by different specialists. A possibility of exchange opinions between

scientists and teachers through the website have been developed recently, as well. The Serbian website offers resources in various languages and links towards similar international projects. It has approximately 200.000 connections a month. Resources related to the biology followed by descriptions of the teaching of seven modules, are *Plants, Food and digestion, Five senses, Growing and aging, Ecosystems, Environment*. All of the modules spread across the different educational cycles and different areas covered in the new teaching program (Fig. 1).

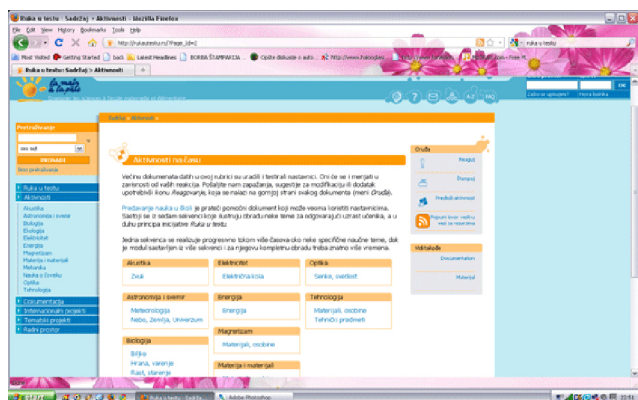


Fig 1: Home page of Serbian web site <http://rukaustestu.vinca.rs>

Module Classification of living beings

Knowing that topics in systematics are usually considered difficult and demanding, boring and complicated, here we present one innovative way to teach systematics in a Primary School.

The basic points: All living organisms are classified into groups. Grouping of organisms is based on the anatomical features and similar attributes. Scientific classification of living beings is based on the hierarchy of nested groups. Similarities between organisms suggest that all known species are descended from a common ancestor.

Duration: through five sequences (Table 1):

Materials and procedures: Pictures of various animals in similar dimensions printed on paper sheets A4 in three sets of different paper colours; scissors; glue; markers in different colors; notebook.

Cutting out printed animal pictures, observing their attributes, evaluating their similarity with other animals in the set, making decisions on criteria for separating, sorting and classifying animals (Fig. 2).

TABLE 1

Module sequences with short description of target concepts

| Sequences | Target concepts |
|---|---|
| <i>Observation and description</i> | Living beings are described and grouped based solely on the properties they have. Different organisms may have similar, i.e. common features. |
| <i>Separation</i> | Separation is binary concept that we use only for the comparison of organisms, without establishing their mutual connection and dependence. Each group of pupils chooses its own criteria, by which then sort the animals. |
| <i>Sorting by gradient</i> | Sorting by the gradient is a continuous approach, where the organisms being compared by the upward or downward gradient (for example: „from the biggest to the smallest one“). |
| <i>Classification</i> | Classification is a scientific approach on which the organisms are grouped solely on the basis of their common anatomical features. Classification involves the formation of groups (sets) of animals that fit each other (hierarchy of the characters). |
| <i>Analyzing results and writing notebook</i> | Understand the difference between separation, sorting and classifying organisms. The only method of classification is a scientific approach, grouping animals based on their parental and causal relationships. Similarities between organisms suggest that they are descended from a common ancestor. Recognize the importance of properly selected criteria, enable to define terms, make an experimental book. |



Fig 2: The practical work in the module *Classification of living beings*.

The *Hands on* method of learning is focused on the pre- and Primary School. With this method, children have a great ability to learn, spontaneously perceive natural phenomena, and learn science and language together. The concept „learning by doing“, helps them to develop cognitive processes, as well as the sense of curiosity and creativity. In front of new and unexpected concrete situations, they are invited to reason and argue. Inquiry-based activities allow them to acquire new communication skills, through open debates in the classrooms, and with the teacher (3). *Hands on* method also allows children to test ideas in a controlled environment and teach the importance of following directions and guidelines. Instead of accumulating large amounts of knowledge, teachers help the children to make appropriate scientific concepts and adopt experimental techniques through their own process of investigation. Children talk about expected results, discuss, and have fun discovering. In the case of module presented here, teachers encourage their pupils to observe similar attributes, arrange the hierarchy of nested groups and classify animals discovering the evolutionary relationships of taxa. Simple tools and three different procedures of separation, sorting and classification, could bring great improvement in teaching systematics of living organisms. On the other side, promoting the ‘common origin’ as the fundamental principle in evolutionary biology, leads to crucial understanding of the diversity among people, while emphasizing our common roots and humanity.

An early education in inquiry-based science could also provide a scientific literacy for all citizens, overcome social barriers and help the future of our societies. It would be of great importance, not only in order to give children basis in scientific knowledge, but also to aim at universalism, research, openness and responsibility. On the other hand, because of their interactions with scientists, teachers gain increased confidence and better understanding of science as a process (8).

Europe has apparently recognized the needing for rebuild the scientific education. We expect that innovation in teaching sciences will give substantial results in Serbia, as well. Our next step will be the collaboration in the frame of the European Project FIBONACCI, the European network for developing and disseminating concepts of

inquiry-based education in mathematics and science, under the call *Science in Society-FP7*.

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