

Eastern Europe into closer association with the present European Union; and (2) that there is a strong push to incorporate an entrepreneurial model (a strong theme of the University of Twente as noted on its Web page) rather than a bureaucratic or academic model into long-term development.

A final note comes from the inclusion of the work of Lev Vygotsky and colleagues as the providers of the theoretical base for much of the work. It emphasizes that these partnerships are two way, with important understandings flowing both eastward and westward.

Each of the three articles provides a different view of these partnerships: the Kommers article showing the high level policies and the broad overview, the Pelgrum and Voogt article for reporting survey results from Central and Eastern Europe, and the final Voogt article giving an account of a pilot project in physics education at three sites in the Russian Federation and in Holland. The thread that runs through all three articles is the pervasiveness and power of information and computer technologies (ICT).

I wish to thank my colleague, Plon Verhagen at the University of Twente, for serving as Guest Editor and thereby providing readers of this column with this remarkable view into the workings of educational technology in the countries of Eastern Europe.

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International Review Editor

Information and Communication Technology (ICT) for Education: Research and Development for the Educational Integration of Technology in Eastern European Countries

by Piet Kommers

□ The many ongoing educational projects among Eastern and Western European countries potentially bring various learning effects, the most common being cultural cross-fertilization. Nowadays the more student-oriented learning practices of Western Europe tend to reorient the more teacher-oriented model of Eastern Europe. The European initiative to support projects in the Tempus and the Copernicus stream can be seen as a substantial survival factor for educational institutes in Eastern Europe. The Tempus policy in terms of "actions" is exemplified in two parallel Copernicus projects on Telematics and Multimedia for Universities in Moscow, Kaunas, Kiev and Sofia. These projects reflect a European attempt to stimulate information and communication technology (ICT) in education. A major conclusion drawn from these projects is that opportunistic media plans for educational reform may finally turn out to be survival factors for the more traditional State-funded institutes rather than the market-oriented training companies that soon suffer from too fragmented investments and a lack of coordination.

Introduction

Based on prior collaborative projects between Eastern and Western European countries, we have collected a number of significant initiatives for ICT integration in real school life. A first line of input is formed by the series of East-West Conferences on Educational Technology held in Moscow (ICSTI '92), Kiev (ICCTE '93) and Simferopol (EW-ED '94) respectively. The three conferences culminated in the book *New Media and Telematic Technologies for Education in Eastern European Countries* (Kommers, Dovgiallo, Petrushin, & Brusilovsky, 1997) showing the state of the art in Eastern European media research and providing an atlas of major research groups and a directory for joint Euro-

pean projects. Its main conclusion was that having started from early pedagogic, sociologic or historic materialistic views, most of the initiatives were eventually overtaken by new media and software engineering opportunities. At the same time it became obvious that didactic and paradigmatic choices should be made. Also it was the conclusion that researchers tend to concentrate their contributions on a focused and hence restricted media scope. More and more attempts were made to provide overall scenarios for learning in the media landscape, promoting a shift from the more formal aspects of computer-based instruction to the dissemination and integration of new media in the real school, academic and corporate training settings.

East-West Conferences on Educational Technology: Theoretical Perspective

From the early '90s these meetings shifted from purely exchanging information between previously separate worlds toward scientific discussions where both Western and Eastern partners were clearly aware of each other's paradigms and agendas. The early meetings after the dispersion of the Soviet Union showed that many Western educationalists knew more than their Eastern colleagues (at least in the more theoretical sense) about Lev Semenovich Vygotsky (1896–1934) and his collaborators including Alexander Luria and Alexei Leontiev, who helped to create the body of research now known as the Vygotskian approach. Vygotsky (1962) provided an alternative to Piaget's view that cognitive development is essentially a process of maturation similar to biological growth by strongly claiming that the main factors in cognitive development are the social contract and the cultural context as a whole (Driscoll, 1994).

Through the period of east-west separation Vygotsky's "Activity Theory" and its further incubation in Galperin's "stepwise procedure" (Galperin, 1959) became quite influential in the West (see, e.g., Gindis, 1996, 1997, 1998, 1999). On the other hand, the Western partners were often surprised by the meticulous studies of United States instruction theorists made by

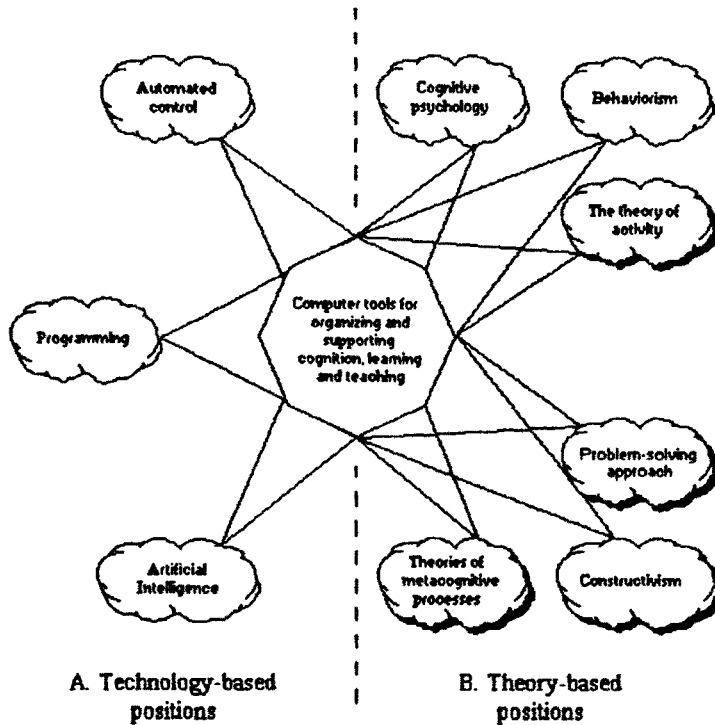
Eastern scientists. Besides Moscow and St. Petersburg, Kiev's Glushkov Institute for Cybernetic Research played a prominent role in the reconciliation and further continuation of both historic materialist and Western learning theories based on behaviorism and other instructional theories. This institute, now called the UNESCO International Research and Training Center, is prominent in the architectural design and implementation of advanced computer-based learning systems. Alexei Dovgiallo was one of the founders. Dovgiallo claims that we need to fit the historical elements in the relation between theory- and technology-based notions (Dovgiallo, Bykov, & Kommers, 1997). This should lead toward new and dedicated psychological and pedagogical theories on media-oriented learning. Dovgiallo approaches the analysis and appraisal of computer tools for cognition, learning and teaching from different perspectives (Figure 1).

Between 1930 and 1950 in the Soviet Union the psychologists and educators remaining there worked in small groups trying to implement ideologically restricted tasks in education while at the same time some scientific schools in Moscow, Leningrad, Kiev, Kharkov, Tbilissi, Kasan, and Novosibirsk attempted to reconcile Vygotsky's theory with Western theories (J. Piaget, M. Wertheimer, V. Köhler, K. Koffka, G. Watson, A. Thorndike, S. Freud, V. Shtern, K. Levin, etc.). During the 1960s the theory of the stepwise procedure in the formation of mental actions (Galperin, 1959) underwent a technology-oriented synthesis with the theory of activity and the ideas of automated control together with behaviorism of Skinner, Crowder, and Glaser, and formed a basis for the so-called *programmed instruction*. According to Dovgiallo (1997), this combination made programmed instruction rather popular and widespread at that time in the Soviet Union.

European Funding of Educational Projects in Eastern Europe: Tempus, Phare, and Tacis

Since the early '90s the European Union (EU) has actively promoted and sponsored Western

Figure 1 □ Analysis and appraisal of a computer tool for cognition, learning and teaching could be made from different perspectives (Dovgiallo, Bykov, & Kommers, 1997).



initiatives to stimulate and codevelop educational projects in the former Soviet states. The Tempus program is the trans-European cooperative scheme for higher education. Whereas Tempus forms part of the overall program of the EU for the economic and social restructuring of the countries of Central and Eastern Europe (the Phare Program), the Tacis Program aims at economic reform and recovery in the Newly Independent States (NIS) (and Mongolia). The associated countries for Tempus Phare are Bulgaria, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, the Slovak Republic and Slovenia. The Tempus Tacis countries are: Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, Kyrgyz Stan, Moldova, Mongolia, the Russian Federation, Tajikistan, Turkmenistan, Ukraine and Uzbekistan. Both Phare and Tacis recognize two types of projects, namely Joint European Projects (JEPs) and Compact projects (CPs).

Since 1991, Tempus has defined three action lines:

1. Tempus Action 1 provides support for JEPs linking universities and enterprises in eligible countries with partners in the EU. Project grants may be awarded for a wide range of activities according to the specific needs of the institutions concerned, including curricular development and overhaul; integrated study courses; development of teaching materials; training and retraining of teachers, particularly in the field of modern European languages; the provision of short, intensive programs; the development of language and area studies; and distance learning. Support equipment and documentation necessary to implement a JEP could also be eligible for funding.
2. Tempus Action 2 serves as a scheme for direct financial support of students from eligible countries, for full-time study at a university in a member state of the EU for between three months and one academic year. Priority is given to students whose

studies are part of a JEP, or who intend to become teachers or trainers on their return (with specific attention for language learning). Also, grants are available to students from universities in the EU to spend a period of study in a university of an eligible country. Action line 2 also supports a wide range of options for the exchange of university and industry staff teachers for teaching or training assignments for short visits as well as for longer periods.

3. Tempus Action 3 supports complementary activities such as projects involving exchanges of young people and youth organizers between member states and eligible countries; participation in the activities of European associations (notably associations of universities); facilitation of publications and other information activities of particular importance for the overall objectives of Tempus; studies and surveys analyzing the development of higher education and training systems in eligible countries; and technical assistance including coordination of the monitoring and evaluation of Tempus.

It may be clear from the stated actions that the Tempus approach has opted for a breadth-first strategy: attempting to address as many Eastern European countries as possible, while at the same time acting as a platform for horizontal actions among other funding streams as well. The development of new curricula and newly organized institutes has a high priority. This means both traditionally state-controlled and new market-driven schooling institutes have a chance to be supported. The priority is given to those participants (both persons and institutes) that have already been linked to a JEP. The major complication from this decision was that during the mid-90s unexpected numbers of Tempus-related scientists stayed behind in the Western host countries. As a result, later Tempus policy has given priority to Western visits to the East. An overall complication is the need to master English as the second language. Younger staff members and even students of the former Soviet schooling institutes speak English. This means that Tempus has heavily invested in English training courses, as was the case in the INCO Copernicus Project MATEN, which will

be described later. Though the impact of these English courses should not be underestimated, it soon became clear that they could not reach the substantially larger target groups. So far those who already have a good basis in English fluency mainly use the courses as stepping stones in their careers. A more recent element in Tempus's complementary activities is to give priority to associations of universities. So far this element has not been implemented strongly. Looking to critical success factors, however, it becomes clear that a focused accumulation of experience in the Western partner is essential to build up sustainable relations that can survive temporary constraints such as staff members who resign from the Eastern partner institute or infrastructures that fail during telematics experiments.

Between 1993 and 1996, the EU invested a total of 67.6M ECUs in restructuring higher education in the NIS and Mongolia by supporting 296 preparatory projects, 22 CPs and 85 full-scale JEPs. In the Phare countries alone, to date, some 1,500 JEPs have been implemented. There has been a mobility of more than 50,000 professors and 27,000 students from 2,200 higher education institutions, with a budget of 601M EC for the period.

INCO-Copernicus

The EU program INCO-Copernicus involves countries in Central and Eastern Europe and aims to strengthen cooperation and exchange with these countries. The program receives a five-year budget earmarked for international cooperation to redeploy the scientific and technological potential of formerly Communist Europe, which should help to augment economic and industrial structures. A description follows of two INCO-Copernicus projects that have been based on preliminary contacts between the Faculty of Educational Science and Technology of the University of Twente and partner institutes in Sofia, Moscow, Kiev and Kaunas (Lithuania).

The Copernicus FDLTN Project

The Copernicus FDLTN (Flexible and Distance Learning through Telematics Networks: A Case for Teaching English and Communication and Information Technologies) project was established to study how computer tools are affecting the ways in which instructional tasks are accomplished. The project explores the interplay between a computer-based design courseware environment employed in the creation of distance courses by subject experts, including the user interface designers and the software engineers supporting the technology. The Copernicus FDLTN project plan formulated: "New information technologies applied within all phases of education have a significant effect on basic literacy of a population, permitting a widespread application of Communication and Information Technology (CIT) in all areas of social practice. The expectations are that establishing nationally approved standards on CIT in education will draw the Central and Eastern European (CEE) countries and NIS of the former Soviet Union closer to already developed technologies in many well developed countries. CIT applications for flexible and distance learning have to contribute to the rapid integration of CEE and NIS countries into the European Community."

The finally approved Copernicus FDLTN project is highly concerned with intellectual teamwork, where people work together over substantial periods of time to create information-intensive products. The variations of the members' needs over time suggest that different communication modalities may be useful at successive stages in the life of a long-term project. Computer-mediated communication (CMC) is often used for some of these stages. To assess the utility of CMC for the various types and phases of intellectual teamwork, experiments were conducted in which participants carried out complex collaborative writing tasks. Assessed were the effect of task divisibility and communication modality on work processes, group performance, and individual experiences, as well as the extent to which group members felt that the group was a viable and cohesive social identity.

Groupware can never substitute for the social

and organizational integration of team members, but it can fill many of the inevitable logistical, knowledge, and communication gaps that always arise, especially in large or dispersed teams performing complex tasks. More precisely, the Copernicus FDLTN project tried to achieve the following general goals:

- To explore the concepts of collaborative learning and collaborative work. What does collaboration mean? What does collaboration mean in learning; in work? What are the differences between collaboration and cooperation? What are the learning implications of different theoretical perspectives on collaborative learning? Can the concept of collaborative learning "learn" from collaborative work and vice-versa?
- To explore in-depth the problems and possibilities of computer-mediated collaborative (distance) learning. There are different concepts of computer-mediated collaborative (distance) learning and of problem-oriented project work. The purpose was to examine more deeply the different approaches.
- To produce an overview of tools currently available for supporting collaboration at a distance and to evaluate some of them more deeply.
- To explore, in-depth, learning in a computer-supported collaborative learning environment: designing the artifacts to support collaboration, teaching collaboration, and understanding distributed social cognition.

The project had five main operational strands:

1. To establish Internet connections and working practices between 2 EC (The Netherlands and UK) and 3 CEE and NIS (Ukraine, Bulgaria and Lithuania) countries for collaborative research and teaching (expertise from Universities of Exeter and Twente).
2. To develop models for lifelong flexible, and distance learning (FDL) in communication and information technologies for teacher training that are appropriate for the CEE and NIS countries and valuable for EC countries (expertise of Sofia, Twente, Kiev, and Kaunas).

3. To develop and distribute a range of software to enhance teaching and learning, especially CIT and computer-aided language learning (an area of expertise of both Kiev and Twente).
4. To develop and disseminate a modular teacher-training course in communication and information technologies to support teachers who teach natural sciences and humanities in Bulgaria, Lithuania, and Ukraine (expertise of Twente, Kiev, and Sofia).
5. To establish and support teachers of English as a foreign language in CEE (Bulgaria, Lithuania) and NIS (Ukraine) countries as case studies in the application of telematics networks and services to flexible and distance learning (expertise of Exeter, Sofia and Twente).

The Copernicus FDLTN project significantly contributed to fundamental and applied research in many areas such as information technology, communications, languages, psychology and education. Its interdisciplinary nature was its major strength, especially as it was reflected within the principal scientific staff. The proposed research builds a technology-based bridge between CIT teacher training in the CEE, NIS, and EC countries. It offers a model for flexible and distance learning that allows learners to acquire skills and knowledge at their own pace, to choose the location of study (at home, at a workshop, at school, etc.), to choose the time for the group sessions, and to navigate in a modular curriculum by using flexible learning materials based on CIT. A significant contribution to the development of CIT teacher education in all participating countries and the corresponding impact on the society has been achieved. The adaptation of educational preservice training and standards (including software and hardware) for CEE and NIS countries facilitated the development of portable technology-based learning materials appropriate for different educational settings and cultures. Properly designed educational software, learning materials and activities allow teachers and students to process and analyze scientific data, to have discussions with distant partners, and to collaborate for producing technology-based learning materials.

The modular teacher-training course on CIT that utilizes the flexible and distance learning model allows the project to overcome a certain paradox as CIT in itself is essentially open in its didactic approach on the one hand but cannot be applied effectively as teachers can hardly include these technologies in their current instructional repertoire. The creation of a telematics network for teacher educators provided an important infrastructure that improved the quality of teaching and research across Europe and supported flexible and distance learning. The case of English as a foreign language has been carefully chosen also to enhance the use of telematics networks internationally including both CEE and EU countries. Teachers of English supported their colleagues within their own countries as well as clients in commerce and government, at least in the early days of the innovation. In addition, universities began preparing teachers for the schools and thus the next generation. This project therefore has important multiplier effects throughout the community within and across the EC countries and will influence the development and enhancement of systems for business, home and personal use. This project was successfully performed and documented. Its success was reflected in the approval of its succeeding project, MATEN, granted to the same project team with partners from Sofia, Kiev, Moscow, Kaunas, Exeter, and Twente. Further documentation is provided on the Web at: <http://www-it.fmi.uni-sofia.bg/MATEN.html>

The MATEN Project

The MATEN project is the multimedia version of the previously described Copernicus FDLTN project. It is based on already ongoing participation of its partners in international projects. A number of ongoing and successfully finished projects related to telematics and distance learning are included:

- "Flexible and distance learning through telematics network: as a case for teaching English and communication and information technologies" (EU DG-XIII, Copernicus 1445);
- "Multimedia applications for educational

telematics network" (EU DG-XIII, INCO-Copernicus);

- "Basics of Internet" (local project funded by Eurasia Fund);
- "Multimedia didactic laboratory: information environment for teachers" (funded by UNESCO). The main objective of this project is to create a special information environment to help teachers solve didactic tasks and to help educate them, especially in the area of applying computer and communication tools in education.
- "Support and telematics application cooperation with Commonwealth of Independent States" (EU DG-XIII, STACCIS).

The main conclusion of the MATEN project is that it is not a trivial cosmetic extension to migrate from text-based into multimedia-based Web-applications. The key issue is the more drastic realization, similar to the Copernican revolution in science, of accepting that the teacher is no longer the central element in the instructional process, but rather that it is the student, both in the economical and the didactical sense. The key experience among the MATEN participants was that by allowing World Wide Web (WWW) material to become highly graphical (with animations, video conferencing and virtual reality), the course designer is able to give a more prominent and decisive role to the student. The student is no longer just a member of the audience, or, to use a medical analogy, a patient. The student is the central key figure who has a personal agenda and who will no longer be immersed in a collection of courses just because they are needed in a national test-driven certificate. The MATEN project has essentially removed the barrier between regular state-driven courses and entrepreneurial learning where participants need to learn in order to survive in ever-more-complex organizations. An important element in the MATEN project was teacher training.

The Training and Retraining of Teachers

Several on-line distance courses have been developed within the framework of the above-mentioned projects:

- "Basics of Internet" (a course distributed via e-mail). About 400 participants from Ukraine, Russia, Belarus, Kazakhstan and other CIS countries were involved in the learning sessions.
- "Communication and Information Technologies (CIT)" (WWW-based course). Some 27 learners from different CIS countries have taken part in the pilot experiment with this course, which concentrates on main concepts and services of Internet literacy.
- "Distance course design and development for teachers" (WWW-based course). Fifteen students from Ukraine, Bulgaria, and Lithuania participated in the pilot experiment with the course. It focuses on how to use the Internet for teacher training and to design one's own distance courses.
- "English distance-learning course for secondary school teachers" (WWW-based course). This course was developed to help teachers of English at the professional language level to access original materials and to communicate with colleagues via e-mail.

Models and Methods

The core work package (WP) of the MATEN project is devoted to the methods and techniques for flexible and distance learning. The research began with a literature and documentation overview on flexible and distance learning using telematics networks. The main goal of the work package is to develop a pedagogical framework for teleteaching in individual and group modes. The scientific output is formed by developing a conceptual model for flexible and distance learning systems using telematics networks, and by creating methods and techniques for courseware development featuring different instructional approaches and distance delivery methods. The resulting model consists of five main components: (a) learning and tutoring, (b) computer-based communication, (c) educational media, (d) flexibility, and (e) organizational environment. Aspects of the management of learning as well as types of learning and instruction are examined. The result is a set of guidelines and instructor manuals for courseware development and intensive teacher and instructor training.

The final substantive outcomes of MATEN are a set of courses, that teach CIT and the English language in a set of contexts: education, business, and computing. Each course also develops transferable skills with new technologies and language. There was also considerable staff development and, in the case of English language, this grew into an award-winning course delivered through telematics to English teachers in higher education.

Conclusions

The result of the series of East-West cooperative projects so far has been a continuous reflection on the nature of learning and a revitalization of the ancient question, how schooling efforts can help restructure society in general and an economic system in particular. The concise review of ongoing Tempus and Copernicus projects shows that the major appreciation of ICT is in its flexibility, its just-in-time nature, and its orientation toward students as customers. These opportunities and the articulations of unorthodox schooling paradigms make it quite complex for traditional institutes to integrate the benefits of ICT-supported learning into practice. Adjacent ongoing Tempus projects show that traditional state-driven universities need to be structured as entrepreneurial rather than academic organizations. At the same time here is a general lack of commitment by the highly versatile commercial training enterprises. A third alternative is the so-called "learning communities" that attempt to establish mutual learning as an ongoing process, without any institutional basis. It is unclear at this moment how the balance between the three will gradually evolve in Eastern European countries in the coming years. Having participated in ongoing Tempus and Copernicus projects and at the same time having seen the dynamics of new, young, up-and-coming entrepreneurs that play a role in the free market, it is my expectation that they finally will become dominant in the propagation and dissemination of expertise. Looking from the aspect of societal reform, however, it is my estimation that further investments in ICT projects should continue in the direction of traditional state schooling institutes as they are able to maintain the momentum of evolution of a learning culture in the long run. □

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Information and Communication Technology (ICT) in Lower Secondary Schools in Bulgaria, the Czech Republic, Hungary, Lithuania, and the Russian Federation

by W.J. Pelgrum and J.M. Voogt

□ This article shows some of the results of an international comparative assessment of information and communication technology (ICT) in education, which was conducted by the International Association for the Evaluation of Educational Achievement (IEA) at the end of 1998. It is shown that the countries in Central and Eastern Europe did not differ systematically from countries in other parts of the world with regard to emphasis on traditional or emerging pedagogical paradigms. However, in terms of ICT infrastructure, systematic differences were observed.