

# INTERACTIVE HYPERMEDIA SOFTWARE FOR SCIENCE TEACHING BASED ON HISTORICAL AND PHILOSOPHICAL APPROACHES OF SCIENCE

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## Abstract

In recent years a different pedagogical framework has been formed, whose main elements are the integration of Information and Communication Technology (ICT) in the teaching-learning process and the introduction of the concept of interdisciplinary approach of knowledge in the Greek Science Curriculum. This ascertainment, combined with the proposal for the contribution of History and Philosophy of Science in Science teaching, constituted the theoretical platform for the development of the educational software "Travelling in the World of Ideas", which is an interactive hypermedia application for the study of philosophical ideas and scientific achievements of ancient Hellenism of Southern Italy (Magna Grecia).

## THEORETICAL FRAMEWORK

The integration of ICTs in the teaching-learning process forms a completely different pedagogical framework, as ICTs constitute a powerful cognitive tool to support Science Teaching. The combination of sound, picture, photo, animation and video is made possible by the significant development of hypermedia techniques, in a way that attracts pupils' interest (Dimitrakopoulou 1999). Moreover, the applications of virtual reality, the three-dimension graphics, as well as the simulations and visualization techniques enrich the learning processes and for that reason are proposed as the sound foundation for the design and development of completed computational environments for science teaching (Mikropoulos 2003). More specifically, the researchers propose the development of hypermedia applications that contain simulations of historical experiments, in cases where the reconstruction of historical experiments and the creation of historical laboratories that help children to overcome the difficulties that they face in the understanding of natural phenomena, are expensive and not feasible. These simulations are drawn in such a way that permit the pupil to re-experience the processes of generating and interpreting the original data in its physical context, thereby casting light on the difficulties faced by the original investigators in arriving at the meanings of what they "saw" (Klahr & Simon 1999).

At the same time, an intense increase of interest in the contribution of History of Science in Science Teaching has grown very considerably on an international scale (Matthews 1994), restoring with new terms G. Holton's and the Harvard's Project Physics core idea on science teaching (Holton 2001). The basic argument for this proposal is that Science Teaching should be combined with the teaching of its nature and its historical evolution. This evolution reflects the development of human thought for the understanding of the natural environment through a fascinating route of discoveries and inversions of previous ideas, as it also happens, proportionally, with the development of children's thought (Skordoulis 2003). Science Teaching may incorporate the History of Science through the development of learning situations and activities that facilitate the learning of the content of Science and promote the cultural and humanitarian dimension of Science (Holton & Brush 2001). In such learning environments pupils can develop a sense of how science really happens by learning something of the growth of scientific ideas, of the twists and turns on the way to our current understanding of such ideas, of the roles played by different investigators and commentators, and of the interplay between evidence and theory over time (Lin et al. 2002). Concrete episodes of the History of Science, which describe how famous scientists faced their theories experimentally and evolved them, e.g. the study of density by Archimedes, support pupils' efforts to understand the research methodology in an authentic learning environment (Allchin et al. 1999). Such historical examples can be combined with innovative methodology, such as the practice in reasoning, justification and comprehension so that pupils are able to think critically and analyze the stimuli of the environment extensively. The pupils' deprivation of their ability to be involved in situations of questioning, querying, observing, reflecting, and discussing constitutes a serious disadvantage in our educational system, leading learners to acquire knowledge segmentally, without being taught in an interesting, systematic and causal manner (Trilianos 1977).

Within the above conceptual outline the educational hypermedia application "Travelling in the World of Ideas" was developed. The dominant thematic direction is the study of philosophical ideas and scientific achievements of Hellenism of Southern Italy and via an original scenario is attempted a) the understanding of the human spirit's evolution, the comprehension of science and its applications in combination with the study of Hellenic culture of Southern Italy and b) the awareness by the pupils that the philosophical and scientific theories are closely connected with technological achievements.

## THE EDUCATIONAL SOFTWARE "TRAVELLING IN THE WORLD OF IDEAS"

### Pedagogical documentation

The development of the software "Travelling in the World of Ideas" is based on the theory of constructivism, as it was formulated by Vygotsky, according to which learners do not transport knowledge in their memory from an exterior world, but they create interpretations of the world based on their previous experiences and their interactions with the natural, social and cultural environment mastering new tools of thinking (Raptis & Rapti 2006).

The educational software "Travelling in the World of Ideas" endeavours to the pupils' link with the eminent Greek philosophers of Southern Italy. Children, looking for answers to some fundamental philosophical issues a) understand the evolution of human thought, science and its applications through the study of Greek culture of Southern Italy, b) connect philosophical and scientific theories with technological achievements and c) learn, by using a cross-thematic method, notions of Science, as density, buoyancy, forces and levers etc.

The software is addressed to 6<sup>th</sup> grade primary school pupils and first two classes of secondary school pupils, giving them the opportunity of dealing with inquiring activities that cover all phases of knowledge acquisition.

### Software Creation

The hypermedia software "Travelling in the World of Ideas" was built entirely with the authoring tool Flash MX Macromedia. The choice of this particular authoring tool was judged as most suitable, as the Flash software provides a dynamic environment of creation of hypermedia educational applications because it allows not only the combination and the harmonisation of sound and movement but also the feature of interactivity as well. These applications can be distributed in compact disks, for executing by PCs locally or can be uploaded and executed via the Internet.

### The content of application

The content of application researches and analyzes the development of the Greek philosophical thinking from the 7<sup>th</sup> century B.C. until 5<sup>th</sup> century B.C. During this period pre-Socratic philosophers develop and study, for the first time, the philosophy and science as holon, creating the rational foundations of western philosophy and science.

The plot of the software content is based on the scenario of philosophical journey of a child, named Jason, who tries, in an adventurous and easy to handle way, to discover the main directions of pre-Socratic thinking and to combine that philosophical reasoning with the scientific breakthroughs of then revealing in this way to his five friends (who tried to find him) not only the greatness of thinking of Greek philosophers, but also the decisive importance that it had in the evolution of Science until today.

### Pedagogical design suitability

The software "Travelling in the World of Ideas" offers pupils the opportunity of an active and exploratory participation in the learning process, mainly in the field of activities, which have been drawn in order to provide a higher percentage of interactivity. Attention was given in the simplicity and clarity of texts, as well as in their compatibility with the age-related and cognitive level of pupils that it is addressed to.

The educational software provides the possibility for individual learning as well as collaborative learning. Collaboration can be developed at the phase of working out the activities and mainly at the discussion phase during the process of informative material that is included in the software.

Self-assessment via the activities that are contained in the software “*Travelling in the World of Ideas*” is also available. This evaluation system neither uses percentages nor any other form of quantitative evaluation. Instead it offers some kind of symbolic reward in case of completion of activity or supports information feedback for the didactic utilization of pupils’ errors.

#### Degree of interactivity

The educational software “*Travelling in the World of Ideas*” devotes a high degree of interaction not only in the part of informative material but also in the part of learning activities, where the pupil participates actively and does not watch passively and uninvolved the alternation of texts or even pictures on a screen. A high degree of interactivity is also noticed in the part of activities where the pupil can execute virtual experiments, make measures, develop writing skills, compose musical themes or paint and finally play ancient games.

The child controls the flow of the software, having the possibility to navigate freely and explore the paths that he or she decides essential (freedom of navigation and control by the children, Raptis & Rapti 2006).

The activities have been structured so as to give the possibility of more than one attempt for their completion. Moreover, stages of help are given to the pupils after certain erroneous trials and children find the right answer utilizing didactic their errors.

#### EVALUATION OF HYPERMEDIA APPLICATION “TRAVELLING IN THE WORLD OF IDEAS”

The educational software “*Travelling in the world of Ideas*” was evaluated, by 6<sup>th</sup> grade Greek primary school students during its development to avoid mistakes in its pedagogic and educational layout. During the evaluation the pupils pointed out problems related to:

- Informative material of the software; certain texts needed to be modified, in order to be compatible with the age-related level of pupils
- The effectiveness of certain simulations; the children proposed the degree of user’s control of the simulations to be increased and the number of hyperlinks and hot spots to be decreased in order to avoid multilayered querying.
- The structure of certain activities; the pupils faced problems during their engagement with certain interactive activities and as a result expressed negative judgements concerning the high level of difficulty of certain activities. Furthermore, they proposed the existence of supporting feedback of information in case of erroneous trials or choices.
- Quality of graphic design; the pupils did not like some graphs, especially the graphs of the characters of the software, and they argued for the use of moving cartoons instead of static icons.

After the analysis of all the pupils’ comments, the software was modified, according to the results of the evaluation in specific domains, such as the content, graphic design and the structure of activities.

#### CONCLUSIONS

As far as the cultural approach to knowledge is concerned, the success of the process of knowledge building depends to a great extent on the

pupils’ readiness to match the culture of their everyday life with the culture of science. For this reason children have to be facilitated by being involved in meaningful and contextualised Science learning activities.

The hypermedia software “*Travelling in the World of Ideas*” was developed taking into consideration the above ambitious proposition. It is an innovative effort to integrate fundamental philosophical ideas and scientific theories of Greek pre-Socratic philosophers, especially those who lived or experimented in the colony of Magna Grecia in Southern Italy. This attempt is in agreement with the wider demand for creating new learning environments that reinforce and promote the innate curiosity of children and encourage their desire for research and discovery.

The main conclusions arising from the data analysis of the pilot implementation of the software “*Travelling in the World of Ideas*” in a small number of the 6<sup>th</sup> grade Greek primary school pupils, showed that the children developed sufficient insight concerning the unbreakable relationship between philosophical ideas and scientific theories, they understood science as a sociocultural procedure that takes place in a specific historical framework, and they were facilitated in understanding fundamental notions of Science in a contextualized learning framework.

The future main research, which will investigate the learning outcomes of the implementation of the software, is expected to lead to some significant data concerning the potential educational effectiveness of the software “*Travelling in the World of Ideas*”.

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