Teaching Information Technology in General Education: Challenges and Perspectives

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Abstract. During the last years a need of a new policy for implementing information and communication technology (ICT) in education has emerged. The Strategy for ICT implementation in Lithuanian education for 2005-2007 has been developed. Standards for school students' as well as teachers' computer literacy have been prepared and implemented. Teaching and learning information technology (IT) course in schools is one of the most relevant issues in information society. The paper deals with the goals and nature of the IT introducing into curriculum. It discuses the links with other school subjects and estimates the relationship between the compulsory IT course and the integrated parts as well as elective modules. The issues of general competencies essential for a contemporary citizen and the role of ICT in their development are also being discussed. Some suggestions in respect of developing IT curricula and general content are presented.

1   Introduction

The Lithuanian school education mainly consists of three stages: elementary (1st-4th grades), basic (5th-10th grades), and secondary (11th-12th grades). Full-time education is compulsory for all children from the age 6 or 7 to 16. Almost all the secondary level schools are state schools. There are approximately 1100 comprehensive schools (basic and secondary) with about half a million students in the country (there are 3.5 million inhabitants in Lithuania).

ICT has rather firm position in education; its availability for teaching and learning becomes increasingly obvious. The main discussions go on different aspects of methodology: what are the most reasonable ways of its implementation, how the teaching should be improved, etc.

Following the results of International Association for the Evaluation of Educational Achievement we can get rather value-free prospect of the implementation of computers into comprehensive schools of different countries [10, 11, 12].

We clearly may trace four main trends: 1) informatics as a separate educational subject; 2) development of applied computer skills; 3) training of information skills; 4) integration of informatics or information technologies in the other educational subjects.

The model of informatics as a separate course in a comprehensive school dominates in majority of East European countries, in which the fundamental and academic trends of teaching are rather more dominating until nowadays. Lithuania also falls under that category. Informatics as a separate subject was established in late 1970s and early 1980s. As a compulsory or partly compulsory subject it has been delivered in Belarus, Bulgaria, Czech Republic, Latvia, Poland, Romania, Russia, Slovak Republic, Hungary, Germany, and other countries [13, 5]. The course is being changed permanently: teaching about computer and training of the programming skills used to get more attention ten years ago, while nowadays much more consideration is devoted to developing the skills of practical ICT use in teaching and learning.

In today's world all countries give rising attention to ICT implementation in education [9]. Those countries which have informatics as a separate subject usually treat ICT as a part of it; however, most of the time and place in the teaching process is assigned to the technology itself, but not to its applying to the process of teaching and learning. In order to emphasize novelty of the course in informatics and the aspect of its applicability most of the countries, including Lithuania, have renamed it into Information Technology.

The second trend – development of applied computer skills – actually is the part of the course of informatics, and especially of IT. The trend is emphasized by those countries which previously didn't have academic course in informatics and which don't use the centralized way of providing computers for education but follow the will and the possibilities of the schools themselves.

Developing of information skills in fact embraces IT trend, but is slightly more of humanitarian studies and is coherent with libraries. J. Herring has introduced the model for developing information skills called PLUS [6]. The further works of this scholar is devoted to the issue of implementation of internet in educational process [7]. There is opinion that internet and CD will become main information sources and school will seriously have to consider this.

Implementation of computer-based technology during the lessons of each subject is one of the main goals of informatics or IT. Such process develops in all countries, although in a different way: it's closely related to economical level, infrastructure and state's priorities over the information society, etc. Some countries and especially those who have deep traditions of integrated teaching (for example, Denmark) implement integrated course of IT more successfully [8]. The parallel processes are preceded in many West European countries: on one hand, the IT trends are taken into account, on the other hand, IT is implemented in different school subjects.

East European countries have much more problems with such integration. The main reasons for it are the following: 1) lack of the technical means in schools; 2) inadequate or partly inadequate curricula or even lack of it; 3) low preparation level of teachers of different subjects to implement ICT in their teaching; 4) domination of academic way of teaching, *i.e.* subjects are being taught separately and have very little connection one to each other. Unsatisfactory attention to new teaching methodologies which require computer-based implementation in subject's teaching and the lack of qualitatively new teaching means have also to be mentioned here.

2   ICT Implementation and Education Goals

ICT implementation is a complex task which includes all elements and areas of education and influences the concept and the system of education. Different motives have revealed the variety of educational goals that may be reached with the help of ICT. The Strategy for ICT implementation in the Lithuanian education (for the years 2000-2004 and the new one for the years 2005-2007) provides that implementation of ICT in education should help to realize the Lithuanian education reform, should fit into general school objects and should satisfy public process and trends of economy in country [15]. Therefore the declared aims are based on the upbringing goals provided in general curricula of Lithuanian comprehensive schools and in conception for Lithuanian education as well as on the general values and principles of school work.

Analysis of Lithuanian comprehensive schools and evaluation of goals that are declared by educational reform has revealed that ICT implementation in comprehensive schools would be useful for different educational purposes, such as: 1) obtaining of a comprehensive education (on one hand, computer literacy is a concurrent part of the comprehensive education, and on the other hand, computers are tool allowing to get latter-day education); 2) upbringing the skills of continual and autonomic learning as well as ability to get handle on the different information sources; 3) stimulation of the communication and the cooperation as well as contribution in understanding of the main principles and values of democratic society; 4) as a result of its cultural, cognitive, and cooperational nature it may benefit an influence on each citizen's cultural self-consciousness and humanistic values.

All of this shows that the role of ICT in Lithuanian education should be regarded as multidimensional. Regarding the synthesis of general motivation for ICT implementation and analysis of Lithuanian education goals, the strategy for the years 2000–2004 has provided three main goals of IT implementation: 1) to provide the prospects and trends of integrating ICT into the Lithuanian general education, 2) to harmonize activities of various institutions, 3) to effectively use the funds allocated for the computerization of education. Strategy for the years 2005–2007 is concentrated on the following goals: 1) breakthrough of ICT implementation in school teaching and learning; 2) creation of educational computer network – well-stocked electronic space designed for teaching and learning as well as nurturing the conditions for modernization of education management and communication between school societies; 3) improvement of all inhabitants' computer competence helpful for solving the problems of social imparity. The goals of both previous and recent strategies embrace economical, social, pedagogical and other objectives.

3   From Informatics to Information Technology

The course in informatics started to be taught in Lithuanian comprehensive schools 20 years ago. The contents of the course, evaluation, and even the name were changed several times; nevertheless IT has remained as a separate subject. Besides, one of the most important components of IT is to make students of comprehensive schools ICT literate [2]. Today so called IT course is compulsory for the 9th and the 10th grades of basic school (68 hours in total) as well as for upper secondary school (11th and 12th

grades, also 68 hours). Students in the 11th and the 12th grade may also choose the optional (advanced) course of the subject. Students have to learn content defined in the course curriculum and obtain the capability defined in the educational standards. IT course usually is taught during the individual lessons of the subject. During the lessons, however, an integrative nature of the course is being stressed; students are prompt to see parallels with other subjects, to employ modern methods, to differentiate contents, etc.

The major developments of educational reforms in Lithuania occurred in the field of curriculum development. The new curricula and standards seek to strike a balance between the quantity of necessary knowledge on one hand, and the acquisition of intellectual, social and civic fluency on the other hand. Recently, IT general curricula and general education standards for basic and upper secondary levels were developed [3, 4]. At the moment the IT curriculum for basic education (5th-10th grades) is being revised. An integration draft should be prepared before long.

The main aim of teaching IT in general education is to develop students' information culture (literacy) in a broad sense. This goal is timely, urgent and of constant value. With the course of time the conception of information culture may change. Both basic and secondary school are striving for this goal. However, in the latter the conception is deeper and more comprehensive.

In our opinion, the information culture is a wide concept, considerably wider than information skills or abilities to work by computer. We consider that at present the conception of information culture covers various abilities and skills [3, p. 367]:

- to systematize the knowledge of ICT that the students have gained before the school or outside of it;
- to develop logical and operational thinking, operation planning skills, creativeness, ability to improvise, self-confidence;
- to refresh their IT knowledge and improve their skills to think and act;
- to give an opportunity for students to choose the direction of their further studies in the field of informatics;
- to develop a general literacy of students' information activities together with other school subjects;
- to get familiar with the elementary ICT and the related concepts and to be able to apply that creatively in daily life and cognition;
- to learn the basic concepts of ICT and understand their meaning, and put it into practice;
- to get familiar with the history and development of IT and their impact on the evolution of society and its culture;
- to improve their skills on ethical issues: to operate with ICT legitimately and reasonably, to link ICT with general issues of the culture of the society;
- to foster a resolve to continuously develop the content and style of one's information activities.

The goal of information culture is understood as an ideal towards which all the information education at schools should be directed, including compulsory and optional courses devoted to informatics.

The content of information culture's notion is constantly changing and is reliant on technological transformations. General tasks and goals of IT teaching and learning are defined also after the notion of information culture. It embraces a broad range of students' cognitive and other abilities and attitudes: starting with acquisition of the main IT terms and ending with creative abilities of improvisation, curiosity for innovations, and perception of cultural and ethical issues related to ICT.

Principle competencies of educated person (reading, writing, and arithmetic) which were dominating for several centuries nowadays are replaced by other ones, such as: information search (Web), text layout (word processing), and handling of numeric data (spreadsheet) (Fig. 1).
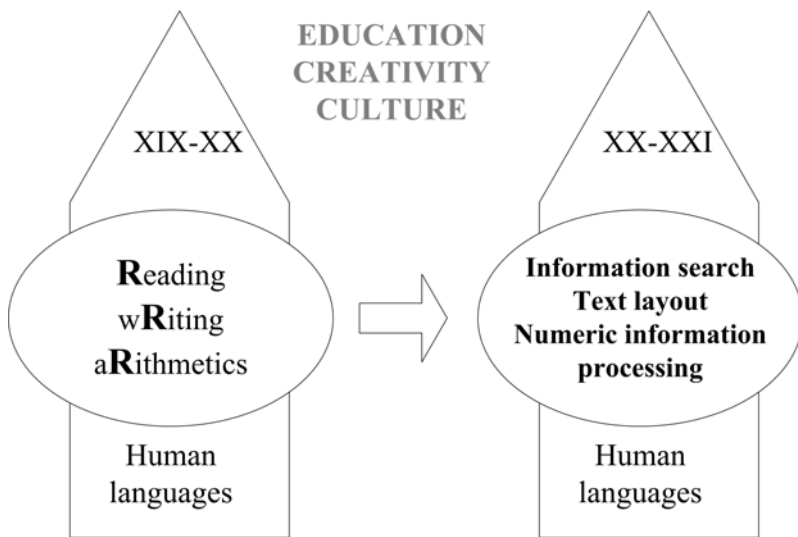

Fig. 1. Changing of basic competencies in society

IT curriculum emphasizes the value-based attitudes and general skills. However, these abilities are the objective of all informational training. The aims of separate IT course are much more narrow and pragmatic. In the last two grades of basic school (9th and 10th) students are taught to summarize ICT knowledge that was obtained in school and out of it, improve their ICT skills, and are prompted to get deeper awareness of informatics as a science which might encourage them for further studies of the subject. The aims of general course of IT for the 11th and 12th grades are cognitive as well, while the advanced course is intended for the training of specific application skills in one of the three chosen areas of ICT (data base, programming or multimedia) [4].

IT standards and contents of its courses are divided into the main ICT topics as it is shown in Table 1. The intended aims for the 9th-10th and the 11th-12th grades are essentially different. The IT standards for the 9th and 10th grades very precisely define the ICT knowledge and skills the students should obtain. The IT standards for the

11th and 12th grades are combined from two components. The first one describes general ability, while the second one is provided to define the particular achievements related to particular topics and chapters. General ability is rather broad and matches the common goals of the course. The content of curriculum is close to that of European Computer Driving License (ECDL), thus the main stress is placed on the substantial intelligence of ICT and on the formation of practical skills.

Table 1. Contents of IT subject curricula

Compulsory course, 9-10 grades	Compulsory course, 11-12 grades	Advanced (optional) course, 11-12 grades
1. Computer (principles of the work with computer)	1. Advanced elements of text editing	1. Data base
2. Text processing	2. Presentation	2. Multimedia
3. Information (basics of information handling)	3. WWW and electronic mail	3. Programming
4. Algorithms (main concepts and commands)	4. Social and ethical issues of using IT	
	5. Using spreadsheet	

Before graduating from the 12th grade students can chose IT school-leaving examination (starting with 2006 it'll be possible to choose State school-leaving examination in programming). The topics of school examination fully matches the curriculum and standard of IT compulsory course, while State examination additionally embrace the programming module of advanced course. Both examinations include test questions on theoretical part (mainly) and practical tasks which rather reveal practical skills of problem solving.

4   Students' General Computer Literacy Standard

Training of ICT literacy is closely related not only to IT course, but also to the Students' General Computer Literacy Standard [14], which is the key to the evaluation in a way as well.

The term *computer literacy* used in the Students' General Computer Literacy Standard covers a wider aspect - not only skills to work with the computer but also skills to implement IT in teaching and learning meanwhile acquiring the most general information skills. Name of the document quite nicely reveals a generality - value on which computer literacy's conception is based.

Computer literacy training is based on the attitude of integrity. The Standard clearly reveals the importance of computer literacy in training process and its connection with IT course: "The Standard defines such computer literacy which can

be achieved only by integrating ICT into the process of education: lessons of various subjects and activities after school, use of ICT in the school libraries. All-rounded computer literacy cannot be achieved just by using IT during the lessons of IT subject" [14, p. 2-3].

Standard emphasizes the necessity of value attitudes in order to apply ITC properly and effectively in training. Student's experience obtained in lessons of different subjects which implement computer technology has a main role in formation of those values.

The Standard specifies the guidelines of the most general value attitudes of students: 1) to perceive the importance of learning in the life of society and the importance of ICT in learning during lifetime, 2) to grasp the importance of ICT in professional activities as well as in everyday life and to become citizens enjoying full rights and taking an active part in society, 3) to penetrate not only the advantages provided by ICT, but also its dangers to equal opportunities of learning and democracy, 4) to understand that ICT shall be based on respect for traditional values of the state and people and shall assist to use the Lithuanian language correctly, 5) to be able to use the opportunities provided by ICT with great responsibility and perceive the importance of observing ethical norms in this area, 6) to be interested in the progress of ICT, improve and update skills of technology application, and enabling to feel safe and confident working with hardware and software with great responsibility.

Standard provides guidelines which are kind of more comprehensive notion of computer literacy. These are the following: 1) value attitudes; 2) general ability (for learning, work, communication, problem solving and research, critical thinking, and evaluation); 3) thematic fields of computer literacy (main principles and notion of the work by computer, basics of information handling, text processing and providing of information, acquaintance with a spreadsheet and data base, social, legal, and ethical issues).

5   Future Directions of IT Implementation into Education

The strategy of ICT implementation in Lithuanian education (for the year 2005-2007) schedules the systematic ICT teaching from the first grades of basic school. A team of experts has approved the IT course for the 5th and the 6th grades (68 hours in total). If some schools do not manage to prepare for these changes starting from the year 2005, they will be allowed to start such course one year later having more intensive course in the 6th grade. IT involvement into comprehensive schools' curricula of younger grades and its integration with other subjects is based on the following:

- wide spread of these technologies and its wide range of facilities;
- natural demand of students, their parents, teachers, and a whole education society;
- necessity of IT implementing in everyday and school life;
- inclination of young people to technological innovations.

It's considered that IT course in the younger grades will determinate the retraction of compulsory IT course in upper grades (especially in 11th and 12th grades) and will encourage students to implement their ICT skills in other subjects and out-of-class

activities. However, during the transition period (2005-2010) IT course will be held in both younger and upper grades. At the same time the IT integration to other subjects should increase (Fig. 2).
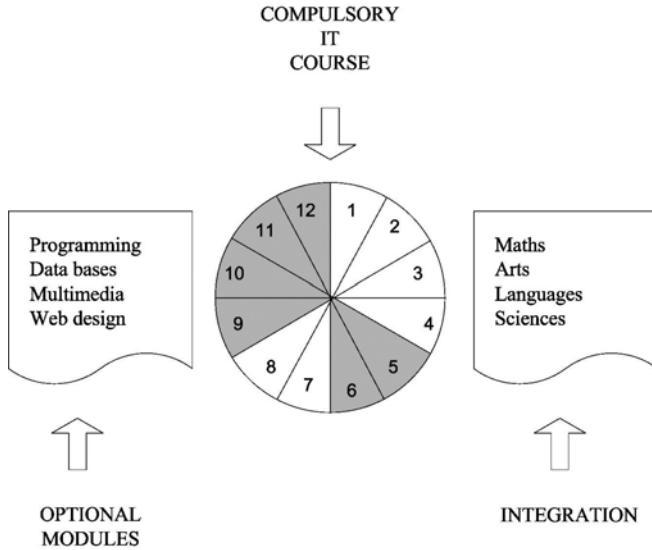

Fig. 2. Compulsory, optional and integrated courses in Lithuanian education

The main purpose of IT course in basic school is to use the IT knowledge and skills for better understanding of all subjects, to acquire the ability and desire for civilized communication not only within the school community but also within the contemporaries of the word. ICT provides a wide range of abilities especially in students' everyday life and encourages continuous perfection of person: it provides more skillful use of writing, speaking, and image as tools for communication and collaboration, cultivates self-support, continuous search of information and its processing, skills of activity planning, and helps to form logical and systematic thinking.

IT course should help to create conditions for students to obtain skills, knowledge, and experience in contemporary IT; however it also should be related to perfection of the learning process and involvement into life of information society.

Information training and encouragement of effective and proper implementation of ICT form not only computer literacy and skills for modern work, but also evolve moral values, if only content and training methods properly match one with each other. Systematic IT training from the younger grades and its reasoned integration with different subjects and themes would qualitatively improve students' modern competencies which are necessary for superior learning.

In the 5th and 6th grades IT course of 68 hours is suggested. Besides this, 34 hours of IT training should be integrated into different subjects (Table 2). Such integration could be shifted into the art lessons (e. g. theme "Computer drawing") and Lithuanian

and foreign languages' courses (e. g. theme "Acquaintance with internet"). The approached themes are directly connected with already mentioned subjects. Nevertheless, other subjects are also encouraged as well as designed activity in several subjects.

Table 2. IT curriculum design: distribution time and themes for 5-6 grades

Themes, subthemes	IT hours	Subjects, integration is addressed to	Integrated hours
1. Introduction to computer programs − Calculator, clock, calendar − Simple educational programs − Educational computer games	10		
2. Principles of computer use − Storage of information − Files, directories − Saving information − Archiving − Search information in computer − Computer and health	6		
3. Drawing with computer − Introduction to graphic editor − Drawing tools − Operations with graphic objects: rotation, flip, inversion − Gallery − Elements of animation	4	Art	10
4. Text and keyboard − Keyboard, levels − Keyboard typing tutor − Writing with computer − Lithuanian characters − Fonts − Styles − Formatting of paragraphs − Spell check − Inserting graphics into texts − Introduction to text layout − Printing	14	Lithuanian language	10

Table 2. (*Continued***)…**

5. Internet and electronic mail	10	Lithuanian language	4
− Information search in Web			
− Internet and its dangers			
− Downloading documents, files			
− Web mail			
− Reading, writing, sending emails			
− Attachments, viruses in attachments		Foreign language	10
− Chats			
6. Projects with Logo	**24**		
− Computer control understanding through Logo program			
− Control the dynamic object (turtle): by commands, keyboard, mouse			
− Repeating			
− Drawing, scanning, composition			
− Using several objects (turtles)			
− Turtles and their shapes			
− Basics of animation			

In the 7th and 8th grades IT course should last 34 hours and integration part in other subjects should include 68 hours. The integration could be addressed to Lithuanian language (themes "Text processing" and "Document creation and publication"), art (theme "Presentation and its arrangement", subtheme "Design elements in websites"), and math (theme "Principles of table processing") courses.

In the 9th and 10th grades IT course should summarize students' knowledge, prompt them to use their skills purposefully and pay attention to right technology implementation and its validity. For those who would like to learn more about computer working principles, a special course on algorithms should be provided. In the 9th and 10th grades IT course should last 34 hours and embrace 17 integrated hours. IT course for these grades should be more specific, intense, and claiming for the ordered and systematic generalization of knowledge.

The suggested course integration is conditional. If some teachers of different subjects have ability and conditions for effective IT implementation in their lessons or other cultivation, ICT integration into these subjects should be promoted. Integrated course should be held by teachers of both subjects, at least at the beginning. It's necessary to properly consider the content of the lesson or lessons, synchronize actions, provide particular tasks, etc. That is the only way to reach a proper level of appropriate abilities. IT teacher with the help of teachers of other subjects will be able to plan the helpful skills for other courses.

6   Conclusions

Learning with ICT is one of the main concepts in education. At the beginning, Informatics has been taught as an academic, knowledge-based course. Progressively the course of Informatics has been changing to practical-based activity, which pays main attention to information technology. IT course, as it is now called in many countries (and Lithuania too), has become ternary one. Firstly, it's a separate part of the course intended to form the most general information skills and knowledge, separate and compulsory course for all. Secondly, the course can be regarded as a component of all subjects. It may be compared with the reading skills that are necessary in all fields. Thirdly, it's more specific and deep knowledge of professional informatics and ICT. We may constantly feel the increasing need of these skills from industry and society in general. Therefore, school should provide optional courses and modules on different computer science issues for those who have abilities and desire to learn it. All three mentioned parts of IT course is represented in Fig. 2.

Content of the course has an extremely important role [1]. If the main competencies of the last century were regarded as a combination of "three R" – Reading, wRiting, aRithmetics – our time invites us to search for something fundamental and necessary. IT course emphasizes three main parts: information search (Web), text layout (text processing), and work with numerical data (spreadsheets). These three are relevant everywhere and for everybody. The fact may be testified by the use of software designed exactly for the mentioned tasks. Consequently, these are the things that should draw the main part of IT school course compulsory for all.

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