

Integration of ICT across the educational system: general guidelines

Solza Sopova Grceva

FON University, Faculty for ICT
solza.grceva@fon.edu.mk

Ivan Kraljevski

FON University, Faculty for ICT
Ivan.kraljevski@fon.edu.mk

Abstract

ICT supported or technologies enhanced teaching includes a whole range of necessary resources, policies and skilled teachers. This issue involves infrastructure, equipment and facilities, educational management, teacher training and support, capacity building of educational institutions, educational content, and above all educational policy.

Teachers' faculties are faced with the challenge of preparing a new generation of teachers for effective use of new learning tools in their teaching practices. For many teacher education programs, this daunting task requires the acquisition of new resources, expertise and careful planning. Above all, it is highly necessary to integrate ICT or even further, E-Learning across teachers' curriculum.

This paper is designed to provide a guide to help teacher educators, schools, administrators and policy-makers infuse, integrate, or embed ICT into teachers' education. The main factors and indicators of success are determined. The strategy and resources presented in this paper were developed by an international group of experts with extensive experience in the integration of ICT into teacher education. It is a result of a successful 3-years European project with a title "Integrating E-Learning across the teachers' curriculum", (IETC), implemented in R. Macedonia. Four teachers' training faculties and four pilot schools (three primaries and one secondary) from R. Macedonia, together with the Universities of Edinburgh, Groningen and Leuven were involved.

Keywords: ICT in education, ICT curriculum, teaching resources

1 ICT IN EDUCATION: WHY IS IT IMPORTANT?

To motivate the students to learn, to enjoy the process of learning, to cope with the problems and challenges of the fast changing world, are only few arguments for using modern technologies in educational institutions. Although there are many scientific debates about the existence of solid proofs whether the technologies really enhance the process of learning, one can not take from the young people their generational right to use them in the process of learning. Technology literacy,

information literacy, visual literacy is integral part of the modern leaving. We have identified several elements that clearly justify the necessity of technology use in education, like:

The most important element is motivation. The student is motivated when his perception of control is increased; when he is engaged into productive work.

The other element is unique teaching capabilities. This is a whole corpus of different new opportunities that make traditional teaching more effective, attractive and efficient. The learners have opportunities like visualization of problems and solutions, tracking their progress, linking to education sources, access teaching tools, etc.

One very important element is that technologies support new teaching/learning approaches, like: Problem solving and other higher skills; Cooperative learning; Individual work; Customized learning.

Also, the teachers' productivity is increased. Instead of traditional instructions, teachers can become more productive through training in computer skills and methods and help their students to meet their individual goals. Now the teachers have many tools in their hands to increase their productivity and efficiency (databases, spreadsheets, presentation software, test generators, etc.) Lately, one of the key elements is the implementation, more or less successfully, of the distance learning that gives a completely new dimension and opportunities to large groups of students. The people from the rural, underdeveloped regions, the students with special needs, also very talented students are among the target groups with new opportunities to equally participate in the educational systems and achieve their academic goals.

2 ICT INTO CURRICULUM

2.1 Guidelines for national curriculum in ICT

When preparing recommendations for ICT curriculum on all stages of education, some essential conditions must be met:

- Students and teachers must have access to digital technologies and the Internet in their classrooms, schools, and all teacher education institutions.
- High pedagogical quality, culturally specific and responsive digital content must be available for teachers and learners.
- Teachers must have the knowledge and skills to use the new digital tools and resources.

The second and third conditions rely on the existence of the following crucial prerequisites ordered by the highest priority:

- Educational technology standards and performance indicators for teachers
- Profiles for technology-literate teachers
- Basic conditions for teacher preparation
- Resources for teachers: lesson plans, curriculum standards etc.

In order to accomplish this, it is highly recommended that ICT becomes integrated into the national curriculum in every stage of the educational process, since uncritical adoption of technologies which are not guided by the quality and pedagogy of the teaching/learning process could be contra productive. This can only be done within a National strategy, National Action

plan and Institutional plans. This issue in MK is underestimated. Although, lately many national educational ICT projects are initiated and lots of resources are put into this direction, some draft strategies have been prepared; they are not yet evaluated or implemented. That makes a room for sporadic, uncritical implementation of technologies with no visible effect; schools, although lately equipped with computers and more or less good Internet connections, do not have the aimed effect. The lectures are still delivered traditionally, only now the way and means for presentations are changed. Internet is used for retrieving information, but significant changes and technology enhanced learning is not yet in place for a high percentage of schools.

Moreover, a sound policy of integrating ICT into the teachers' curriculum at the teachers' training faculties have to be strongly paired with the national standards of use of ICT through the curriculum of pupils 6 -18. In order to initiate this process in MK, within our project we prepared recommendations based on the standards developed at International Society for Technology Innovation for teachers and students (<http://www.iste.org/>) on one hand, and on the institutional experience of our EU partners'. We adopted the roadmap through 6 phases of knowledge and skills that the students should demonstrate in the technologies supported teaching, starting from creative thinking, communication and collaboration, research, problem solving, digital citizenship (legal and ethical issues of using technologies), to the advanced understanding and application of technology concepts.

In coherence with NETS-T (educational technology standards and performance indicators for teachers), an Educational Technology Standard for teachers in Macedonia is recommended, containing three competency levels (A – Basic, B – Advanced, C - Expert). For each level, performance indicators in five sub-domains are defined:

- The general use of ICT: ability to use common ICT tools (hardware and software)
- Design of learning environment: ability to integrate ICT into learning environment
- E-learning integrated into the curriculum: ability to integrate ICT as a cross-curricular theme into subject teaching, taking into consideration specific needs of the students and the aims of the curriculum
- Assessment of e-learning: ability to evaluate study process and learning outcomes of students with ICT tools
- Professional development: ability to monitor and reflect one's professional development with ICT, for an example to participate in virtual communities of practice

Working on the IETC project, together with our EU partners, we have been exposed to their educational strategies of integration of the ICT into their schools curriculum (www.ise5-14.org.uk). Trying to match our educational setting we are providing some general guidelines for ICT curriculum in schools, which we think are to a great extent applicable. They might be useful also to the policy makers in MK and wider when preparing national standards. Here are some phases in students' cognitive development which emerge directly from the specific objectives in technology supported learning.

- Using, which is concerned with building of knowledge and the development of skills, together with confidence in using technology
- Creating and presenting, which involves the development of ICT knowledge and skills that pupils will need to create and effectively present their own ideas and other material

- Collecting and analyzing, which deals with the use of ICT tools, such as databases and spreadsheets, and to solve problems
- Searching and researching, which addresses the development of skills and concepts in using ICT to search information and to research topics? It involves the effective use of resources such as Internet and CD-ROMs.
- Communicating and collaborating, which is concerned with use of ICT to communicate and collaborate with other individuals and groups. It involves use of tools and techniques such as e-mail, conferencing, chats.
- Controlling, simulations and modeling, which involves the development of knowledge and skills in using computers to instruct and control devices as well as to make measurements of, and model the environment
- Developing attitudes in relation to ICT in society. In this phase pupils progressively develop informed attitudes about the applications, but also implications of ICT in society.

2.2 School level-planning for ICT integration

The term school in this document is wider. In many paragraphs, all the statements could be easily applied to all our educational institutions, including Teacher training faculties.

When planning to introduce the ICT into the schools curriculum, first assessment and a sound planning should be put into place. In the assessment phase different aspects should be targeted. We can only suggest some of the issues that should be carefully investigated: what is the school infrastructure, what is the quality of the Internet, whether there is a school network, are all the classes equipped with computers or instead there is a lab with computers, is there a wider community network in place, where and how the teachers are involved in additional training, do they have an ICT teacher or technician in the school, whether there is support from the school management, etc.

Depends on the assessment analysis, the school should prepare its own plan for ICT integration, of course complying with the national standards, recommendations and adopted national policies. In order this plan to succeed, and technologies are accepted, the school should be clear about some important issues, like:

- The issue of recognizing the advantage. The teachers have to be convinced in the reasons why adopting innovations in their teaching and to what extent;
- The issue of complexity. The teachers should perceive new methods as easy enough to be implemented in the classrooms;
- The issue of compatibility. The teachers have to feel that the new methods are compatible with their ideas of good teaching and values; ICT is not about replacement, but rather a complementary process;
- The issue of sharing and transparency. It always helps that the teachers learn from each other when adopting innovative methods.

Further on, the practical aspects are no of less importance. They should be seriously targeted and part of the plan, for an example:

- Plan the yearly budget for different ICT purchases. This should allow for yearly upgrades, as for the maintenance of the existing equipment.
- Plan teacher training. People with knowledge are more rare and worth than any technology. All the success stories are based on trained and motivated people.

- Involve all the teachers and other personnel. The plan to succeed should be widely supported, by: parents, community, district, school administration, and teachers.
- Match technology to the needs and integrate into the curriculum. The main question here would be: What are we teaching now and how it can be improved with technologies?
- Coordinate the activities in the broader setting (community, district, a network of schools, academic institutions where available, etc.). Some of the solutions are best designed in schools, others are within a network or a community, but all plans should be paired and coordinated.
- Logistics should be planned. The availability of resources might be a limiting factor, like computers, LCD's, software licenses. Teachers tend to use what is available, instead of planning what would be better or more appropriate to be used in their classroom.

2.3 Integration of cross curriculum technologies

Within the IETC we have categorized, paired with its pedagogical value and implemented with the teacher students and with the in-service teachers, a wide range of software products, general and educational [1]. The table below shows the purpose of its cross wide application:

Table 1. Software products in teaching/learning process

Word processing SW	Databases	Spreadsheet SW	Presentation SW	Video/Audio production SW	Tutorials	Problem solving SW	Simulations
Writing, simple drawing	Locating, organizing, selecting information	Keeping records	Non-linear multimedia presentation	Editing a picture	Lecturing	Make decisions	Modeling of real world
Group works (letters, poems...)	Improvement of research skills	Analyzing the data	Presentation skills	Skills to work with digital devices and products (cameras, camcorders)	Explanation	Analytical skills	Analytical skills
Improvement of individual writing	Testing their hypotheses	Products with numbers (charts, graphs, timelines...)	Oral skills	Production of animations (esthetics, abstract concepts...)	Feedback	Cope with complex problems	Work with abstract concepts
Writing across curriculum		Demonstration of abstract concepts	Organizing the information	Making short movies (sounds, recording of speech, titles)	Evaluation	Interdisciplinary approach	Approximations, simplifications
Keeping records				WEB page editing and 3D products		Problem solving skills	

Although there are some subject specific software products the entire spectrum of the above ICT tools and programs can be used and combined in any subject area. It is up to the teacher skills and motivation, resources available to enhance the teaching with some or many of the technologies from the previous classification. Here we give an overview of ideas that we had an opportunity to practice with our students [2], [3].

Languages

Through the languages people communicate, think and learn. In lower grades, the language course concentrates on development of fundamental skills: reading and writing, speaking and listening. In the upper classes the teacher puts the focus on literature, art of communication, expressions, style, and composition. Technology can be used in all above mentioned processes. Here we provide an overview of ideas how that could be accomplished. A good technology supported instruction in languages should be:

- Student centered;
- Focused on integrating different language skills, like reading, writing, self evaluating;
- Interactive activities involved as much as possible;
- Language instruction should be integrated with the content instruction;
- Activities should match real life applications;
- Students should achieve established proficiency standards;

The biggest problem that is a subject of debates in language instruction when it is technology supported is the problem of contextual instruction versus direct one. Namely, the computer programs are very appropriate and efficient when comes to teaching grammar rules, syntax, vocabulary and even translation. When it comes to dialogue, speaking, composition, the technologies are far less useful.

Among the technologies that are excellent for language instruction are product for desk top publishing, drafting software for development of more complex works, editing and revising software, tutorials (for an example for pronunciation), quizzes, computer guided instruction, etc.

Mathematics

There are many specific tools used in the technology supported instruction in mathematics. For all the important areas like: Algebra, Geometry, Numbers and Operations, Measurements and Data Analysis there are specific software solutions. The software solutions are following the actual processes like: Problem solving, Communication, Proofs, Relations, Representations, and others.

Software solutions can provide great help in understanding of abstract concepts, but also can help developing computational skills. There are many web based resources and repositories of reusable learning objects that deal with certain problem or topic.

Music and Arts

- Integrating technologies in arts curriculum expose students to new and very exciting experiences that were not present in the past. The whole new culture of artistic expression is emerging with the new media and technologies. This new culture requires that students develop many different skills, far beyond a mere computer literacy. They are now exploring animations, multimedia experience, and graphics with far more powerful tools than ever before. To summarize, in arts curriculum there are tools that enable:
- Manipulation and production of images
- Drawing techniques and elements
- Technology that supports graphics with Desktop publishing
- Technology for design
- Collaborative work
- Presentations, virtual tours, etc.

In music curriculum there is also a wide variety of different technologies that support different teaching processes, like:

- Composing and rearranging music
- Listening and analyzing
- Evaluating performances
- Learning theoretical elements (notating and reading music)
- Performing on instruments
- Music related to cultures and history
- Theory lessons with quizzes

In our E-Learning Centre at the Teachers training faculty, we have several MIDI keyboards where students can actually compose and arrange the music electronically. There are far more sophisticated and powerful programs that simulate the functions of a recording studio. Different sequencers and audio editors offer the student to manipulate the recorded music and to be very creative in that. As for the arts curriculum, also the same phenomena apply with the music: a whole new cultural paradigm emerges with the development of the technologies and our students were very excited using new technologies.

Social studies

Social studies are about people, cultures, places, environment, history, events and society. There is endless number of different technologies and information that support every aspect of these studies. Comparing to the other subject areas, the technologies involved in this case are much more simpler, but very effective to be applied in the curriculum. That is why on many surveys, the social studies teachers are highly scored in using technologies. There is a certain problem with smaller cultures and populations which have not an access to many topics and articles on their own language. But, even then, there are still many tools available. The tools that we experimented most are those for:

- Searching information
- Communication
- Exploring visual information
- Researching topics
- Learning facts
- Inter-cultural dialogue, etc.

3 ICT TECHNOLOGIES APPLIED WITHIN THE PROJECT

Our experience through this project clearly supports the principle that teachers should be able to create their own content electronically, instead of the concept where they have to work only with prescribed digital contents provided by some national body. Teachers, following the standards and guided by the pedagogy behind the course, should have a freedom of their own creation and choosing of the most proper technology to interact with the students.

Within the project we have established a modern E-Learning Centre. It has multimedia computer classrooms and one laboratory. The laboratory and the classrooms are equipped with interactive white boards, graphic tablets, midi keyboards, digital cameras, camcorders, scanners, color printers, publishing facilities and fully licensed authoring software like Adobe Creative Suit, Microsoft licenses, etc. The computers are on the University network connected also on our web server.

The vision for this modern Centre is to:

- Serve as an expertise Centre for the Teacher Training Faculties, total four in MK
- Help and expertise Centre for the district schools
- Laboratory for the teachers at the University where they can get advice and actually prepare their lectures with the use of different technologies
- Practical exercises with the students

- Provide expertise on the national level, since in MK there is a lack of such professional expertise
- Preparing digital content
- Organizing courses and workshops on E-Learning

For that purpose we created and maintain an educational portal that is used in MK both, by the Teacher Training faculties and by the schools.



Figure 1. E-Learning Web portal for teachers

In the project, we have exposed the teachers and the students on different software and hardware tools, with different success. The main problem that we experienced was that most of the teachers were not prepared to change their methodology of delivering the lectures. They were just changing the media, not the way of presenting the material. They were very uncertain to interact with the students, which is enabled with many technologies, to move towards problem based teaching, not mentioning the interdisciplinary approach. It was only after many working sessions, that some of them to a certain extent, succeeded to implement such concepts. Positive examples were provided from the ICT teachers [4], music, art and foreign language teachers. On the average we are satisfied by the results achieved, because all of them made a significant shift in their vision and put efforts into adopting new way of thinking about their teaching. For an example, the teachers found Adobe Captivate a very good and efficient tool for preparing different tutorials. Some of them put some sound recordings and created really very good lectures that help students to adopt concepts at their own speed and time. On the Figure 2 below is the snapshot of a tutorial about Microsoft Excel functions.

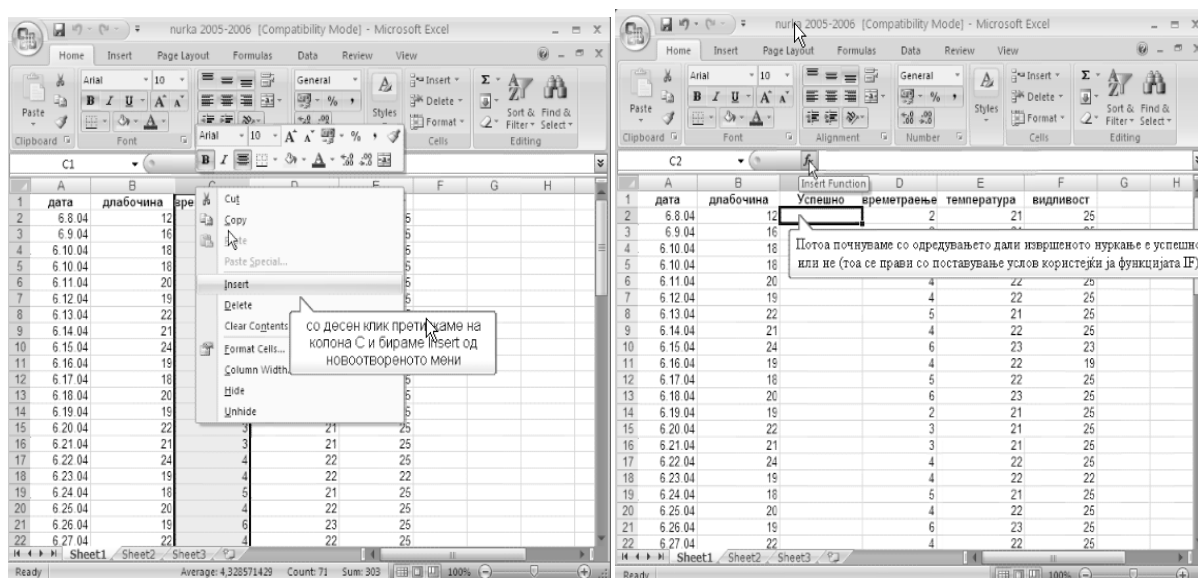


Figure 2. Tutorial made with Adobe Captivate about Excel functions

On the contrary, the situation with the student teachers is quite opposite. They were very responsive and almost immediately realized that the new technologies give them a huge opportunity to present the teaching units in a more creative and interactive way. As a result we have a collection of some very imaginative student works in almost every subject area.

In the project we were using different software: starting with the most simple presentation software, instructional software for making tutorials (like Adobe Captivate), Windows Movie Maker, Media Player, Quick Time to the more complex author ware software. We also demonstrated some very advanced features of the Adobe Creative Suite 3, Master Collection (like Flash Player, Acrobat, Photoshop, InDesign) but they were complicated for most non-ICT professionals. Blogs and wikis were very easily implemented. All the courses at the Teacher Training Faculty are placed on the open source Content Management System, Moodle.

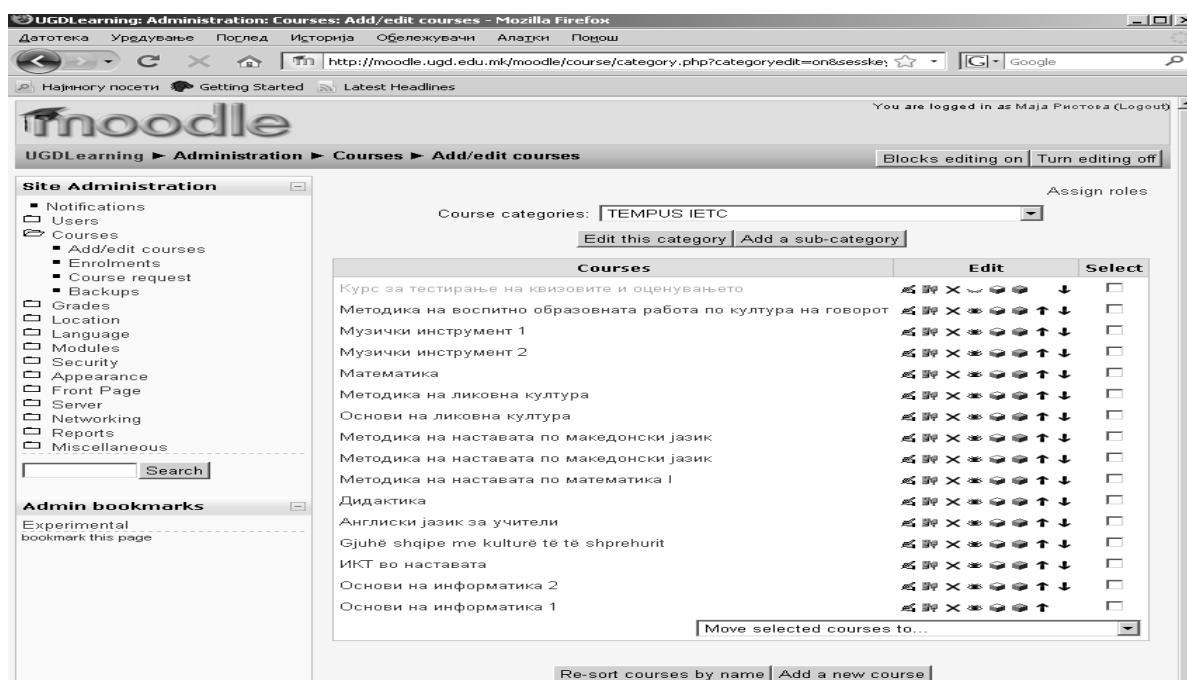


Figure 3. From the Teachers Training Faculty curriculum under Moodle

Lots of the teachers found it helpful to use general knowledge resources, like encyclopedias, atlases, virtual tours etc. among them Wikipedia in Macedonian language. Generally it is difficult to find many resources in our language. Also, there are a lot of ready made software repositories with learning objects from every subject area, which presents certain concepts (like in biology animation about division of cells, or in math's operation with fractions, music parts, instruments playing, etc.). Many of them are language independent and we encouraged the teachers and the students to make use of them. One can find rich educational collections on different sites like the Merlot repository or on www.prim-ed.com. More advanced teachers and students prepared their own learning objects in SCORM standard, for which they received training [5], [6], [7].

4 CONCLUSION

The integration of E-Learning across the teachers' curriculum (in most of the subject courses and especially in the different methodologies of teaching), we see as a most efficient model on the road of implementing ICT in the whole educational system. Uncritical adoption of technologies which are not guided by the quality and pedagogy of the teaching/learning process could be contra productive. Our experience clearly supports the principle that teacher students should be able to create their own content electronically, instead of the concept where they have to work only with prescribed digital contents provided usually by a national body. Teachers, following the standards and guided by the pedagogy behind the course, should have a freedom of their own creation and choosing of the most proper technology to interact with the students. Within our project we have positively tested this initial hypothesis.

The paper provides a broader framework for ICT integration into teacher education, but also in schools and describes the essential conditions that must be met for successful technology

integration. It also gives ideas how to build up an efficient strategy for ICT integration into the curriculum, answering to questions why, when and how this integration is meaningful and justified. Experiences and examples from the IETC project are used to provide guidelines on the long road towards efficient, technologies enhanced teaching.

References:

- Grceva, S., Zdravev, Z., "Promoting new technologies in the classroom, step by step", Proceedings of the Second International Balkan Congress: Searching excellence in education, Edirne, Turkey 2004.
- Roblyer, M.D. and Slack, F. Using software tutors and tools: Principles and strategies, Integrating educational technology into teaching, Prentice Hall, 1997.
- Roblyer, M.D., Integrating Educational Technology into Teaching, Starting out on the Internet: A Learning Journey for Teachers, Prentice Hall, 2007.
- Grceva, S., Zdravev, Z., "Design of an E-learning course for the students on the faculty for pedagogy", Proceedings of the International Conference: Culture and Education, Plovdiv, Bulgaria, 2004.
- Zdravev, Z., Grceva, S., "Developing Learning Content Management Systems based on Learning Objects – Issues and Opportunities", The Fourth International Conference on Informatics, Educational Technology and new Media in Education, Sombor, ,R. Serbia, 2007.
- Zdravev, Z., Grceva, S., "Developing Learning Objects Systems through implementation of Learning Object Metadata Standard", The Second International Conference on Informatics, Educational Technology and new Media in Education, Sombor, Yugoslavia 2005, Proceedings of papers, volume 1, pages 273-279
- IEEE LTSC, Standard for Learning Object Metadata (LOM), IEEE1484.12.1