QUALITY CHANGES IN SCIENCE EDUCATION THROUGH INTERNATIONAL PROJECTS

O. ZAKOV*, B. MITREVSKI**

University Ss Cyril and Methodius, Faculty of Natural Sciences and Mathematics, Skopje, Macedonia

* zoliver@pmf.ukim.mk
** boce@pmf.ukim.mk

ABSTRACT

New environment and fast technological development defines new needs in general, especially in education. This paper explains the changes in the Macedonian educational system and efforts made during the last five years to modernize the education. The focus is given to the changes in science subjects.

Keywords: science education, teacher training, curriculum

The New Primary education in Macedonia

In the Republic of Macedonia primary education is compulsory like in other European countries. But, since 2006, with the newest Law on Secondary Education, secondary education became compulsory, too. With this law and the Law on Primary Education many changes began. Most of these changes are related to the primary education. The primary education used to be eight years. Since the Law in 2006 it is extended to nine years. The children used to start the primary education with the age of seven, but with the newest Law they start with age of six. The primary education is divided into three cycles:

- First cycle (1-3 grades, age 6-9)
- Second cycle (4-6 grades, age 9-12)
- Third cycle (7-9 grades, age 12-15)

The primary education continues supporting and developing some universal qualities like: democracy, equality, multicultural society and respect to others. But, with the newest directives some old objectives are intensified and some new are added: respect and individual differences between students, quality education and international comparable knowledge, lifelong learning, collaboration among school, parents and local authority. The new directives are built in the new curricula. New are the optional subjects, offered in the higher grades, at least one and maximum two subjects per grade. School activities in the nine-year primary education include compulsory curriculum and extra curriculum activities. These are comprise of compulsory subject, compulsory optional subject, class unit discussion, before and after school classes, additional lessons, interest activities and activities with gifted pupils.
What is in it for the science education?

The new primary education includes continuation in studying science. In order to obtain this, besides the old subjects in 7th, 8th and 9th grades (biology, chemistry and physics), new subjects are included in 4th, 5th and 6th grades: Nature, Natural Sciences and Natural Sciences and Technology (Table 1).

<table>
<thead>
<tr>
<th>Subject (Number of classes per week)</th>
<th>Grades</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Get acquainted with the environment</td>
<td>Nature (2)</td>
<td>Natural Sciences (2)</td>
<td>Natural Sciences and Technology (3)</td>
<td></td>
</tr>
<tr>
<td>Biology</td>
<td>(2)</td>
<td>(2)</td>
<td>(2)</td>
<td></td>
</tr>
<tr>
<td>Physics</td>
<td>(2)</td>
<td>(2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chemistry</td>
<td>(2)</td>
<td>(2)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The science subject’s objectives are to:

- Provide scientifically based knowledge related to life and physical sciences in order to understand themselves and the world around them,
- Enable students to see relationships between science and others subject and area,
- Prepare students to study and understand science in the upper grades, and have ability to acquire new knowledge and adopt concepts,
- Prepare students to formulate, analyze and solve problems, set up hypothesis, test it, work with data and discuss results,
- Apply acquired knowledge and skills and
- Understand basics in history of science, the role of science and technology in society and the influence of science in everyday live and development of society.

The science education involves inquiry-based learning, designing procedures and equipment, finding solutions for problems. All this requires trained and skilled teachers in the first place, and equipped classrooms.

The problems

Most of the science teachers in primary schools studied two years School of education. This does not make them trained and skilled enough for the new science education. The new Law on Primary education requires the teachers to complete their education and get a university degree. The Law also requires the teachers to commit to life-long learning.

On the other hand, apart from the efforts made by few individuals, the New Education is not incorporated at the university level and in the pre-service teacher training program.

Besides the efforts done by the state institutions, big help came from the international projects. The biggest help came from the USAID projects, mostly because of the big budget and the endurance. We will take a closer look to few of the projects which had greatest impact on the science education.
E-school project

The USAID funded e-Schools project started on August 1, 2003 and was closed on March 31, 2008. It was implemented by Education Development Center, headquartered in Washington D.C [1].

The e-Schools Project’s objectives have been to promote alternative and non-traditional methodology by placing the student in the focus of the learning process. In this respect, e-Schools’ endeavours were directed towards integrating information and communication technology in the learning process and changing the role of the teacher from presenter of information to facilitator. The e-Schools Project prepared and executed a training cycle including nine master trainers, 344 teacher trainers and 6,620 primary school teachers from all over Macedonia, whereas in the secondary schools, three master trainers, 218 teacher trainers and 2,838 teachers were trained.

The e-Schools Project was commissioned by USAID to install 5,950 computers and 460 servers donated by the People’s Republic of China in 360 primary and 100 secondary school buildings throughout Macedonia. Following the computer installation, the e-Schools Project conducted comprehensive training program in all primary and secondary schools in the country, in order to best guarantee computer application and proper use in the learning process.

In addition to the teacher training and hardware installation, the Project contributed to the instilment of information and communication technology in the Macedonian primary education system through the development of the first educational software in Macedonia, ToolKID. Its target students, and therefore teachers, belong to the K-4 grades.

The e-Schools Project through collaborative work with Mk Connects Project developed the very first educational web portal in Macedonia for the primary and secondary schools in both Macedonian and Albanian language [2]. The education portal is linking the school communities in a virtual working environment and was turned over to the Ministry of Education and Science to be managed and administered.

Creative Teaching and Learning Project

This project was funded by USAID and implemented by Foundation Open Society Institute-Macedonia [3]. It was launched in 2002 and will be finished in 2009. In the second half of 2005 the Project focused its activities to teaching faculties in order to improve the quality of pre-service teacher training. Eight teacher faculties nationwide were included in the project [4]:

- Pedagogical faculty, University in Skopje,
- Faculty of Philosophy, University in Skopje,
- Faculty of Philology, University in Skopje,
- Faculty of Mathematics and Natural Sciences, University in Skopje,
- Faculty of Humanities, University of Tetovo
- Faculty of Natural Sciences, University of Tetovo
- Pedagogical faculty, University in Stip,
- Pedagogical faculty, University in Bitola

The aim of this was to help the faculties in incorporating the new methods in teaching and learning at the university level, as well as designing new studying programme for the pre-service teacher training, which will include the new methods. Teams at the Pedagogical faculties in Skopje, Stip and Bitola worked together with their management in defining competence based curricula compatible with European directions for teachers. All eight faculties received additional
technical support and advice according to their needs during this last year of the project’s implementation. All eight faculties were involved in teaching methodology training for staff and intensive training for senior year students. The core teaching staff together with the Faculty management started working on re-designing their curricula which is expected to become operational by the end of the project implementation.

**Primary Education Project**

This project was funded by USAID and implemented by Academy for Educational Development. It was launched in 2006 and will be finished in 2011.

Main objectives of the Primary Education Project (PEP) are organized in four components [5]:

- School renovations
- ICT in education
- Improving the Quality of Mathematics and Science Education
- Improving School-based Assessment

Most important component for the science education is Improving the Quality of Mathematics and Science Education [6]. The main objective of this component is to help in building students critical thinking skills to succeed in a knowledge-based global economy. It is implemented in partnership with Indiana University. To achieve this objective, PEP works on:

Training mathematics and science teachers in using modern, active teaching methods, such as problem-solving and inquiry- and project-based approaches [7].

Through a variety of models of professional development, such as mentor teachers, regional training and school-based programs, PEP works with math and science teachers to help them adopt and practice effective and innovative teaching and learning practices in their classrooms. PEP develops and conducts workshops for mathematics and science subjects teachers in using active teaching methodologies. By the end of the project in September 2011, PEP plans to have trained all the mathematics and science teachers in Macedonia’s primary schools.

Improving math and science education for grades 1-3

In partnership with Step by Step, Macedonia, PEP trained 30 BDE advisers for lower grades and organizes training workshops for generalist lower primary teachers in the use of active teaching methodology during math and science lessons.

Developing school-based and national networks to support teacher’s professional development:

PEP helps school subject’s teacher councils and regional learning teams to develop programs and materials for in-school professional development activities. PEP also organizes school visits and follow-up support to trained teachers. For sharing information and better communication a blogspot is established ([http://mspep.blogspot.com](http://mspep.blogspot.com)).

Developing challenges for student’s math & science clubs in schools

This includes organizing and supporting school and regional competitions in the area of Mathematics and Science.

Developing print, digital and hands-on resources to improve teaching and learning

In cooperation with mathematics and science facilitators and Indiana University consultants PEP develops teacher’s manuals, lesson examples, videos of lessons and hands-on materials that teachers can use in their work with students. These materials are available for all mathematics and science teachers in electronic and paper format. Also, digital resources for computer use in math and science subjects are being identified, and adapted for Macedonia.

Implementation of new math and science curricula
PEP supports BDE subject curriculum working groups in improving the mathematics, physics, chemistry, biology and geography curricula. We work to provide teachers with the knowledge and skills required for implementing the student-centred teaching and learning approaches which are required in the new curriculum.

**Conclusion or What the Science Education obtained so far and will obtain in the future?**

In the frame of E-School Project 5950 computers and 460 servers were installed in 460 primary and secondary schools. About 10000 teachers from primary and secondary schools were trained in use of ICT through project-based learning strategies and networking. This was the first big shift on a large scale concerning the change towards the New Education. This project prepared the teachers for further bigger changes.

Through the Creative Teaching and Learning Project the quality of the pre-service science teacher training was improved, modern methodology was introduced in the teaching at the university level and was incorporated in the new curriculum. The pre-service teacher training curricula was redesigned in terms of contents and methodology. Media lab and a teaching cabinet at the science teachers’ faculties were equipped. A subscription to an electronic base of academic magazines was obtained. Students are trained in contemporary teaching methods and new contents.

The Primary Education Project continued where E-School project stopped. About 3000 science teachers and 120 students, future science teachers were further trained in performing contemporary methods and: inquiry-based learning, problem-based learning and project-based learning. Additional second round of trainings for the science teachers will continue in autumn 2009. PEP project will supply science classroom in the primary schools with modern experimental equipment: sensors, data-loggers, software etc.

The first web portal established in the frame of the E-School project will have continuation in the portal established by the PEP with complete new set of training materials “Toolbox”. The second phase of training will start in the fall of 2009. The science classrooms will be equipped with apparatus, sensors and equipment for experimental work.

All activities in the frame of these projects were carried out in cooperation with the Ministry of Education and the Bureau for Development of Education. The changes are incorporated in the new curricula [8].

**References**