The role of information and communication technology in science teaching and learning

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Dr. Piet Kommers is an Associate Professor at the University of Twente and Lecturer at Fontys Academy in the Netherlands. His specialties are educational technology and cognitive ergonomics. Conceptual representations for learning has his major interest. For the UNESCO institutes in Kiev and Moscow he made studies into new didactic methods based upon ICT tools and infrastructures. New PhD studies are planned into the rationales for adaptation and userinterfaces. Summer schools for PhD students are planned in Finland and Malta. Piet Kommers will chair the ICALT-2006 conference in FONTYS Academy in the Southern Netherlands.

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University degree courses (including science teacher preparation programmes) and professional development programmes are undergoing rapid changes in a global effort to respond to the new requirements of the knowledge society. There is renewed optimism that a new generation of programmes will respond to the need for increased emphasis on flexible learning and thinking skills and, within our science courses, information and communication technologies (ICT) will serve as a medium for attaining a new equilibrium between expertise, value systems, thinking, collaboration, and personal and development skills.

At the same time, the rapid development of ICT has led science educators to take a closer look at the processes of science teaching and learning in our schools and universities. There has been a shift from the use of science as a vehicle through which students learn and use IT skills to the use of ICT skills as tools to assist learning in science. There has also been growing interest in the use of ICT to support whole class teaching and learning that challenged the role of both the teacher and the student. This development affects the epistemological, philosophical and socio-cultural traditions in both science and schooling, and raises new questions about the effectiveness and impact of technological applications on science education. For example, are our educational systems measuring up with regard to the innovative potential of ICT applications? To what extent are there gaps between objectives and educational practice? Which innovations exist and what is the evidence of their effectiveness? What effect do the continuing developments in web-based technologies have on the collaborative aspects of learning environments?

Research in this domain has a long way to go. However, its results have already demonstrated that ICT has an important role to play towards optimising science teaching, learning, and management processes (Crook, 1991; Watson, 1993; Schofield et al., 1993; McFarlane and Friedler, 1998; Ely, 1999; Mooij, 2004):

- ICT can help to present science curricular themes, concepts and sub-concepts, to different learners or groups of learners at different places at different times and assist in evaluating the learning process.
- ICT can also help to assess each learner's initial and evolving competence.
- ICT can provide for stimulating learning experiences.
- ICT can record and evaluate progress in relation to specified outcomes.
- Students are more highly motivated when their learning is supported by ICT and are more engaged in activities, which result in increased interest and longer attention span.
- ICT can provide access to a huge range of resources that are of high quality and relevant to scientific learning.

- The ICT multimedia resources that are available enable visualisation and manipulation of complex models, three-dimensional images and movement to enhance understanding of scientific ideas.

- ICT widens the range of material that can be used in science teaching and learning to include text, still and moving images and sound, and increases the variety of ways that the material can be used for whole class, group and individual learning. This means that a teacher can go some way to meeting the needs of students with different learning styles.

- Computers also allow repetitive tasks to be carried out quickly and accurately so that more student time can be spent on thinking about the scientific data that have been generated.

- ICT provides opportunities for teachers to be creative in their teaching and in finding innovative ways of facilitating student learning.

- ICT could enhance the scope for learners to engage in responsible self-regulation and self-evaluation of learning processes and outcomes.

Despite the advantages that ICT appears to offer to science teaching and learning and the rapid developments in hardware and software which mean that a great deal is now possible, there remains a considerable gap between the aspirations of experts and the realities of the classroom. The purpose of this special issue is to present the role of ICT in support of science teaching and learning. It attempts to describe current practice and to identify and to clarify some of the issues that face schools and colleges in trying to improve the ways in which they make use of new technologies to enhance teaching and learning in science. It does not claim to cover comprehensively every aspect of ICT in science but aims to contribute to current thinking about this topic.

The papers in this volume were selected from a total of 267 papers presented at the Sixth International Conference on Computer Based Learning in Science (CBLIS 2003), held on July 5–10, 2003 at the University of Cyprus, in Nicosia Cyprus. The papers selected for this special issue were then reviewed anonymously by two members of an International Review Committee.

We are proud to host papers from all the areas of current thinking in this discipline. In particular, there are four papers that compare computer-based learning to experimental learning environments, one paper on web-based learning environments, one paper on lifelong learning, and three papers on modelling and simulation environments.

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