Editorial

The thematic focus of the fourth issue of the CEPS Journal is visualisation in education. Thus the main purpose of this issue is the presentation of the use of visualisation elements in different areas of education. The submitted papers were mostly from the field of science education, and the review of the manuscripts resulted in only papers from science education being published.

Visualisation in education relates to a specific way of teaching and learning content in various subject areas (natural sciences, mathematics, social sciences, languages, art) with the aid of specific images. With the assistance of visualisation elements, so-called visual learning takes place. This encompasses a familiarity with systems of symbols within scientific disciplines and the development of an ability to interpret the meaning of a particular concept with the use of these systems, all of which are presented with some kind of representation. The following content areas are presented in the papers published in this issue of the CEPS Journal: (1) visual representation as a tool for: (a) illustrating concepts, (b) problem solving, (c) explaining ideas, (d) assisting individuals' mental models of concepts and their integration into the individuals' already existing mental scheme of the concepts, and (e) identifying and changing misconceptions; and (2) the importance of different ICT visualisation approaches in the process of learning.

Visualisation is used in science education in its broad spectrum, from static physical models and different types of pictures to multimedia animations and interactive simulations of science phenomena. Modern ICT visualisations (animation, simulations and virtual reality) are becoming an increasingly important tool for presenting abstract and complex phenomena that were previously impossible to present to students at different levels of education. These interactive simulations and virtual reality environments can offer students active learning and opportunities to manipulate science phenomena to the level they feel comfortable with while learning science concepts. As Gilbert (2005a) pointed out, the two main roles of visualisation in education are to visually represent science concepts (external visualisation) and the formation of the learners' mental model of the represented concept (internal visualisation). He also stressed that although external visualisation is a more frequent subject of science education research, internal visualisation must also be understood as an important research issue. An important aspect of visualisation in education lies in the fact that textual learning material has a linear structure, and thus offers the least support for developing adequate mental models. Therefore, 2D and 3D visualisation, and especially dynamic representations such as multimedia and interactive simulations supported by modern ICT, offer the learner the greatest support in developing the internal visualisation of science concepts. Visualisation should tell a story in the process of learning. Based on an analysis of science textbook visualisation, Tversky (2005) suggested that two types of visualisations dominate: structure visualisations (diagrams showing the special and conceptual relationship of a specific part of scientific phenomena) and process visualisations (diagrams showing changes in scientific phenomena over time). They also concluded that many representations combine both types in order to show different important aspects of the presented phenomena to the learner.

An important aspect of visualisation that is not well researched in the field of science education is the concept of metavisualisation, which can be interpreted as a part of metacognition (Gilbert, 2005b). It can be suggested that future research should be focused not only on the types of external visualisations that are important for learners' understanding of science concepts, but also on the importance of learners' understanding of their mental model forming. Various research strategies should be used to explore these aspects of presentations in science education, especially strategies focusing on qualitative approaches to determining learners' internal visualisation (Vogrinc & Devetak, 2007). Finally, it is important to emphasise that visualisations are an essential part of teaching, understanding and creating scientific ideas (Tversky, 2005), and as such an important and interesting area of science education research.

In the present issue of the CEPS Journal, four papers from respected authors from different countries, including Turkey, England, Scotland, Australia and USA, discuss visualisation in science education.

The paper by B. Timur and M. F. Tasar entitled *In-Service Science Teachers' Technological Pedagogical Content Knowledge Confidences and Views about Technology-Rich Environments* presents teachers' confidence in technological pedagogical content knowledge and illustrates their views about using technology-rich environments (TRE) in science instruction, which is an important issue. The authors discuss the importance of computers and related information communication technologies in enabling visualisations of various scientific concepts, natural phenomena and mechanisms by creating technology-rich environments (TRE). It is important that teachers are aware that TRE offer them opportunities to visualise science phenomena that might be difficult or impossible to view, dangerous to conduct experiments about, impractical or too expensive to bring into the classroom, or too messy or time consuming to prepare in a school laboratory. However, they note that science teaching cannot and should not be undertaken entirely by TRE, but that it is nonetheless absolutely imperative for science teachers to know how to integrate technology into science classrooms. This paper addresses challenges faced by in-service science teachers when creating TRE and gives suggestions for successful TRE integration into science teaching. Timur and Tasar present results and discuss findings showing that in-service science teachers have a low level of confidence in using TRE during science teaching. Teachers participating in the study, however, stressed their need for professional development activities regarding the effective and meaningful use of TRE in science teaching.

In the second article of the present issue, *Student Engagement with a Science Simulation: Aspects that Matter*, S. Rodrigues and E. Gvozdenko propose guidelines for forming interactive science simulations. The authors try to illustrate the importance of multimedia technology that affords an opportunity to better visualise complex relationships often seen in chemistry, describing the influence of chemistry simulation design facets on user progress through a simulation. Three versions of an acid-base titration simulation were randomly allocated to 36 volunteers to examine their interactions with the simulation. The impact of design alterations on the total number of interactions and their patterns were analysed according to specific factors, namely: (a) the placement of a feature on the screen, (b) the alignment of the sequence of instructions, (c) additional instructions prior to the simulation, and (d) the interactivity of a feature. The authors also present interactions between individual factors, such as age, prior experience with science simulations and computer games, perception of the difficulty of science simulations, and general subject knowledge, on one hand, and the efficiency of using the simulation, on the other hand. The results show that the centrality of the position of an element significantly affects the number of interactions with the element, that re-arranging the sequence of instructions on the screen in a left-to-right order improves the following of instructions, and that providing users with additional written advice to follow numbered instructions does not have a significant impact on student behaviour. The results also indicate that the interactivity of a feature has a strong positive correlation with the number of interactions with that feature, which warrants a caution about unnecessary interactivity that may hinder simulation efficiency. The authors concluded that neither prior knowledge of chemistry nor the age of the participants has a significant effect on either the number of interactions or the ability to follow on-screen instructions.

In the paper entitled *Exploring the Impact of and Perceptions about Interactive, Self-Explaining Environments in Molecular-Level Animations,* A. Falvo, M. J. Urban and J. P. Suits report on a study of university students' perception of using interactive animations of the submicroscopic level of chemistry concepts in the learning process. Using the mixed method of pedagogical research, the authors also investigate perceptions of the animated learning tool used. This study explores principles of cognitive psychology designed to investigate the main effects of treatment and spatial ability and their interaction. The results show that science majors score more highly than non-science majors in retention measures (i.e., structure and function) but not in transfer. Significant main effects were found for treatment in function questions and spatial ability in structure questions. There was a significant interaction between treatment and spatial ability in structure questions. Additionally, the authors of this study reported that participants believed the key and the motion of ions and molecules were the most helpful parts of the animation. The study also shows that students perceive the animations as being supportive of their learning, suggesting that animations do have a role in science classrooms.

The last contribution to this thematic issue about visualisation in education is entitled *Visualisation of Animals by Children: How Do They See Birds?*, in which S. D. Tunnicliffe describes pupils' mental models of birds. She emphasises the fact that children learn to recognise animals from their earliest years through actual sightings in their own observations of their world, but also through second-hand representations in various forms of media. Young learners begin with a template specimen, to which they refer when they see another animal that resembles it, naming the animal accordingly. Gradually, they learn to distinguish members of the subordinate category – bird in the case of the present paper – into subcategories. The author examined drawings as a means of accessing students' mental models, and through their interpretation she studied students' representations of both phyla and species. She also used interviews with participants in order to explain the students' drawings. The results show that as children mature they observe more and more details about the birds they see, thus increasing their knowledge not from school but from their own observations outside school.

Later in this edition, we find one paper in the Varia section by B. Šteh and J. Kalin, entitled *Building Partner Cooperation between Teachers and Parents*. The authors present the goals of teacher-parent cooperation, various potential models of establishing mutual cooperation, and conditions for achieving quality interactive cooperation. They discuss the partnership model as the optimal model of interactive cooperation between teachers and parents, as it includes the distribution of expertise and control with the purpose of ensuring optimal education for children. In the second part of the paper, B. Šteh and J. Kalin present findings of an empirical study carried out on a representative sample of Slovene primary schools. Teachers and parents were asked to give their opinions regarding the need for mutual cooperation, to express their view of each other when fulfilling their respective roles, and to state where they perceive the main obstacles to mutual cooperation. The results show that building positive mutual relationships between teachers and parents is a prerequisite for improving successful cooperation.

In the third part of the present issue of the CEPS Journals, there are two reviews of monographs. The first book is entitled *Facilitating Effective Student Learning through Teacher Research and Innovation* (2010) by editors Valenčič Zuljan, M. and Janez, V., published by the Faculty of Education of the University of Ljubljana (ISBN 978-961-253-051-8), and the second is entitled *Play Space [Prostor igre]* (2011) by Tomšič Čerkez, B. and Zupančič, D., published by the Faculty of Education and the Faculty of Architecture of the University of Ljubljana (ISBN 978-961-253-053-2).

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