

## INFORMATICS IN PRIMARY AND SECONDARY SCHOOLS: REVISIONS IN MACEDONIAN EDUCATION

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### ABSTRACT

Informatics is important subject in the Macedonian educational curriculum. During last 15 years, dramatic changes of the curriculum (in positive and negative directions) have happened, making the process interesting for observation. In this paper we present the state of the curriculum in Macedonian primary and secondary schools, concerning informatics, the most recent changes and plans for near future.

### I. INTRODUCTION

Before 10 to 15 years Pascal or Basics programming was taught in Macedonian schools, enabling pupils to learn how a mechanized turtle could be instructed to carry out complex maneuvers. But, with the revisions in the curriculum, the schools switched teaching programming to training pupils to use Office and similar tools. The Computer Society of Macedonia (CSM), as non-governmental institution, intended to change this situation by including the computer science in the primary and secondary education. In this paper we explain the efforts of CSM in that direction and present the goals, views and opinions about the matter. The way pupils were being taught informatics needed to be revised. But changing the curriculum is not a simple work. Nevertheless, CSM made some important steps to change the situation.

Macedonian society aspires to become an information society, but was the current situation in education in line with these aspirations? To develop such a society one need to create more programmers, software developers, trainees who can design embedded systems and so on. In order to create such a force is not necessary only crude knowledge of computer applications but topics that are relevant, intellectually sustaining and life-enhancing for students.

### II. THE ROLE OF MACEDONIAN COMPUTER SOCIETY IN THE INFORMATICS EDUCATION

The main activities of the Computer Society of Macedonia are fostering, popularization and promotion of informatics and its applications in Macedonia. Some of its activities are directed towards improving the status of informatics in the society and meeting the needs of experts and expertise in institutions and organizations in the country. Most of the goals that CSM has in its scope are related to education in informatics at all levels of education. As a special goals and objectives connected with this area are:

- To perform educational activities by organizing seminars, courses, symposia, training courses and issuing publications;
- To organize, realize and participate in competitions for pupils/students;
- To organize information schools and camps;
- To organize thematic conferences to promote the teaching in schools as curricula, textbooks, etc.;
- To encourage the use of ICT in teaching other subjects in schools and universities;
- To enrich the literature in information by issuing the professional, scientific, methodological and professional publications;
- To prepare standards and criteria and make recommendations for evaluation of IT effort and knowledge;

According to these goals, the curriculum in informatics subjects in primary and secondary schools in Macedonia has been analyzed and it was compared with the curricula in other countries. It was found that the topics covered by the subject informatics are mainly associated with computer applications

and work with computers, while the computer scientific aspect of informatics is almost entirely ignored. On the other hand, the subject informatics in secondary, even primary school in some of the countries close to Macedonia deeply covers the topics of computer science. Moreover, the number of teaching hours for the subject informatics in the nine year primary education is very small with 2 classes per week in the sixth grade and one class per week in seventh grade. Therefore does not correspond with the efforts of Macedonia to promote itself as an information society.

Because of this the CSM decided to take concrete steps towards improving the situation. The aim was to point the current state of informatics in education to the government institutions, the possible implications in the future and to give suggestions and recommendations for the next steps.

### III. WHY MACEDONIA NEEDS PROFOUND STUDY OF COMPUTER SCIENCE IN PRIMARY AND SECONDARY EDUCATION?

With the purpose of improving the situation in the education, CSM produced an open document, which was presented to the key decision makers in Macedonian government. The key points of that document written in 2009 are given in this section.

What are the needs and requirements of any modern society? According to the program for lifelong learning, the digital competences are among of the responsibilities that each individual needs to acquire to be able to actively involve himself as a useful member in the society. Proper, safe and ethical use of information technology in work or free time is essential. Each person should know the basic computer applications such as word processing application, work with tables and databases, and data storage and data processing. It is also necessary for everyone to learn about the possibilities of the Internet and e-communication media, such as electronic mail and network tools, for work or entertainment, information sharing and collaborative network learning and research, but also to be aware of and to understand the potential risks from them.

Everyone should also understand the ICT support of the innovation and creativity and be aware of the validity and safety of the available information and legal and ethical principles involved in the interactive use of ICT. The skills include the ability to search, collection and processing data and their systematic use, learning about relevance and distinguishing the real from the virtual.

Are the requirements listed above appropriate for the Macedonian society needs? Yes. Is it enough? No.

Macedonia aspires to be an information society. It means that the goal is not only maximal use of ICT, but also making an industry that will produce information technology for a wider market. So the Macedonia's requirements are:

- Many experts that will be able to participate in the creation, installation and maintenance of the e-society services;
- Many experts that will form the base of the IT industry.

Therefore, information literacy of all students is not the only objective of the Macedonian education. Production of a range of IT experts is also the one. But the current state in the informatics education of in Macedonia does not correspond with the objectives Macedonian society has. In the time when all government efforts leads to the building of information society, the number of classes for the subject informatics is lowest comparing with any other subject. In particular, under the current curriculum, the informatics is taught with 2 classes per week in the 6th grade and 1 class per week in the 7 grade of primary school and between 2 and 6 classes in all for years of secondary school (which means 2 classes per week for 1-2 years as compulsory subject, and 2-3 classes per week for 1-2 years as elective subject in some particular schools).

The question is why the pupils need to learn biology with 2-3 classes per week during 7 years and not need to learn informatics? Is not learned only how the animals or plants look like In the subject biology, but also the details about cells functioning and some other crucial parts of the biology science. Really, there are many professions related with biology, like medicine, agriculture, pharmacy, but will each pupil choose such a profession? Of course, not! There are many professions connected with computer science as well.

These facts are learned because it is good to know the basics principles of life. But, it is also good to know how the computers, which are integral part of our life nowadays, work.

### IV. IMPROVEMENT OF THE SITUATION IN THE PRIMARY SCHOOLS

As a result of the efforts of CSM and some other institutions, in 2010/11 the Minister of Education brought amendments to the curriculum of the eight years primary education. By this decision, the new subject *Programming*

was added to the list of elective subjects in VII and VIII grade with 2 classes per week, i.e. 72 classes per year, Figure 1.

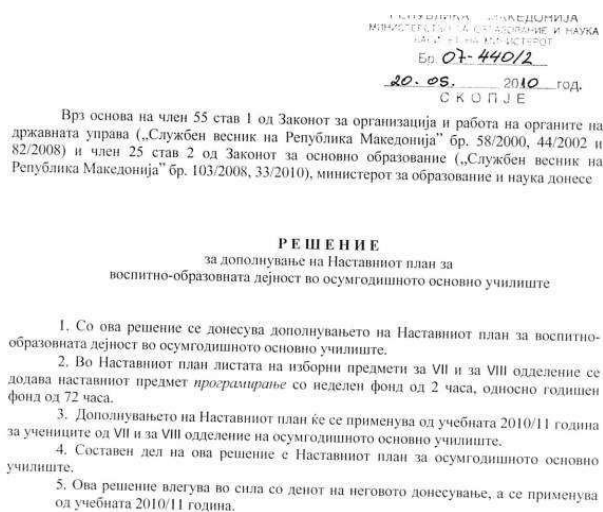


Figure 1: The supplement to the curriculum of the 8-years primary education.

This supplement is essential for the education in informatics, because pupils in primary education will be introduced to the basics of programming, as one of the most important parts in computer sciences. Moreover, this subject will stimulate the algorithmic thinking of students, as a creative component that successful experts possess.

Additionally, this way of thinking and reasoning should be encouraged at a younger age, so the efforts of CSM are towards the inclusion of programming earlier as an obligatory subject as well as the inclusion of elements of logical algorithmic thinking in the lower grades.

According to the new curriculum for the nine-year primary education, elective subjects in informatics are offered from third grade. The subject “*Work with computer*” is a facultative for the pupils in III grade and elective in IV or V grade. In the last three years of primary school pupils have the opportunity to elect two subjects related to informatics and computer sciences, *Project in Informatics* and *Programming*.

## V. THE SITUATION IN THE SECONDARY SCHOOLS

According to the curriculum for secondary school Informatics is represented by the following subjects:

- gymnasium education - general

- mandatory subject *Informatics* in first year with 2 classes per week (72 classes per year)
- elective subject *Information Technology* in second year with 2 classes per week (72 classes per year)

- gymnasium education - science and mathematics, additional courses

- elective subject *Programming Languages* with 2 classes per week (72 classes per year) just for subdivision science

- elective subject *Programming Languages* with 3 classes per week (108 classes per year) just for subdivision mathematics

- technical/vocational schools

- mandatory subject *Informatics* in first year with 2 classes per week (72 classes per year)

- mandatory subject *Informatics* in first year with 2 classes per week (72 classes per year)

Additionally, the content for the mandatory subject Informatics in the first year and the mandatory subject Informatics and elective subject Information Technology in the second year of studies was rather the same as the content of subjects in primary education and only involved teaching computer applications for word processing, work with spreadsheets, basic graphics and presentations. Because changing the curriculum is much more complex process, the first step was directed in modification of the content of these subjects, incorporating topics from other areas of computer science.

After modifications, one half of the new curriculum in the first year is mostly concentrated on deepening the knowledge gained in primary school about office applications and Internet. The second half introduces programming (in C++). Since the programming is the hardest part and most of the students are introduced to it for the first time, it is divided in two parts, one in the first semester and the other in the second semester. Topics that are treated in the first year are:

- Hardware (6 classes)
- Software (6 classes)

- Program for text processing (6 classes)
- Programming in C++ (36 classes)
- Program for spreadsheet calculations (10 classes)
- Computer networks and Internet (8 classes)

In the second year, the emphasis is again placed on the programming, and there are other topics covering different areas of computer science. The topic Multimedia and computer graphics is prevalent in number of classes, as the topic which would be interesting for students and will awaken their creativity. The topics in the second year are:

- Databases (12 classes)
- Programming (22 classes)
- Multimedia and computer graphics (24 classes)
- HTML (14 classes)

#### VI. THE SITUATION IN UNITED KINGDOM

In fact the situation in Macedonia is similar to the situation in the United Kingdom; initially children taught programming, and then move on to learning the Office tools. For that reason a vigorous debate has begun on what should be done about information and communication technology (ICT) in the school curriculum.

Here, we present some observations of this problem by John Naughton, professor of the public understanding of technology at the Open University, given in his column in Guardian on 31.03.2012 [3]. He states that “Starting in primary school, children from all backgrounds and every part of the UK should have the opportunity to: learn some of the key ideas of computer science; understand computational thinking; learn to program; and have the opportunity to progress to the next level of excellence in these activities.” This is the same as our perception. He also says that almost everything they have done over the last two decades in the area of ICT education in British schools has been misguided and largely futile. Instead of educating children about the most revolutionary technology of their young lifetimes, the focus is placed on training them to use obsolescent software products. According to him, in UK think that learning about computing is like learning to drive a car - knowledge of internal combustion technology is not essential for becoming a proficient driver. But cars don't run the world, monitor our communications, power our mobile phones, manage our bank accounts, keep our diaries, mediate our social relationships,

snoop on our social activities and so on, whereas networked computers do all of these things.

Therefore, except the set of key concepts that are essential if schoolchildren to understand the networked world in which they are growing up our children need to learn a new way of thinking about problem-solving - computational thinking, understand the difference between human and artificial intelligence, learn to thinking recursively, being alert to the need for prevention, detection and protection against risks, using abstraction and decomposition when tackling large tasks, and deploying heuristic reasoning, iteration and search to discover solutions to complex problems.

The world of our children, except physic, chemistry, biology will be also shaped and configured by networked computing and if they don't have a deeper understanding of this stuff then they will effectively be intellectually crippled.

#### VII. CONCLUSION

In this paper we analyzed the programs and plans for the subject Informatics in primary and secondary schools in Macedonia in last few years, and we presented the opinions of Computer Society of Macedonia on that matter. We presented the arguments that were given by CSM in order to motivate changes in Macedonian society and education. We explained the modifications of the curriculum done after the initiative of CSM. At the end, we presented the situation in UK, were nowadays there are major initiatives to impose changes of the same type.

#### REFERENCES

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