

## COMPUTER-BASED COGNITIVE TOOLS IN TEACHER TRAINING: THE COG-TECH APPROACH

Emrah Orhun\*

### INTRODUCTION

This paper describes an international collaboration for training teacher educators in using computer and information technologies in education. This initiative has been taken by the COG-TECH (Cognitive Technologies for Problem Solving and Learning) Network which aims to foster collaboration between the European and the Mediterranean countries in the field of information technologies in education. The initiative includes three projects (MED-CAMPUS Project B-359 and C-359, 1993-1995, and INCO Project 973367, 1998-2001) funded by the European Commission. The main purpose of these projects is to train teacher educators in the Mediterranean countries to use computers as effective pedagogical tools. Under the auspices of the European Commission, COG-TECH introduces teacher educators to a set of computer-based cognitive tools in international summer schools and local workshops. Applied research conducted as part of the projects have addressed issues such as the development of appropriate content for training teacher educators to use cognitive tools in teaching, the identification of the strengths and limitations of several tools for different learning situations and the factors affecting the implementation of IT innovation in education.

Cognitive tools are devices learners can use to transcend the limitations of the mind in activities of thinking, learning and problem solving (Pea 1985). Computer-based cognitive tools are believed to serve as catalysts for facilitating development of meta-cognitive awareness and generalized self-regulatory skills (Lajoie and Derry 1993). Examples of computer-based cognitive tools that have been used to support learning include Logo, microworlds, semantic nets, concept mapping, idea processors, hypermedia, knowledge-based/expert systems, Prolog and computer-supported cooperative work applications (Kommers et al. 1992). In addition to being based on a sounder epistemology, cognitive tools are also more generalisable and transferable tools which can support multiple outcomes (Jonassen 1992).

The training programmes aim to facilitate the development of the following know-how by the target group of teacher educators:

- Knowledge of a set of computer-based cognitive tools and an understanding of their potential and limitations for teaching and learning.
- Knowledge of learning theories like constructivism and their implications for teaching and learning with computer-based cognitive tools.
- Knowledge of a set of pedagogical strategies and didactic scenarios that will foster meaningful learning and development of metacognitive skills.
- Competency in using one or more computer-based cognitive tools for a range of pedagogical goals.
- Knowledge of criteria for selecting and assessing educational software.

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\* Department of Computer & Information Science, Troy State University Montgomery, AL 36103, USA.

- Knowledge and skills sufficient to join or form networks among schools of education and primary and secondary schools using information and communication technologies.
- Awareness of the need for changes in the roles of the teachers to act more as facilitators and managers of learning, encouraging self-directed learning and co-operation, and less as transmitters of knowledge.

### COG-TECH SUMMER SCHOOLS AND WORKSHOPS

The training activities of the projects include international summer schools and national follow-up workshops, which introduce the participants to a set of computer-based cognitive tools. One of the goals of the summer schools has been to train some of the participants to a level sufficient for conducting similar training in their countries. Three summer schools and six workshops entitled "Computer-Based Cognitive Tools for Teaching and Learning" have been organized since 1994 in Turkey and Jordan. Altogether 110 educationalists from 16 countries have taken part in the summer schools and 140 teachers have been trained in the workshops.

The question of which computer-based cognitive tools should be included in the training programmes has required a balance between the interests of those COG-TECH partners who have integrated computers in their teaching and the needs indicated by the partners representing Mediterranean countries. The opinion of several external experts was also taken into account in selecting the software and finalising the content of the programmes. During 1994-96, concept mapping tools, Logo, control technology, computer-mediated communications, expert systems and Prolog were included in the training programmes (Orhun et al. 1997). The software used in the teaching and learning activities included PDC ESTA expert system shell and Prolog, SemNet, Learning Tool, TextVision, Inspiration, Geomland and Logo. Control technology equipment included Lego Dacta Control Lab and Fischer-Technik materials. Computer-mediated communication activities were conducted using Netscape, Hotdog, WinPmail, IRC, Institute and Collage software. The summer schools were conducted largely through hands-on activities and project work. There were two theoretical lectures and two panels concerning epistemological and pedagogical issues and approaches to information technology in initial teacher education in the participating countries.

The evaluation of the training involved summative evaluation of the programme and assessing the usability of the tools used. The usability of the software was measured by The Software Usability Measurement Inventory (SUMI) developed by Human Factors Research Group at University College, Ireland. Usability questionnaires completed in the second week showed Netscape, Hotdog, Inspiration and Esta were all found to be reasonably usable by the participants while LEGO Logo and Prolog were less satisfactory to use. The participants increased their level of confidence in using the tools significantly at the end of the summer school. As a result of the feedback received from the participants, the training activities of year 2000 focussed on a smaller number of tools. The Summer School on Computer-Based Cognitive Tools for Teaching and Learning, held in 2000 in Turkey was organized around the following six modules with the indicated software tools:

1. Theory of computer-based cognitive tools (Interactive Physics)

2. Concept Mapping (Inspiration)
3. Expert Systems (PDC ESTA)
4. Computer-Mediated Communications (NetObjects Fusion)
5. Virtual Reality for Learning Special Topics (Cosmo Worlds)
6. Integration of ICT in Education and Didactics

The summer school started with a short introduction to project objectives and computer-based cognitive tools and introduced all of the tools during the first week. Participants started to present and discuss project ideas on the fourth day which were further elaborated on the fifth day. The overall aim of the projects was specified as to develop learning and teaching materials using a set of cognitive tools in an integrated manner. In parallel to the project work, participants were asked to form committees to address some of the issues related to the implementation of IT innovation in education and to the dissemination of the project results. On day 12 the participants presented their projects. All the projects developed web-based learning materials using the available tools (except ESTA). The committees also presented their reports on the same day.

#### OUTCOME OF THE SUMMER SCHOOL 2000

Participants were given several questionnaires on day 12 to collect data on their experiences with the tools (usability measures) during the school, and on their evaluation of the school. The results indicate that the participants were introduced to new concepts and tools during the summer school. After attending the summer school the participants significantly increased their level of understanding of the tools, their confidence in using the tools, as well as their confidence in designing curricula and implementing curricula using the tools. The levels of confidence reached in designing or implementing a curriculum using the tool is in general lower than the level of understanding or level of confidence in using the tool. This may indicate a need for more emphasis in the summer school on designing curriculum that embodies computer-based cognitive tools. The highest levels of understanding and confidence were achieved for Inspiration, which was followed by NetObjects Fusion. The participants indicated that they were very likely to use these two tools within the next year. The likelihood of use within the next year was significantly lower for ESTA and Interactive Physics compared to the other tools.

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