Towards a modern approach in teaching and learning the subjects of informatics in pre-university education

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Abstract

Nowadays Information and Communication Technology (ICT) has been recognized to be an effective educational technology which promotes dramatic changes in the teaching and learning processes. In the pre-university studies generally ICT tools have been used and taught but not informatics as a scientific discipline with its own concepts and methods. To outline and analyze the current situation of teaching the subject of informatics in pre-university studies, a questionnaire has been compiled to survey the opinions of the students about the way and quality that the subjects of informatics have been taught, the competences of the teachers, the curricula of the subjects and the laboratory conditions. Data from the questionnaire have been collected from the students of the first and second years from the main universities of Tirana, Vlora, Elbasan, Shkodra and Korça and from the pupils and teachers from the main high schools in Tirana. The curriculum of the subjects of informatics, interviews, observations, practices and methodologies used in the developed countries have been analyzed to draw the conclusions.

Issues with the use of ICTs and multimedia in teaching and learning

Introduction

Recently an increase of the discussion on the need for changing the informatics' curriculum in pre-university education is observed. Technology and informatics provide the infrastructure in redefining the work and communication with other scientific disciplines, such as engineering and business. Dynamic development of informatics as a science and information technology has faced us with new challenge in education and pedagogical process. The boundaries and the contents of this dynamic science are changing continuously. For this reason, it is needed to define the informatics science in order to determine the boundaries, which in the case of this science are flexible. Computer science is the study of computers and algorithmic processes including their principles,

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their hardware and software design, their applications and their impact on society (Tucker et al., 2006).

However, this discipline in pre-university education is often confused with the uses of this science in the education process such as: learning the basic software applications such as word processing, Excel, PowerPoint, Access, improving the typing with the keyboard and acquiring the calculation techniques in support of other subjects. Nowadays, although the use of new technology in a particular area is important, the ability to learn and to use that technology independently from the applications through improving algorithmic thinking or programming to solve the problems is more important. These skills would create advantage in the global economy.

The adjustment of the curriculum is a difficult process, and in particular for informatics this process becomes more difficult for many reasons related to this scientific discipline. The dynamic evolvement of this discipline and inappropriate informatics teachers are the two main reasons of the difficulties which are encountered during the changing of curriculum of informatics subjects. In total, the success of the learning process will depends on the effectiveness of all processes.

In Albania, informatics is relatively a new subject in the curriculum of pre-university education. For the first time in the world, informatics was introduced as a subject in the education system at 80's, and in Albania it has been introduced during 90's, in the last year of high school. It was extended to all high schools, with a curriculum consisting mainly of Windows system, block schemas and the Microsoft Office base package: Word processing, Excel, PowerPoint.

For a better understanding of the current status of the curriculum in pre-university studies and the problems that are encountered in teaching and learning processes in high schools, we have made a survey with the students of the first and second years in the main universities of the country, interviews with the pupils and teachers of the high schools and an analysis of the curriculum of informatics subjects. The analysis of these data as well as the discussions and recommendations on the methodology and technologies used in western countries will be presented in the last sections of the article.

Current curriculum of informatics subject and ICT in pre-university education

According to the literature (Rautopuro et al., 2006) informatics education in schools is based on three pillars which include:

- The use of information and communication technology to support the teaching and learning processes, for example the use of the word processing, databases, etc. for other disciplines such as mathematics or other sciences.
- Support of learning process by the use of services and tools which offer information and communication technology in the distribution of learning materials, for example through a web-based environment for learning.
- The learning of information and communication technology as a scientific discipline: concepts, skills and processes of the information and communication technology.

In practice, merely the use of information and communication technology will offer little opportunity for pupils to get the knowledge, concepts and skills which are needed in

acquiring the information technology as a scientific discipline. According to a definition (Drenoyianni, 2004) the education of information and communication technology includes a set of sophisticated cognitive skills such as analysis, implementation, extracting and collecting, organizing, managing, interpreting, presenting, evaluating and building of information.

Together with the changes and development of technology, curriculum of pre-university education in Albania has been evolved to adapt to those changes, but not in the same way for all directions. In the 10th class during an academic year, ICT and informatics have in total 72 hours, while the 11th and 12th class the informatics and ICT subjects have 36 hours. During the 10th class the basics of hardware and software are taught, as well as the office package which occupies the main part of the hours. As for the elective curriculum, in the 10th and 11th class, ICT and informatics have in total 36 hours during an academic year, while in the 12th class the informatics and ICT subjects have 34 hours. Tables 1 and 2 represent the current curriculum in percentage for each field that cover the total hours dedicated to ICT and informatics subjects in the teaching program of pre-university education in Albania. This information is based on the core curriculum of Ministry of Education and Science (MASH), Institute of Education Development (IZHA).

Table 1. Core curriculum

Fields, classes	The percentage of hours for each field during an academic year
Hardware, 10	9.7%
Software, 10	6.9%
Windows, 10	11.1%
Word, 10	26.4%
PowerPoint, 10	11.1%
Excel, 11	44.5%
Access, 11	36.1%
Internet. Electronic mail, 10	12.5%
Uses of internetit, 11	19.4%,
The effects of the computers and internet on the society, 12	50%,
Algorithmic, 10	13.2%
Publisher, 12	50%
Main functions of applicative programs, 10	8.3%

Table 2. Elective curriculum

Fields, classes	The percentage of hours for each field during an academic year
Dreamweaver, 10	30.6%
Introduction to WebPage Design, 10	19.4%
Web page Design (html), 10	36.1%
The use of CSS, 10	13.9%
Publisher, 11	27.8%
C++, 11	38.9%
Internet, 11	33.3%
HTML, CSS, JavaScript, 12	29.4%
Dreamweaver, 12	29.4%,
Adobe Photoshop, Ilustrator, 12	23.5
Windows Movie Maker, 12	17.6

As we can see from the table 1, a small percentage from total hours, less than 14%, is dedicated to the programming and hardware fields in one academic year of the pre-university education. Even the results of table 2 show that the learning of informatics as a scientific discipline (programming) has a small percentage compared to the tools and the usage of information and communication technology in the core curriculum during one academic year.

Methods

In order to outline and analyze the current situation of teaching the informatics' subjects in pre-university studies, a questionnaire has been compiled to survey the students of the first and second year at the main universities in the country and in the same time the pupils and teachers of high school were interviewed. The main goal of the survey and interviews was to extract the level of knowledge, capabilities and capacities of the teachers, the conditions of the laboratories as well as the interest of the pupils for the informatics discipline. After the analyses we divided the teachers into two groups. The first group, which is the biggest one, is composed of the teachers who do not have ICT as primary direction. They have skills as a user in computer, with its various applications, and they have basic knowledge which they have acquired through various trainings done privately or organized by the regional education directorates. The second group is composed of those teachers which are relatively younger and their education is mainly on informatics or scientific direction. Teacher from this group are more capable and more competent in teaching different fields of informatics discipline.

After analyzing the results of the survey and the interviews we can say that informatics subjects have been taught mainly from physical and mathematic teachers or others. These teachers were not able to teach appropriate topics of informatics, such as algorithms and programming, which are the main informatics directions on this scientific discipline.

Surveys and the interviews are the best methods to get information about the way and quality of the lessons and instructions of the informatics' subjects, skills of the teachers, the curriculum of the subjects, and the conditions of the laboratory in pre-university education. Survey was composed of three parts: the first part of the survey has general information questions such as: gender, district where the pupils and students are coming from or have completed a high school studies, the location of the school where they are studying/have studied, in village or city, the kind of school (professional or gymnasium). These data will help to understand not only the informatics education problems in general, but also the informatics' education problems of specific regions of Albania. At the second part of the survey there were questions about the teaching program. At the third part questions were about the percentage of knowledge acquired during the class. An evaluation system was build up with five options ranging from 1 that is less important to 5 which is the maximum rating. We used the same questions for the interviews.

The results of the survey and discussion

After collecting and analyzing all the data from the questionnaires we got the results for each question in graphics, some of them are displayed in the following figures. The figure 1 gives information about the status of informatics laboratories in the schools. 96% of the students related that their schools are equipped with laboratories and only 4% of them answered that they do not have any informatics laboratory at school.

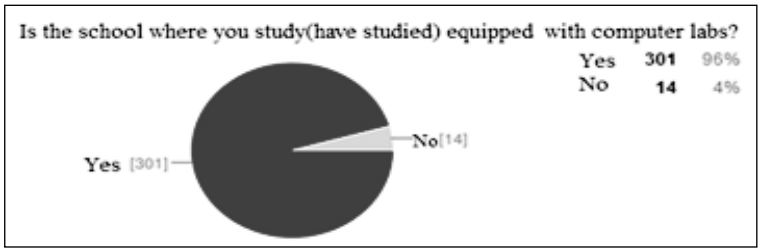
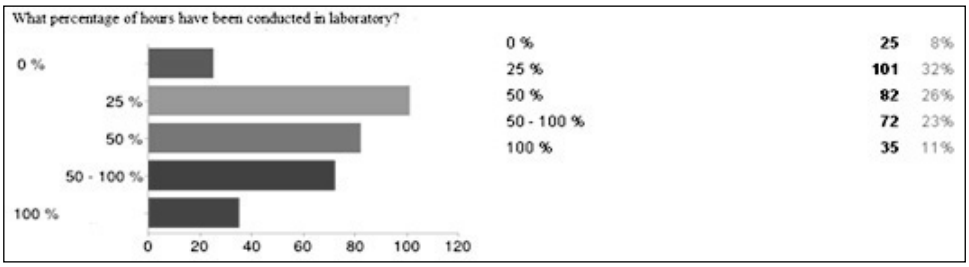


Figure 1. Equipment of schools with computer laboratory

Next question was about computer workstation. 66% of the student answered that 1 or 2 pupils were sitting in one station, and only 6% person confirmed that they were sitting 5 or more students in a workstation.

Another question was about where the informatics classes took place. The figure 2 shows us that in 26% of the answers, 50% of the teaching hours of the information and communication technology subjects were conducted in the laboratory, and 11% of the answers have confirmed that they have conducted all the informatics classes in the laboratory and only 8% of the students replied that they did not have any classes in the laboratory.

Figure 2. The percentage of hours conducted in laboratory



Nowadays the development of technology has reduced the cost of hardware, making possible for each family to own a computer. During our surveys and interviews related to that question 88% of students answered that they have a computer at home, and 73% of those were connected to internet. Generally the computer has been used during the learning process for subjects other than ICT discipline.

Another important rubric of the survey was regarding the level of knowledge acquired by the students in the various fields of ICT taught in high school. The result of the survey was: 19% of the pupils have got little knowledge in the field of internet; 21% complete knowledge of the internet and 60% enough knowledge for the Internet. The question about the knowledge acquired in the field of algorithmic and programming gave interesting results: 34% of the students did not get any knowledge about algorithmics and programming and 37% received full knowledge. The same result was even for the field of web programming, which had respectively 31% and 42%.

In figure 3 the level of the knowledge that the student have received in the Microsoft Office Package is shown, 58% of the students had taken above the average results in the applications of this package.

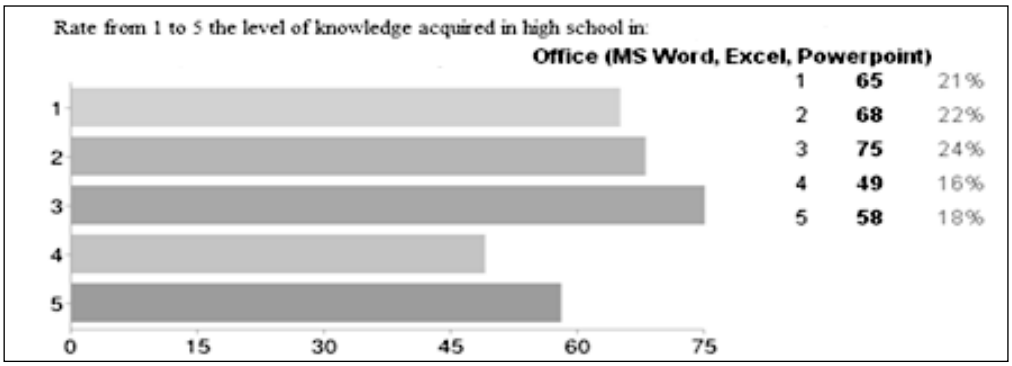


Figure 3.The level of the knowledge in the Office Package

In figure 4 the knowledge of the students about the use of the computers and their core programs is presented. The results show that the students have taken good knowledge in the operating system Windows and its core applications, 48 % of the students are above the average and 19 % of them have low knowledge. The knowledge taken in the architecture and the organization of the computers are good, 46% are above the average.

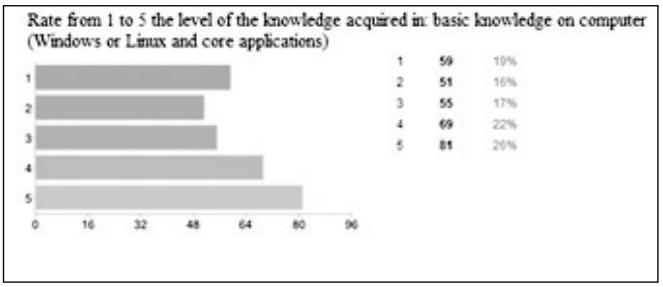


Figure 4. Knowledge acquired in the field of operating system and the core applications

The students were surveyed about their interests in the fields of ICT and informatics. The group of students who were not interested in programming and algorithmic constitutes 27%, while 38% are very interested in these fields. Figure 5 illustrates their interest in Office package programs. Just like for the office package, the students interest for the internet is not very high.

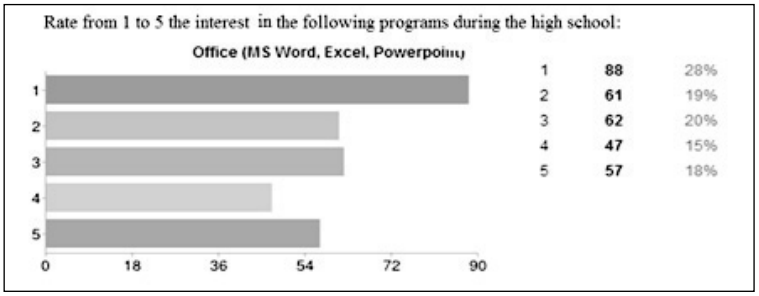


Figura 5. The students' interest for the Office Package Applications

It is easier for the students to use the computer and the internet. The reason for these results is the fact that most of the schools are equipped with laboratory and the

majority of classes are held there and the knowledge in these fields of informatics are absorbed well by the students. In the survey it was observed that students have very good knowledge of the office package programs (word, excel, PowerPoint) and the Internet, but they are not very interested in these programs. Office packages and internet are widespread in years and occupy a good part of the informatics subject's curriculum, which brings partial repetition of educational topics and lesser interest of the students in these classes. 24% of the students do not have interest in web programming and organization of the computers. Respectively 44% and 39% have more interest in these areas. In figure 6 it is shown the interest of the students in the architecture and organization of the computers.

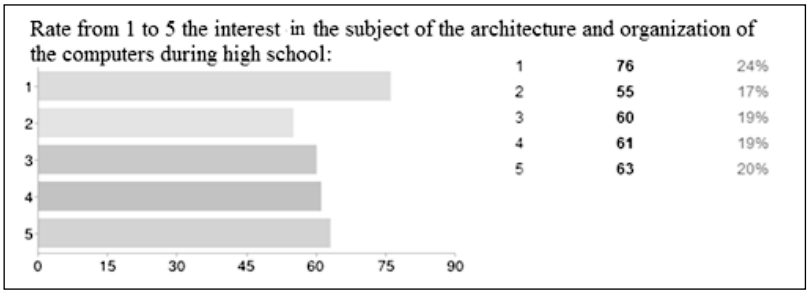


Figura 6.The interest of the students in the architecture and organization of the computers

In Figure 7 it is presented in graphical form, the opinions that the students have about the importance that different fields of informatics should have in the curriculum of informatics subjects. 41% which consist the majority of respondents, think that should be given more importance to algorithmic and programming in the curriculum, while 21% think that should be given more importance to web programming and only 7% think that the office package is important.

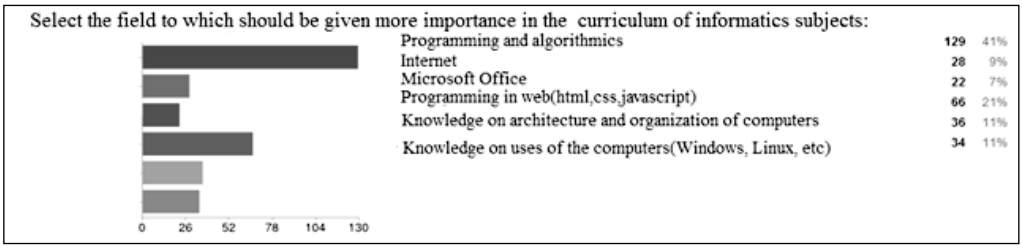


Figure 7. The students' opinions about the importance that different lines of informatics have.

Practices and methodologies from developed countries

To improve curriculum of informatics and information technology we can rely on international guidelines developed for the fields of informatics which include content and ways of learning. Appropriate guidelines for this purpose may be Uneskos curricula (Anderson et al., 2002) and that of the ACM K-12 curriculum model (Tucker et al., 2003).

The purpose of Unesco's curriculum is to produce practical and realistic guidelines that will serve to developed countries as well as developing countries. The curriculum can

be implemented according to the resources that are available, on time and at minimum cost because it is designed in modular form so that education authorities can choose the appropriate elements in order to meet the objectives set by each country, according to the degree of development.

By ACM curriculum model K-12 computer science is not programming or computer uses, but the study of computers and algorithmic processes, including their principles, hardware and software design, applications and impact on society. According to this curriculum model it is necessary that the curriculum of informatics subjects have deeper concepts such as: the organization of the computer (hardware, software), information systems, networks, digital presentation graphics, databases, modeling and stimulation, algorithmic thinking and programming, security, limits and the impact that information technology have on society.

Providing teachers with high quality and updated knowledge in the fields of information technology, the production of attractive textbooks in these subjects, developing software and educational resources for students and teachers are the main ways to support informatics education (Castle et al., 2008).

The standard developed by the German Society for informatics and information and communication technology is new and has innovative ideas for teaching informatics. This standard recommends two main areas for teaching: content and process. The content area can be combined with each process area and with typical tasks that are suitable for pre-university education. Part of content covers the five basic concepts: information and data, algorithms, languages and automata, information systems, information technology and society. Process area promotes actions combined with the following concepts: modeling and implementation, presentation and interpretation, structuring and networking, communication and collaboration, argumentation and evaluation.

Conclusions and recommendations

Based on this study, the majority of respondents agree with the fact that information and communication technology is an important part of education that should be strengthened. From the questionnaire completed by students it is noticed that they are very interested in the informatics discipline, but the main problem that they rise is the lack of qualified teachers able to teach the necessary knowledge so as to make informatics classes more interesting. It is recommended to open one scientific master for the informatics teachers. The aim of this master should be training the current staff of informatics teachers and prepare the future generations of teachers.

In the same time another issue raised mainly by students is the informatics subjects curriculum that has deficiencies in the computer science as a scientific discipline, leaving little space to programming. It is recommended to reduce the hours of office package and replace them with new topics which will develop the students' logic to algorithmics, programming, software architecture, communication networks, operating systems etc.

Other recommendations that will help to improve the pre-university education in informatics discipline are the following:

- Adoption of international standards and best practices in pre-university informatics education.
- Wider use of information technology and in other disciplines and to make it a tool for the learning process.

- Use of easier and more convenient tools and environments to start the programming such as kodu (Kodu) in primary education or scratch in secondary education (Scratch).
- Increase the computing laboratories and their quality as well as find ways to repair and maintain these laboratories.
- Draft of new school textbooks that best suit the improved curriculum including specialists of the fields as authors.

The results of this study are of particular importance. This study may serve as a preliminary to identify the problems that informatics and ICT disciplines have in pre-university education in Albania giving useful recommendations to improve it. The improvement of the informatics disipline in pre-university education is a necessary step to prepare the next generation for a global information society.

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