

RESEARCH OF ICT EDUCATION IN THE CZECH REPUBLIC

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Abstract

Information or ICT education in various forms has become an obligatory part of curriculum in all developed school systems. However, the approach to ICT education is not uniform across countries. There are substantial differences in organizational set-ups, topics range and forms of corresponding school activities. More than that, the general concepts, goals and learning content declared in the national curriculum and policy documents has to be concreted, aimed and transformed by teachers into the school-level curriculum. During the transformation, the teacher's experiences, personal attitudes, professional skills and technology competences project into her/his decisions and they influence the process and the results of ICT education. Therefore, further differences emerge as teachers' understanding of some key concepts and their attributed importance slightly varies. These facts stress not only the importance of modern, competence oriented information education in the primary and lower secondary education, but also the necessity of research activities trying to identify the situation and the concept of development of ICT competences of pupils with impact of research findings on the elaboration of methodology of information education and improvement of teachers training in the given direction.

The Faculty of Education at Charles University in Prague deals with ICT education and information literacy as one of its main research topics. In 2006 – 2007, a group of faculty researchers and PhD students in cooperation with the Ministry of Education of Czech Republic performed a national research project focused on curricular, processional and organizational elements of ICT education in Czech primary (ISCED 1) and lower secondary (ISCED 2) schools. The main goal of the research was to gather relevant indicators of the state and tendencies in this rapidly evolving area of elementary education and to propose steps to improve the quality of pre-service and in-service teacher training in the field of ICT integration into their subject. The research topic was, in general, the development of pupils' ICT competences and its determinants. The research field was an area covering the wide range of various ICT activities realized in specialized subjects and cross curricular projects. An interactive on-line survey system was used as a research tool and data were analysed by standard statistical methods to produce a global portrait of ICT education in Czech schools. The survey was addressed to teachers being involved in any form of ICT activities at a particular school. Relevant responses were collected from 930 schools across the land. The paper presents a short summary of the research project and some results.

Key words: *information and communication technology, information education, information literacy.*

Introduction

It is a generally appreciated and widely proven fact that the Information and Communication Technology (ICT) or Information Society Technology (IST) by which the society is thoroughly penetrated, bring about the changes in the structure of working activities and the ability of operating the above has a significant influence on employment possibilities, the success and the quality of life of a person. Therefore the information education tending towards the building of information and technological literacy and the development of relevant skills has become a part of many conceptual and program documents as well as it has become the goal and the subject matter of various segments of lifelong learning.

From the perspective of the approach to technology and the ability to use it effectively including the ability to use its educative potential within the framework of lifelong learning, the society may still differentiate. Information literacy may be understood as a factor that draws the division line between those who can operate the technology, know how and when to use it, and those without the skills then having the lack of information or the resources of knowledge. As the success of individuals may be widely determined by these abilities, the accessibility of ICT and the chances of training to use it should be as open as possible. A serious problem of so called digital divide emerges between individuals and their groups, and also among the whole areas or states with a different access to technology, the level of cognitive skills, and therefore the general ability of exploiting these technological possibilities. It can have a serious impact on economic and social position of people or groups (Digital Divide.org, 2008). The risk of widening the socio economic divide mobilizes the activities of developed countries and above national organizations from the perspective of the approach of citizens to the technology and improving their ITC literacy (OLPC project, 2008).

The prominent position in providing the information education as well as the intentional development of ICT competences and relative cognitive and operational skills essential for effective exploitation of ICT is reserved, within the frame of formal education, for the primary and lower secondary schools. Although the importance of informal information education based on experience with the ICT at home, in spare time, or during various entertainment activities should not be neglected, the core of information education as for setting the base for the key competences is irreplaceable.

These facts stress not only the importance of modern, competence oriented information education in the elementary education, but also the necessity of research activities trying to identify the situation and the concept of development of ICT competences of students on elementary schools with impact of research findings on the elaboration of methodology of information education and improvement of teachers training in the given direction.

The Faculty of Education at Charles University in Prague performed in 2006 – 2007 in cooperation with the Ministry of Education of Czech Republic a national research project named VIV06 focused on curricular, processional and organizational elements of ICT education in Czech primary (ISCED 1) and lower secondary (ISCED 2) schools.

The ideological and conceptual background of the research are the same as the premises of modern information education in the sense of development of information technology competences, based on the reflection of changes in the society and the specific role of technology in these changes. It reflects the position of an individual from the perspective finding a place in the society, the educational needs, the influence of modern trends and tendencies in education. For the orientation and concept of the project, the enquiries and analyses of core constructs connected to information education were significant. The information education was here understood as educative influence aspiring to develop information or information technology competences in order to reach adequate level of ICT literacy.

The modern notion of information education that presented the solution for the orientation of the research project VIV06 is based on the reflection of the above mentioned processed in education as well as in the society. It takes the polyvalent characteristics of ICT into account and its exploitation is an essential part of many occupations, the cause of changes in the qualification structure and the tools for obtaining such a qualification on one side and as contents, means and part of educational environment on the second side. Above all it is derived from the understanding of the key role of information and technology competences and in the framework of elementary education. It also as-

sumes that the current concept of information education must support the development of skills or competences enabling the adaptability of students, transfer of knowledge and skills into new contexts and the ability of learning in a rapidly changing environment. These characteristics demand strict application of competent approaches with the support of transferability of knowledge and skills within information education and to the development of relevant key competences and building the information and technological literacy.

From the perspective of the development of ICT competences the property of the current notion of information education is the integration of results into the into the activities and solving of problem connected to work with information as well as the integration of information, technological and cognitive dimension into the building of wide ICT literacy. When meeting this goal the comparisons should be supported, the generalization and the above platform creation of models of activities: We should not just stick to the level of acquiring only a set skills bound to a certain application or platform without the ability of transferring it in other circumstances or conditions. The links to other spheres of life of a school is an important characteristic here. The functional implementation of ICT and the relevant competences cannot be understood as a sole subject of teaching within the curriculum of special lessons and fields. The information education must be supported within a variety of educational activities and fields as well as the school environment must offer a sufficient number of opportunities for building informational literacy.

Research goals and problem fields

During the years 2006 and 2007 a research project Research of Information Education (VIV06) focused on the field of information education in the elementary education in the Czech Republic was carried out by the employees and post graduate students of the Department of Information Technology and Technical Education at the Faculty of Education, Charles University, Prague with the support of the Czech Ministry of Education. The research was based on wide exploration, the target groups were the teachers of informatics-based subjects or teachers that are execute the information education and the development of IT competences at elementary schools.

The task of the project VIV06 was to offer through research enquiry a scientific evidence on the situation and the concept of the development of IT competences of students of elementary schools, to identify the key signs and processes in the given rapidly changing field of education, to offer prognosis of these changes and contribute by the outcomes to the improvement of the training of teachers for securing a modern competences oriented information education on elementary schools.

The subject of the research in the project VIV06 was the development of IT competences of students and their main determinants. This general concept of the research subjects was detailed in five field of problems oriented on /1/ characteristics of information education activities, /2/ topical units of information instruction activities, /3/ stage and concept of the development of the ICT competences of students, /4/ structure and manner of the development of ICT competences of teachers, and /5/ implementation of ICT competences into instructional activities and into life of schools.

These problem fields specified below structure the research field into inter linked tasks aspiring to solve the problem from curricular, procedural, and organizational aspects of relevant educational activities realized at schools of the Czech Republic.

The research field of the VIV06 project has been framed by the information education, or the field of educational activities realized at elementary schools in the direction of IT competences of students both within specialized informatics subjects, topical units or informatics oriented projects, and as an implementation of relevant activities into other subjects, school life and environment.

Wide model of information education was applied for the project purposes, understood as a complex formative process that leads to the acquisition of essential IT and cognitive knowledge and skills, or gaining the competences related to understanding the information needs, selecting relevant sources and means, searching, evaluation, processing, communication and effective use of information including the technology mediated and supported communication and cooperation, using the potential for education towards information literacy.

The main target of the VIV06 project was to recognize the real situation, structure, organization and tendencies as for the development of information and technology, or ICT competences of

students in a sense of building the relevant level of their IT literacy. The application goal was to get the relevant background for improvement of IT education on elementary schools and of the training of teachers.

The sub goals of the research project point out the research activities in relation to the understanding of the declared mission, subject, main goal, and orientation of the fields of problem. The following points thus belong into the chart of sub goals of the research project oriented on the curricular, procedural and organizational aspects of information education.

- To determine the theoretical outcomes and elements of IT education in context of understanding the key competences.
- To analyse the systems of key competences and offer the characteristics of IT competences from the perspective of their contents and structure.
- To offer the analysis and comparison of models of the development of ICT competences of teachers.
- To offer the characteristics of informatics educational activities on elementary schools as for the kind, orientation and scale.
- To research the concept and contents tendencies within the information education activities at elementary schools and steps taken to build the IT literacy.
- To analyse the manner of development of IT competences of elementary school students from the perspective of the target level of IT literacy.
- To identify the importance and the role of IT competences on various levels of generalization with links to the content structures of IT education.
- To understand the links when building the IT competences in the sense of development of wide understood IT literacy.
- To offer characteristics of the level of ICT competences of teachers of IT subjects and of the teachers of non IT subjects.
- To specify the structure of ICT competences of teachers of informatics based subjects and their readiness to realize the wide concept of information education.
- To identify the relationships and links between the structure and level of ICT competences of teachers and the concept and contents orientation of IT education.
- To find out to what extent and in which manner are, or should the IT competences be developed.
- To derive the direction, level, or how the information and technology competences should be incorporated into the life of the school.

The research of curricular, procedural, and organizational aspects of information education realized in the conditions of elementary schools was oriented into relatively wide field, where it was possible to identify several main points of interest for problem fields.

From the logical perspective the first field of the research enquiry was the educational activities within those the relevant information and technology skills are developed at elementary schools. Various kinds of activities were considered here, such as subjects, thematic units, projects and topics, which may be all called the information educational activities.

The second field was the contents of the research activities. The range of topics or topical units creating possible contents of information instruction activities, mainly the IT subjects and their links were considered here.

The third field of the research enquiry, from the intention of the research the most important one, was the problem of the situation and development of IT, or ICT skills of students of elementary schools. The model consisting of layers was considered here including competences understood as the first level of realization of relevant key competence, and further competences (knowledge sets, skills, attitudes values) of lower level of generalization understood as its parts, or as the parts of information and technological literacy of students.

The fourth field of problems was the complex of relevant competences of teachers. The following indicators were mainly considered: ICT competences of teachers involved in information

education activities on the background of other teaching competences, level of ICT skills of other teachers, its acquisition and development, as well as information and methodology resources used by teachers of information instruction activities during the preparation of lessons.

The fifth field of problems was the implementation of ICT competences into the educational activities of students and teachers. The indicators of entering the ICT into standard learning activities of students and teaching activities of teachers, including the training for these activities, and into the educational environment of schools understood as a space for application and development of IT competences of students and teachers were considered.

Methodology of Research

A complex questionnaire with 20 main questions and 175 sub questions was developed by the research team to serve as a basic tool for the research. Some sub questions were multiple, so the total number of queries reached 243.

As the team was also interested in the use of graphical interface when realizing on line questionnaires within www applications, the questionnaire was designed in such a way that it supported the manipulation with graphical components (drag and drop, sorting, placement) on the screen with the possibility of statistical evaluation of all the activities of the respondent (Mudrak et al., 2005).

This solution was chosen on the presumption that the use of graphical objects, symbols, or banners enables the respondents to react more straight forward, often faster, with the possibility (and also possibility of evaluation by researchers) of operation with subjects also on intuitive basis. It enables to take into account the structural components as much as the holistic approaches, as by interactive work with graphical objects the phase of transformation of opinions into codes and numbers is bypassed. The right hemisphere work is then more precisely observed. The motivation factor in the form of a pleasant design in colour of the questionnaire application and the manipulation with the objects should serve as a good motivational example (Mudrak et al., 2007).

Within the questionnaire enquiry into the aspects of information education and development of ICT competences of students of elementary schools, all the schools with lower secondary education classes were addressed. 3529 representatives of schools were directly addressed with the request for assistance. 930 respondents representing the participating schools (one per school) filled in the questionnaire fully or partially. Due to the complexity of the questionnaire, the quite demanding questions, and the time load expected when filling in, the number of responses may be considered as very high.

The sample of 930 respondents was made of the teachers of informatics oriented subjects. Women and men were equally represented - men (50.5%) and women (49.5%), mainly university educated (only 6 % without a degree), with mainly education degree (75%), science degree (9%) and technical degree (8%). All respondents have attended some of the official IT courses for teachers, majority of the have reached higher or special level of ICT skills. More then two thirds of the respondents have been teaching for more then 9 years, and the majority for more then 5 years IT oriented subjects.

The geographical spread of the sampler was quite equal and it reflected the density of elementary schools and their location in the Czech Republic. This is valid for the number of schools in individual regions, the size of the region, and the size of schools with the number of students. The sampler also reflected the situation in equipment of schools with the ICT means, i.e. the number of computers in the labs, the capacity of labs, and the number of computers outside the labs.

Results of Research

Although the scale of the sampler was quite wide and in many parameters reflected the real spread of the given indicators, it was impossible to secure the totally adequate sampler as if chosen by random. The results below, obtained by the use of the methods of mathematical statistics, can be, therefore, related to the given sampler of respondents, the generalization and judgements should be made very carefully.

The following facts can be mentioned among the main outputs in the context with the given

goals and research tasks of the research project VIV06 oriented on the curricular, procedural, and organizational aspects of ICT education in primary and lower secondary schools in the Czech Republic, based on the questionnaire answers of respondents from more than 900 schools in the Czech Republic:

Characteristics of information instruction activities

- Information instruction activities are realized at schools in a wide range of compulsory and non compulsory subjects oriented on ICT and using other subjects for incorporating informatics oriented topics as well as realization of information oriented projects.
- Individual information instruction activities are realized on various scales in all elementary school grades. The total volume of these activities grows with at higher grades.
- The volume of information activities significantly grows from beginning of lower secondary education with the introduction of compulsory informatics based subjects.
- The total volume of information educational activities at schools is mainly determined by the use of ICT within the lessons that are not directly IT oriented. The second place is occupied by the lessons of compulsory IT subjects.

Topical units of information education activities

- From the perspective of the importance of individual topical units of informatics based subjects for the development of information and technology literacy of students of elementary schools the respondents submitted the following chart:
 - Word processing
 - Basic user skills, work with operation system, file administration
 - Information seeking and communication
 - Work with spread sheets
- As the least important topical units of informatics based subjects for the development of IT literacy of students of elementary schools were marked:
 - Theory about information, its sources, ICT and information society
 - Work with library documents and printed information resources
 - Mind mapping and concept mapping
 - Algorithm design and programming
 - Using databases
- The structure of information technology competences of the respondents influences also the selection of other key and other units. The respondents very often tend to mark those they master themselves, and, on the other hand, they point out as unimportant those where their IT competences are lower.
- With the units the respondents marked as key for the development of IT literacy of students there is also an agreement on the order of succession the units should be taught.
- From the succession of topical IT subject units perspective several opinion streams were noticed. All answers from the respondents agree the units should be thought in the following order:
 - Basic user skills, operation system, file administration
 - Word processing
 - Information seeking and communication
 - Work with spread sheets
 - Computer graphics
 - Presentations

- Multimedia applications
- Web publishing
- Using databases
- The biggest differences in the opinions of respondents regarding the order in which the topics should be taught:
 - Theory about information, its resources, ICT and information society
 - Work with library documents and printed information resources
 - Mind mapping and concept mapping
 - Computer hardware
 - Algorithm design and programming
- Algorithm design and programming are most frequently listed among introductory units by teachers beginning their career. More experienced teachers usually mark this item as a suitable for secondary education.

The stage and understanding of the development of IT competences of students

- From the competences of higher level the following ones are considered as the most important for the development of information and technology literacy:
 - To analyse the obtained information and find the important piece for the given task
 - Use more resources of information in problem solving
 - To be able to evaluate the various forms of given information
- The most important competences of lower level that are marked as important for building an information literacy of students of elementary schools are:
 - Creating documents and editing using word processor
 - Understanding the tree structure of directories and files
- As the least important competences of lower level of generalization from the perspective of building and development of information and technology literacy linked to a certain application or activity are:
 - To create mind maps and concept maps
 - Create web pages in (X)HTML
 - Design algorithms and programs
- The following competences are marked as the most difficult for students to learn:
 - Design algorithms and programs
 - Defining of problems, making hypotheses, suggest a solution of a problem
 - Create web pages in (X)HTML
 - To create mind maps and concept maps
 - To analyse the gained information and determine the important pieces for the given task
- The following are marked as the easiest competences for the students to get:
 - Create and edit text in word processor
 - Understand the tree structure of directories and files
- Understanding of the importance of the IT competences and their level how demanding they are for acquisition corresponds with perception of similar topical units of informatics based subjects.
 - Competences bound to units the respondents see as essential are marked as important for the development of IT literacy and also marked as easy for students.

- The competences linked to units the respondents marked as unnecessary, often also their own competences were marked as insufficient here, and these units were seen as unimportant and difficult for students.
- The respondents judge the importance of IT competences in the context of how demanding they are, which they see a limiting factor for their development.
 - The competences seen as demanding also marked as unimportant for the development of IT literacy on elementary schools.
 - The competences marked as not so demanding are, on the other hand, seen as an important factor for the development of IT literacy on elementary schools.
- From the perspective of the opinions on the most suitable timing of building the IT competences at elementary schools the respondents agree these competences should be thought in the following order:
 - First the competences focused on reading and understanding of information should be developed. It means competences as to be able to judge the reliability of the source of electronic information, find the way in various forms of information, and to analyse the pieces of information and determine those important or relevant.
 - The visualization of data and information should follow. This means the ability to select and organized the information into charts and sheets, schemes, or other structures as well as creates graphs in spread sheet software including the use of spread sheets to get more information.
 - The suitable time to start the effective development of competences based on the transformation of complex knowledge, e.g. the ability of creating a using thought maps and notion maps, algorithm design and programming or creating the web pages using the (X)HTML code, is, according to the respondents, on higher secondary level.
- The students should be able to create and edit word processor documents and work with file tree structure as early as on the elementary school level, or in the first two grades of lower secondary level at the latest.
- Almost two thirds of respondents of respondents would start with algorithms and programming on higher secondary school level.
- The respondents teaching the lower secondary level consider the development of IT skills on elementary level as difficult and unsuitable. Those teaching on elementary level claim that many skills can be developed there already.
- As for the description of the current stage of development of IT skills the respondents underline the importance of on the development of the ability to search for and get the information from electronic resources. This ability is seen to be important also from the perspective of supposed optimal situation.
- Among other abilities that the information education on elementary schools should develop there is the ability to use more information resources when looking for information, the ability to analyse the received information, determine the important parts for the given task, and to distinguish within the information load.
- The especially effective way of development of IT competences of students is the use of ICT on cross curricular basis.

The structure and means of development of the ICT competences of teachers

- As the main competences for teachers' profession the respondents pointed out communication skills, psychological and educational skills, and organization skills. The ICT competences go after these three and are considered a standard part of professional portfolio of every teacher regardless the subject thought.
- The majority of respondents perceive the current level of ICT skills of teachers of non

informatics based subjects as relevant. Nevertheless they characterize these basic skills as the ability to operate basic software, mainly text editor, and using the Internet, These skills are not frequently used for instruction purposes.

- From the professional perspective, or as their own ICT competences, the teachers of informatics subjects declare only such a level they themselves consider the lowest acceptable. A third of them declare their ICT skills not sufficient for realization of instruction of informatics based subjects.
- The following competences may be considered an everyday part of specialized portfolio of respondents:
 - Word processing
 - Information seeking and communication
 - Basic user skills, operation system, file administration
 - Work with spread sheets
 - Creating and using the presentations
- The differences in general level as well as in structure of competences among respondents are given mainly by the level of following units which are here the main factors of differentiation on the level of competences.
 - Mind mapping and concept mapping
 - Algorithms design and programming
 - Creating and publishing of web pages
 - Basics of data base operation, creating of data bases.
- Among the most frequent means of improving ICT skills of teachers is self education and studying of professional IT literature.
- An important resource of education for teachers with lower level of ICT literacy was the system of SIPVZ courses. With the growing level of ICT skills the positive evaluation of SIPVZ courses declines and the importance of self education and studying of professional literature grows.
- The dominant resource for preparing the instruction and materials for instruction are produced by the teachers themselves.
- With a growing level of information and technology competences the respondents during the preparation of materials for instruction rely on non educative information resources i.e. scholarly literature or topical or informational web resources, and they tend to abandon the educative resource such as text books and multimedia applications designed for elementary schools.

Implementation of ICT competences into instruction activities

- From the point of implementation of ICT into the education environment and life of schools the use of the technology by students prevail in various subjects, including handing in assignments in electronic form, when creating supportive materials for instruction as well as the use of technology outside of instruction.
- The ICT means are rarely used in the field of control and evaluation of the students. The virtual learning environments are also rarely used (VLE, LMS).
- The scale and the level of implementation of ICT and information and technology competences into instruction is developing mainly in those directions that are less demanding on time and qualification of teachers.
- The determining factor for the level of implementation of ICT into the school environment is not the importance of an individual activity for the development of information and technology skills of students, but the time demand of the activity on teachers.

- Teachers possessing higher ICT competences tend to lead the students towards broader usage of ICT as an everyday tool of work and communication.
- The respondents do not consider the current situation in integration of ICT into education sufficient and are aware of the space for improvement in all directions of implementation.

Conclusions

In general, the following can be stated based on the outcomes of the research project VIV06 in relation to the curricular, procedural, and organizational aspects of information education at elementary schools in the Czech Republic, taking into account the limits arising from the origin of the data and the relevance of the sampler of respondents:

- The information education at elementary schools is not limited to the subject information technology itself. The development of information technology competences is also supported by the wide usage of ICT in other subjects not directly focused on informatics, and also in various educational information activities that are not directly linked to these subjects.
- The information education realized within the information subjects tends towards narrow understanding of the subject oriented on mastering the basic user skills and basic applications. The topics of informatics as algorithms as well formalization supporting the modern concept of information literacy are not considered so important or pushed to higher secondary level.
- A structure and a level of ICT competences of teachers of information subjects have a decisive influence on the concept and orientation of information education realized within these subjects. The topical units or competences the teachers find hard to master or consider difficult are often evaluated as less important for developing the ICT literacy by them and they do not employ them.
- A half of teachers of IT subjects declare that their information and technology competences are on the level they themselves consider as the minimum acceptable for the duality realization of instruction of information subjects on elementary school. A third of the teachers declare they do not even reach the minimal level accepted.
- The condition for effective development of IT competences of student sis, besides the relevant contents orientation of information education, also wide implementation of ICT and relevant competences into the teaching of various subjects as well as into the life of school. The development of competences takes place mainly when the teachers of various subjects use the ICT for creating the study materials, to organize, control, and evaluate the instruction, to communicate with students and to realize internet educational activities.
- The especially important fact that determines the implementation of ICT into the school environment is the time load that certain kind of implementation represents for teachers. With the growing load on teachers, the level of usage of various means of integration of ICT into the educational activities of schools decreases.

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