ICT PROJECTS IN MACEDONIAN EDUCATION FROM 2005 TO 2019

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Abstract

This paper is dealing with the different aspects of the process of computerization in the Macedonian primary and secondary schools. We analyze the ICT projects implemented in the Macedonian education in the last decade and a half, with a special focus on hardware and software procurements, trainings of teachers, publication of training manuals and textbooks, implementation of ICT in the educational process, and the final products of the conducted ICT projects, including the developing of management environments for learning, educational websites and Web portals.

In this period, USAID has been one of the main actors in the global education reform in Macedonia. USAID's projects: E-Schools.mk, Macedonia Connect and the Primary Education Project were three successful stories in the process of computerization in the Macedonian schools.

The ToolKid software was the first educational software which was implemented in all primary schools in Macedonia since the 2006/2007 school year.

We are describing the main achievements of the governmental project: “Computer for every child” in detail. EDUBUNTU, a version of the Linux operating system designed for educational purposes, was installed in all schools, together with the Open Office software and the accompanying programs from EDUBUNTU: Keduca, KTouch, HT Track and iTalc, as well as 18 other educational programs.

The most significant websites and portals created in the framework of the national ICT projects were: “Portal for primary and secondary schools”, “Skoool.mk educational portal”, “Electronic textbooks web portal”, and “Aggregator of video content Web portal”.

In the period of 2005-2010, the author was a direct participant in most of the national ICT projects as a trainer, an author of manuals and a consultant. He had the opportunity to have both a direct insight into the ICT equipment at the dozens of schools and continuous communication with teachers who attended his trainings. It enabled him to gain a lot of knowledge about the equipment in the schools, the application of ICT and the use of educational software and digital learning materials in teaching different subjects.

The process of the mass computerization in Macedonian schools has its own good and bad sides. The main advantages of this process were: improving the school infrastructure, procurements of ICT equipment; implementation of different educational software tools, holding numerous trainings, seminars, and workshops with teachers for innovative use of ICT in education, increasing awareness among school management, teachers and students for the importance of ICT application in education etc.

On the other hand, over the past years we witnessed a lack of a serious, planned, organized and continuous approach in ensuring sustainability of the implemented projects, which resulted in a gradual loss of the benefits from them. A good portion of the final products of these projects have lost their useful value. Many Web portals and websites that were the result of these projects became inaccessible, and some of them remained active, but with a reduced functionality.

There is also insufficient concern for both, the continuing training of teachers and their professional development. In the absence of a planned and organized activities intended to improve their competencies and skills, and the lack of long-term plans and programs for their trainings, this important area, which is crucial for high effectiveness of the educational process, is left to the teachers themselves.

Keywords: computerization of education, ICT projects, hardware and software procurements, teachers' trainings.

1 THE PROCESS OF COMPUTERIZATION OF MACEDONIAN SCHOOLS

The first serious equipping of the Macedonian schools with 5300 PCs was the donation from the Government of the People's Republic of China. The first part of the donation were 2000 computers, along with peripherals and spare parts, which arrived in Macedonia in the summer of 2003. These 2000

computers arrived with operating systems installed, but the system did not include educational software. In the summer of 2005, Microsoft donated over 6,000 licenses for Windows XP, Microsoft Office, Frontpage and Encarta software packages.

After the Ministry of Education and Science (MoES) distributed the computers to schools, the USAID e-School project installed networked computer labs in all of the (then 100) secondary schools and organized training for teachers on the integration of information technologies in education. In January 2004, the second part of the donation, containing 3,300 PCs and 300 printers, arrived. These computers were distributed to 360 primary schools in Macedonia. USAID has again supported the donation through the e-School project, this time connecting primary school computers through wireless LANs to allow teachers greater flexibility.

1.1 The three USAID projects

In the last fifteen years, USAID has been one of the key players in Macedonia's global education reform. USAID's participation in this process resulted in three projects: E-School.mk (2003-2008), Macedonia Connect (2004-2007) and the Primary Education Project (2006-2011). These are three successful stories of the process of computerization of Macedonian schools. The Academy for Educational Development, WorldLinks, the Education Development Center, the Macedonian Center for Civic Education (MCEC), On-net and other domestic NGOs and private companies round out the list of participants in the computerization process.

1.1.1 The "e-School" Project

In addition to the aforementioned networking of 460 computer labs in all secondary and primary schools in the Republic of Macedonia, within the project "E-School", trainings for 180 teachers of different profiles (head trainers or trainers of trainers) from secondary schools, were organized and conducted in order to acquire knowledge and skills for integration and innovative use of ICT in the regular school instruction. In the second phase (dissemination), this group of head trainers conducted training for 2,500 primary school teachers. These trainings were titled "Innovative use of ICT in primary schools" and "Innovative use of ICT in secondary schools". An additional 1900 teachers completed basic ICT skills training. The next activity within the project was the training of 120 primary school teachers (head trainers), who then trained 5200 primary school teachers.

1.1.2 The "Macedonia connects" Project

The high costs of access, coupled with the poor quality of communication services and limited expensive access to broadband, hampered and hindered the efforts for development and economic growth. The consequences of this happening were obvious in the Macedonian schools: only a small percentage of students and teachers had access to the global Internet network.

In 2004, USAID launched a three-year project "Macedonia Connects" to provide free and easily accessible broadband across the country (almost 550 elementary and secondary schools, research institutes, universities and dorms) and facilitate its use in all sectors of society, not just schools.

As a result of the Macedonia Connects project, Macedonia has become the first country in the world to be almost completely covered by wireless internet throughout its territory.

1.1.3 The Primary Education Project

The Primary Education Project (PEP) was one of the last USAID initiatives in the area of primary education in the Republic of Macedonia. One of the goals of this project was to increase the quality of teaching and increase the employability of young people. The project is a continuation of the series of successful USAID funded projects to strengthen the Macedonian education. The PEP activities implemented in all schools throughout Macedonia included: 1. School renovations, 2. ICT in education, 3. Improvement of mathematics and natural sciences teaching, 4. Improvement of assessment and 5. Development of labor force. Within the project over 15,015 teachers were trained to use different types of ICT in teaching and learning. The support system for teachers included training of 646 students who were part of the Student Technical Support Teams and training of 1,505 teachers who served as mentors to these student teams.

The module of the PEP project for ICT in education saw the need for interactive learning and learning through games, so it adapted 46 educational applications for natural sciences, as well as 113 education games for the students in elementary education. The employes in this module took part in about 1000

learning classes in order to see and understand how the teachers that attended the trainings, use the technology.

The above mentioned shows that the donation from the People's Republic of China and the USAID projects were the main factors in the initialization of the process of computerization in Macedonian schools. Prior to the start of the 2007/2008 school year, each primary school had a computer lab with 5-20 personal computers, and each high school was equipped with one or two computer labs with 20-40 computers. These laboratories were often used in the process of teaching and learning ICT in the framework of the following curricula subjects: "Informatics" in primary schools and "Informatics", "Information technology" and "Programming languages" in secondary schools. Statistically, in that period in the Republic of Macedonia the ratio pupil: student was 1:56, ie 5-20 computers for 300-2500 students in primary schools and 20-40 computers for 700-1200 students in secondary schools.

2 TOOLKID SOFTWARE LOCALIZATION

The ToolKid software, based on the Comenius Logo, has been used in all primary schools in the Republic of Macedonia since 2006. The Macedonian version of this software has been revised, expanded and adapted to Macedonian and Albanian language from the Bulgarian version according to the national curricula in the Republic of Macedonia. The localization of this software started in 2005. E-School was responsible for the implementation of the ToolKid software. From the implementation of ToolKid until the introduction of the new concept of nine-year primary education, elementary school teachers were legally required to use the ToolKid software in at least 30% of their regular classes. Following the completion of the adaptation and localization process that took place in 2005-2006, training was provided on how to use the ToolKid software package in multiple phases for all first to fourth grade teachers. In the period between 2007-2008, six manuals were developed for the training and practical use of the ToolKid software package: Educational Games, Text and Sound, Combining Information, Graphics, Algorithms and ToolKid + (Figure 1).

Figure 1. ToolKid manuals.

The ToolKid program was used as a mean for integrating the information technology into the teaching process. It was not intended to replace the tools, methods and techniques used in teaching, but to supplement them, enabling teachers and students to work in a new environment that offers new ways of teaching.

The ToolKID educational software could be useful in all subjects of K-4 education (mother tongue, mathematics, nature and society, society, art education and music education). Its organization is such that enables students to acquire solid informatics literacy and culture.

3 THE "COMPUTER FOR EVERY CHILD" PROJECT

At the end of 2006, the Government started implementing the "Computer for Every Child" project in all 366 primary and 93 secondary schools in the Republic of Macedonia. The project was based on the National Strategy for the Development of Education in the Republic of Macedonia, 2005–2015.

The plan envisaged that the realization of the project would take place in several interdependent steps:

- Procurement, installation and maintenance of equipment;
- Creating local networks and enabling internet connection;
- Teacher training on equipment use, software tools and e-content;
- Developing a Learning Management Environment (e-obrazovanie.mk);
- Development of electronic content and electronic textbooks (skoool.mk, e-ucebnici.mk).

For the purpose of this project, activities and/or projects were divided into several categories, including: infrastructure and hardware, software, teacher training, portals and websites, and other activities.

3.1 Infrastructure and hardware

- Supply and installation of 98,710 workstations (17,818 PCs from the Chinese company Haier, 80,892 tin-clients from US company NkComputing and 98,710 LCD monitors, keyboards and mice), which met the needs of all high schools and one-third of primary schools in Macedonia. The main feature of the thin clients is that they connect to the personal computers and can operate as standalone machines. They are significantly cheaper than the personal computers, possess high quality, and significantly reduce the maintenance and power costs. They are also protected from theft and practically useless outside of the school.
- Purchase 100,000 new chairs and 50,000 new school benches with protective installation ducts.
- Installation of new indoor and outdoor electrical installations (mostly in the satellite schools) or repairs to existing ones which improved the power supply in all central and regional schools across the country;
- Setting up the new communication infrastructures or making repairs to existing ones and setting up computer systems;
- Distribution of 22,000 laptops equipped with Intel Atom processors to teachers (6500 for high school teachers and 15,500 for primary school teachers) in 2009. Purchase 53,000 Classmate laptops for all first to third graders.
- As of 2010, a total of 180,000 student jobs were equipped with 160,000 PCs X300 accessible devices, connected to 20,000 PCs running PC software virtualization.

3.2 Software

In 2009, with the decision of the Ministry of Information Society and Administration (MISA), the transition from the commercial Windows operating system to the open source operating system Ubuntu (Ubuntu) was made. Edubuntu 7.04, a version of the Ubuntu school-based operating system, was installed on all hitherto purchased computers.

Local ICT experts hired by MISA have identified over 120 open source educational tools from the following subjects: mathematics, informatics, physics, chemistry, geography, Latin language and music, along with the Open Office software. Advisers from the Bureau for Development of Education (BDE) analyzed these tools and selected 43 educational tools that they considered most suitable for the realization of the objectives of courses. In the next phase the applications were translated into Macedonian and Albanian language and adapted to the Edubuntu operating system. The BDE advisors have made modifications and additions to the curriculum in the area of didactic recommendations in the aforementioned teaching subjects, making the use of the tools mandatory for teachers. The next step was installation of: selected 43 educational tools, the Open Office Office software (Writer, Calc, Impress,

Draw, Base and Math) and the Intelligent Workplace Management (iTalk) program for workplace management in the classroom, on the teachers laptops, which were designed primarily to access Internet-based applications.

The Ministry of Information Society and Administration in 2010 provided localization of 513 e-contents in Macedonian and Albanian language and their placement in the newly created portal skoool.mk. These e-contents were donated by Intel. The mapping of digital content into the curriculum by subjects and grades was done by the BDE.

In 2011, the localization of the GCompris educational package, designed for elementary education and work with children with special educational needs, was made. The software was installed on the teacher and student notebooks. The Bureau has linked the educational activities to the software and curricula.

3.3 Trainings for teachers

After completing the process of adapting and localizing the ToolKid software package, the trainers from Bulgaria, Ivailo Ivanov and Vesela Ilieva, performed a 15-day training on the usage of ToolKid on a group of 20 head trainers. In the period 2009-2010, the head trainers delivered a ten-day training course (80 hours) for 414 first-to fourth-grade teachers in the 100 pilot schools where the ToolKid software was installed. This group of teachers then conducted training for all other teachers from the first to the fourth grade;

The following week-long trainings on the use of the Edubuntu operating system were conducted in the period of March-June 2009: general training that included the Edubuntu operating system, iTALC, KEduca, KTouch, HT Track and the OpenOffice Office software (Writer, Calc, Impress, Draw, Base and Math) and specialized training in the Edubuntu application courses.

The trainings were conducted in all secondary schools by the University of Ss. Cyril and Methodius University - Skopje (Faculty of Natural Sciences and Mathematics, FNSM) and FON University - Skopje. About 6,300 high school teachers were trained. In the period February-May 2010, one-week trainings were also held for primary school teachers. FNSM and FON developed special websites and published training manuals for the training needs.

In order to implement the new curriculum for the subject "Working with computers" in the third grade in November 2009, three-day seminars were organized with 710 teachers (two from each school). Such seminars were also organized for BDE advisors. Then these teachers continued the training (dissemination of training) within their schools for all the other teachers. In March 2010, the second (advanced) part of the teacher training for the subject "Working with computers" was completed.

In the summer of 2010, in collaboration with MISA, the BDE advisors conducted one-day regional training on e-content, which were followed by two teachers from each primary school on the following subjects: mathematics, physics, chemistry and biology (grades VI, VII, VIII and IX), as well as mathematics and environmental studies in both, the first and second phase of nine-year primary education. Then these teachers conducted trainings (dissemination of trainings) of the other teachers in the primary schools in the above mentioned subjects.

In 2011, one-day trainings (in two phases) on the use of the GCompris educational package for elementary teachers and for the teachers working with children with special educational needs were conducted.

Workshops were held as part of the USAID PEP project: a) for teacher mentors of the Student Support Technician Clubs (2007), b) "Technology-Based Teaching and Learning" for Elementary School Teachers (2007).

3.4 Portals and websites

3.4.1 Portal for primary and secondary schools

The portal for primary and secondary schools (www.schools.edu.mk) was funded by USAID and developed and maintained through the Macedonia Connects and e-School.com projects until the start of the 2007/2008 school year, when the MoES took over the responsibility for its maintenance and upgrading.

This educational portal (Figure 2) provided a link between teachers and students from all primary and secondary schools within a virtual work environment. The portal provided online resources for school principals, teachers and students and made it easy to share their experiences and practices.

The purpose of this portal was to provide public access to all information on primary and secondary education and to offer a big range of services for students and teachers. Through this portal, visitors had access to the list of all schools in Macedonia and their contact information. All primary and secondary schools using this portal were able to create their own websites served by the portal, and all students and teachers were able to obtain official (school) email addresses.

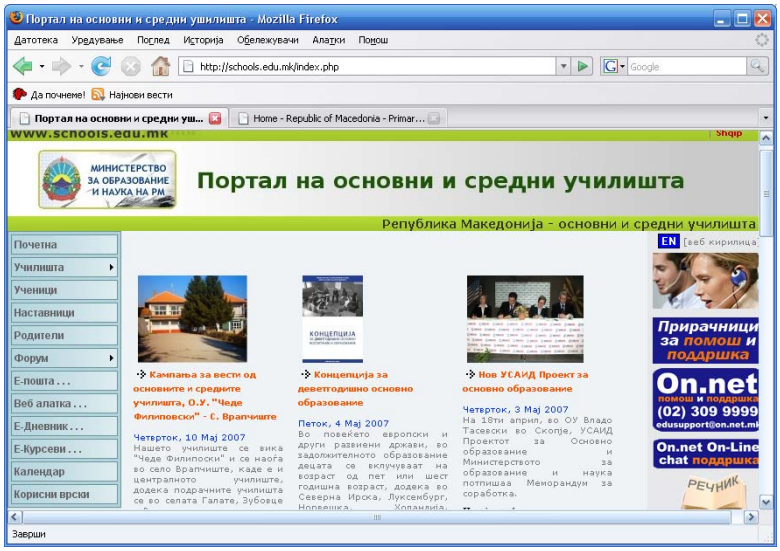

Figure 2. Portal for primary and secondary schools.

The portal provided online collaboration and exchange of information to all primary and secondary teachers and students through discussion forums. The portal provided other tools as well, such as a calendar, a library of uploaded documents, and more.

The portal included tools that could be used for the professional development of teachers and provided support in the implementation and improvement of the teaching process. The portal was conceived as a dynamic one, to be developed in accordance with the needs and capabilities of its users. The portal operated in three languages. The portal has not been available for use in a long time.

3.4.2 The educational portal "school.mk"

In the autumn of 2009, as a result of the signed Memorandum of Cooperation with the Republic of Macedonia, Intel donated 513 e-contents (learning facilities) to MISA, which were intended for teaching and learning in the following subjects: mathematics and environment in the first elementary school period; mathematics and science in the second grade of primary school; mathematics, physics, biology and chemistry in the third grade of primary school and mathematics, physics, biology and chemistry in secondary education.

Figure 3. Skoool.mk Educational Portal.

MISA in 2010 provided the localization of these e-contents in the Macedonian and Albanian language, while the mapping of digital contents in the curriculum by subject and class-year was done by BDE experts. MISA also provided the development of the skoool.mk portal where these e-contents were uploaded. This portal (Figure 3) is a free online resource designed to help students understand and explore key math and science concepts. The portal enables theoretical information to be represented and supplemented by audio-visual presentations and abstract content to be realized in a more concrete way. The portal also offers the opportunity to validate the acquired knowledge and systematize it, as well as to validate the knowledge through self-assessment tests (for primary school subjects only). The portal was expected to stimulate students' interest, curiosity and discernment.

The skoool.mk portal contains the following types of e-content: simulations, multimedia lessons, learning notes and additional educational tools.

The e-skoool project has been implemented in the educational systems of 25 countries worldwide, including many developed countries, such as: Britain, Turkey, USA and Russia. It is also of great importance to the education system in Macedonia.

The Electronic textbooks web portal (http://www.e-ucebnici.mon.gov.mk) is a MoES project launched in April 2010. The portal (Figure 4) is a digital library for electronic textbooks in pdf format, intended primarily for primary and secondary school students, but also for the use of their teachers and parents.

Figure 4. Portal for electronic textbooks.

Using the resources of this portal the students are able to download free textbooks which will help them master the content in an innovative and interesting way, and the teachers will have assistance in the preparing and presenting the teaching material using these information technologies.

The digital library contains textbooks that are approved for use in the primary and secondary education and for which the MoES has acquired copyrights. These include most of the textbooks for primary and secondary vocational education and a small portion of textbooks for upper secondary education.

The available digital textbooks for primary education can be downloaded in all languages in which the teaching is conducted, and the digital content for the elective subjects can be downloaded in the community language for which the textbook is intended (Vlach, Roma, Bosnian). The existing digital textbooks for vocational secondary school can be downloaded in all available languages. They are categorized according occupations, educational profiles and year of study.

3.4.3 The "Video Content Aggregator" web portal

The "Video Content Aggregator" web portal (www.eduvideos.mon.gov.mk) was launched in 2011 by MoES, and there was a significant improvement in 2015. This portal allowed students and teachers from primary and secondary schools to watch educational video content related to certain topics in the school curriculum.

The embedded videos were intended for free use for educational purposes, for vocational training, as well as in the educational process for people with disabilities. The video content posted on this portal had to meet the educational standards specified by the MoES expert team and the copyright rules. The suggestions for an additional video content were posted by the registered users of this web portal, and they were then required to go through the approval process. Viewing of video content was possible without users' authentication.

Unfortunately, this web portal has been unavailable for a long period of time, and according to the latest information the portal contained about 1000 different video contents.

3.4.4 Other activities

Projects which deserve to be noted:

- "Wikipedia - Open Internet Encyclopedia in Macedonian" (https://en.wikipedia.org/wiki) with about 100,000 articles,
- Makedonika Foundation's "Cinema Library", an online library of about 1,000 free e-books with unlimited access;
- 40 educational programs in Macedonian and Albanian language to popularize the Edubuntu operating system (OpenOffice and associated tools) that were developed in 2009 as a part of the MISA project, in cooperation with FON University-Skopje. The broadcasts were transmitted on both MRT program services and A1 and A2 program services;
- Website "Collection of Materials for the 21st Century Teaching" (http://toolbox.pep.org.mk, not available in recent years) - Online archive of various professional text and video teaching materials, additional reading literature, examples of good practice, videos on filmed classes and other information. After the PEP project was completed, the site is not available.
- The portal for disabled people "I want, I know, I can" (sakamznammozam.gov.mk, not available in recent years) was a central place where disabled people could find information on any novelties that they are dealing with, make complaints, ask questions about their problems, get to know their rights, opportunities and services offered by the state institutions, and discuss various topics of relevance to them. The portal was completed in June 2009 and has been unavailable for a long period.

4 CONCLUSIONS

In the overview we presented in the area of application of ICT in the Macedonian education from 2005 to 2019, the following data was used: brief press releases and reports on the majority of the ICT projects which took place in Macedonia, containing data for the purchased and installed hardware, the purchased, localized and installed software products, the renovation of the school infrastructure, the construction or modernization of the network infrastructure, the internet access, the conducted trainings for the teachers, professors and advisors from the the BDE, the training manuals and the educations portals and websites.

In the period of 2005-2010, the author was a direct participant in most of the national ICT projects as a trainer, an author of manuals and a consultant. He had the opportunity to have both a direct insight into the ICT equipment at the dozens of schools and continuous communication with teachers who attended his trainings. It enabled him to gain a knowledge about the equipment in the schools, the application of ICT and the use of educational software and digital learning materials in teaching different subjects.

The process of the mass computerization in Macedonian schools has its own good and bad sides. The main advantages of this process were: improving the school infrastructure, procurements of ICT equipment; implementation of different educational software tools, holding numerous trainings, seminars, and workshops with teachers for innovative use of ICT in education, increasing awareness among school management, teachers and students for the importance of ICT application in education etc.
On the other hand, over the past years we witnessed a lack of a serious, planned, organized and continuous approach in ensuring sustainability of the implemented projects, which resulted in a gradual loss of the benefits from them. In our review we concluded that many web portals and websites that were the result of these projects and which were previously functional are not longer usable. Some of them became inaccessible or remained active, but with a reduced functionality ("Primary and Secondary Schools Portal", "Video Content Aggregator", "21st Century Teaching Materials Collection" website, The portal for disabled people "I want, I know, I can"). In the future we must insist on ensuring the sustainability of the final products of the projects upon their completion.

There is also insufficient concern for both, the continuous training of teachers and their professional development. In the absence of a planned and organized activities intended to improve their competencies and skills, and the lack of long-term plans and programs for their trainings, this important area, which is crucial for high effectiveness of the educational process, is left to the teachers themselves.

It is also necessary to regularly monitor the state of educational software, digital learning materials and the process of teaching and learning by using ICT in the schools in developed countries, especially in those whose students achieve the best results on international and regional competitions in mathematics, informatics, natural and technical sciences, as well as in surveys, such as TIMMS and PISA. The monitoring of these results should involve the competent ministries, as well as the educational and scientific institutions in our country. These findings should be further shared with all relevant factors and used in the process of preparing, planning and organizing procurement and/or creating quality educational software solutions that need to be localized and adapted to the national education curricula.

ACKNOWLEDGEMENTS

The research presented in this paper is partly supported by the Faculty of Computer Science and Engineering, at Ss. Cyril and Methodius University in Skopje.

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