Research on ICT literacy education in primary and lower secondary schools in the Czech Republic

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Abstract

The implementation of ICT literacy education as obligatory part of primary and lower-secondary school curriculum is a feature of school systems of developed countries. We may consider a wide spectrum of approaches ranging from limiting ICT literacy education to practising mastering software tools on the one hand, to the approach emphasizing pupils’ algorithmic thinking development on the other hand. School educational programmes and teaching in action obviously differ. And yet the method and topical orientation of ITC literacy education definitely have a profound effect on pupils’ information technology competencies or digital literacy development. This paper briefly reports on the project focused on the Czech Science Foundation Project - Information Technology Competencies of Children and Their Development in Primary and Lower Secondary Schools examining the current state, structure and trends in development of ICT literacy education in Czech primary (ISCED 1) and lower-secondary schools (ISCED 2). The project involving 1183 participating schools (ICT teachers) provides findings on particular issues including characteristics and thematic units of educational ICT activities, pupils’ information technology skills development and implementation of ICT competencies into educational activities.

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1. Introduction

The professional as well as personal life’s quality is nowadays significantly affected by the command of specific knowledge, skills and attitudes sets referred to as the “second” or “new” literacy. Information technology competencies rank among top of newly significant competencies, therefore broadly understood information literacy,

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ICT literacy, or digital literacy became to be seen as the second literacy. Develop of its appropriate skills has become the object of the attention of a number of conceptual and programme documents and also lifelong learning aims (e.g. European Commission, 2006; Anderson, 2008; Ala-Mutka, et al, 2008; European Commission, 2010; ITU, 2012).

Primary and lower-secondary schools play an important role in providing ICT literacy education and developing information technology competencies, or cognitive and operational skills and attitudes necessary for the effective use of information and communication technologies. Modern ICT literacy education must support the development of the abilities, or competencies enhancing pupils’ adaptability, knowledge and skill transfer into new contexts and the ability to learn in a rapidly changing environment. It is to develop pupils’ critical thinking skills, their ability to make a decision and argue reasonably, it is to develop algorithmic thinking and problem-solving skills; it is to enhance creativity and creative thinking in pupils. These features lead to application of competence approach with the support of transmittance of knowledge and skills in ICT literacy education leading to the development of key competencies building up information technology, or digital literacy (Eurydice, 2002; European Parliament and the Council, 2006; Ala-Mutka, 2011; Ferrari, 2012).

ICT literacy education as part of primary and lower-secondary school curriculum is a feature of school systems of developed countries. However, ICT literacy education is not realized uniformly and differences among the systems can be seen in organization, extent and forms of educational activities (areas, subjects, thematic units, projects) and their conception. Differences can be assumed also between the programme declarations and understanding goals and tasks and content transformation and concretization of the educational activities of schools and teachers. We may consider a wide spectrum of approaches ranging from limiting information education to practising mastering software tools for searching and processing primarily text information on the one hand, to the approach emphasizing pupils’ algorithmic thinking development on the other hand (e.g. Balanskat & Gertsch, 2010).

2. Aims of the Research and Research Methods

The above-mentioned premises accentuate the need of research activities seeking to identify the current state and conception of the development of pupils’ information technology competencies in primary and lower-secondary schools.

In 2006 was carried out the research project Research of ICT Literacy Education 2006 (VIV06). The research was focused on a wide area of ICT literacy education within the primary and lower-secondary education in the Czech Republic. Relevant data were gathered from 930 schools, resp. respondents representing individual primary and lower-secondary schools (Rambousek et al, 2007, Rambousek & Wildová, 2010). In 2012, a two-year long research project Czech Science Foundation Information Technology Competencies of Children and their Development in Primary and Lower Secondary Schools (VIV12) was initiated whereby the staff of the Faculty of Education at Charles University, Prague, intend to follow up the project VIV06 and carry out a similarly large survey in Czech primary (ISCED 1) and lower-secondary (ISCED 2) schools.

The main aim of the VIV12 project is to understand the current state, structure, orientation and tendencies from the point of view of information-technological, or ICT skills of pupils in respect to building up a certain level of their information technology literacy. The object of research activity within the VIV12 project is the development of pupils’ information technology competencies and its main determinants. Such a generally defined research topic can be rendered specific in five problem areas: (1) First we focused on educational activities developing pupils' information technology, or ICT skills at primary school. (2) Then we focused on the content of educational ICT activities. We considered a wide spectrum of topics, or thematic units comprising possible content of educational ICT activities. (3) The third area concerned the current state and development of pupils’ information technology, or ICT competencies at primary school. (4) The fourth area comprised a set of teachers' competencies. ICT competencies of teachers of educational ICT activities were primarily considered. (5) The fifth area concerned the implementation of ICT competencies into pupils' and teachers' educational activities. We explored indicators of introducing ICT into pupil’s standard learning activities and teacher’s standard teaching activities and into school learning environment understood as an opportunity to use and develop pupils’ and teachers’ information technology competencies.

As a basic tool for first stage of researching the aspects of ICT literacy education, an elaborated questionnaire (a
questionnaire for teachers) with 17 complex questions including 186 partial questions was developed by the research team. Following the above mentioned research areas the questionnaire was divided into the following thematic parts: (1) Characteristics of educational ICT activities. (2) Thematic units of educational ICT activities. (3) Current state of pupils' information technology competencies development. (4) Structure of teachers' ICT competencies. (5) Implementation of ICT competencies into educational activities. Within the first stage of the research VIV12, the said questionnaire was employed with 3,500 randomly selected schools in February and March 2013. At this stage, research data were obtained from 1,183 respondents representing different primary schools (usually one respondent from each school). Due to the fact that each school was represented by one respondent, the response rate was 34%.

The questionnaire survey undertaken in the first stage of the project (a questionnaire for teachers) is supplemented with other research methods in the second stage of the project. 146 schools participated in the second stage of the project aimed at schools interested in closer cooperation. They administered a questionnaire for pupils, which was completed by 2,507 pupils from 112 schools. In addition to the questionnaire for pupils, another survey was carried out for those who were interested, in which teachers expressed their opinions and experience concerning ICT literacy education, for which there was not enough room in the questionnaire for teachers. The last empirical method was a method of case studies of the implementation of ICT competencies into pupils' and teachers' educational activities, or into school environment.

The following part presents selected findings obtained within the research areas of the first stage of the VIV12 research project focused on the issue of ICT education in primary and lower-secondary schools in the Czech Republic and also some comparison with the VIV06 project (Rambousek et al, 2007; Štípek et al, 2008).

3. Selected findings

The sample consisted of 1,183 teachers of ICT-orientated subjects returning the questionnaires fully or partially completed. Both sexes were equally represented in the sample, it comprised 46% of men and 54% of women. This distribution corresponds with the characteristic of teachers of ICT-orientated subjects even though the total of primary and lower secondary school teachers comprised only 16% men and 84% women in 2012.

Although 3,500 schools were randomly selected, it was not possible to ensure full representativeness of the sample corresponding with the random sampling. The results below can be, therefore, related to the given sampler of respondents, the generalization and judgments should be made very carefully.

3.1. Characteristics of educational ICT activities

Educational ICT activities are realized in primary and lower-secondary schools in a more extended spectrum through obligatory and optional subjects focused on ICT, integrating informatics or ICT topics into other subjects, using ICT in other subjects and realizing informatics-orientated projects.

Educational ITC activities are mostly (90.5%) performed within a compulsory subject in primary schools (ISCED 1). We can also quite often find ICT in non-ICT subjects (75%). In lower-secondary schools (ISCED 2), a compulsory ICT subject is virtually present in all cases (97%). Other types of activities also show a noticeable rise. Using ICT in the subjects, who are not primarily, oriented on ICT or informatics, accounts for the majority of all educational ICT activities in primary and lower-secondary schools. This is a positive shift in contrast to the findings of the project VIV06.

3.2. Thematic units of educational ICT activities

Regarding the significance of thematic units of ICT-orientated subjects for developing information technology literacy of the primary and lower-secondary school pupils, the respondents consider the following for the key thematic units (ranked from the highest average score on 0 - 100 scale and listed as median): Searching for and retrieving information from the internet (M=93); Word processing – editing documents, basics of typography (M=90); Safety on the internet, copyright, ethical principles (M=94); Basic user skills, working in an operating system, file management (M=81); Creating and using presentations – working with presentation applications (M=77); Communication and cooperation in digital environment (M=74). In contrast to the findings of the VIV06
Creating and using presentations ranked among the most significant thematic units. Among the least significant thematic units of ICT-orientated subjects with the viewpoint of developing primary and lower-secondary school pupils’ information technology literacy belong the following (ranked from the least preferred): Creating and publishing websites - HTML, CSS, PHP etc. (M=29); Using databases – fundamentals of database systems, database design (M=22); Algorithm design and programming – developing algorithmic thinking (M=20). Even though we cannot agree with ranking the above mentioned thematic units among the less significant from a standpoint of current understanding of ICT literacy education, this evaluation is the same as in the VIV06 project.

From the viewpoint of investigating real preferences for thematic units of ICT subjects, we created a hypothetical situation where the amount of lessons was significantly decreased and so the content of ICT subject was also noticeably reduced. Respondents could choose from 5 thematic units, which they would keep, but at the same time 5 units that they would give up. (a) Respondents would keep (relative frequencies): Word processing, creating and editing documents (86.3 %); Searching for and retrieving information from the internet (79.1 %); Safety on the internet, copyright, ethical principles (58.8 %); Creating and using presentations (45.7 %); Basic user skills, working in an operating system (45.1 %). (b) Respondents would give up (relative frequencies): Using databases – fundamentals of database systems, database design (80.9 %); Creating and publishing websites by HTML, CSS, PHP (73.4 %); Basics of information theory (62.3 %); Audio and video on the PC, using/producing multimedia (58.0 %); Algorithm design and programming (51.9 %). The real preferences for thematic units of ICT subjects were not changed in comparison with findings of the project VIV06.

As for the relation between the thematic units and pupils’ age, we investigated teachers’ opinions on the most suitable period for introducing the thematic unit, whether it should be in primary school, lower-secondary school or as late as in upper-secondary school. According to most respondents, the following thematic units should be definitely introduced in primary school (relative frequencies): Safety on the internet, copyright, ethical principles (0.89 %); Searching for and retrieving information from the internet, data collecting (0.85 %); Word processing, creating and editing documents (0.83 %). In lower-secondary school, mainly thematic units such as Working with spreadsheets (84.10 %); Audio and video on the computer (72.40 %) and Creating and using presentations (71.30 %) should be introduced. Most respondents shift the introduction of the following thematic units only to upper-secondary school using databases – fundamentals of database systems, database design (67.50 %); Algorithm design and programming (54.50 %) and Creating and publishing websites (53.50 %).

From the viewpoint of continuity, or the order of teaching thematic units of ICT subjects, respondents responded by placing particular symbols on the timeline. Within a basic analysis, each thematic unit was given median (M) ranking representing an overall view of the order of thematic units (total 14 topics) as they are usually taught at school. PC hardware and software (M=2), Basic user skills (M=2), Safety on the internet (M=3), Word processing (M=4) and Searching for and retrieving information from the internet (M=4) are ranked among the introductory topics. The greatest differences in respondents’ opinions on the sequence of thematic units, or on the order in which they should be taught, concerned the following thematic units: Basics of information theory (M=6), Computer graphics (M=6) and Communication and cooperation in digital environment (M=6). Algorithm design and programming (M=11) are ranked among the introductory topics mainly by beginning teachers. Respondents with longer teaching careers prefer to rank this unit as same as Creating and publishing websites (M=11) or Using databases (M=12) into later teaching, best into secondary school teaching. These findings are virtually the same as the findings of the VIV06 project.

Respondents spend the most time on the following thematic units: Word processing – creating and editing documents (87.9 %); Searching for and retrieving information from the internet (64.6 %); Safety on the internet, copyright, ethical principles (55.4 %); Creating and using presentations (55.4 %). Respondents spend the least time on the following thematic units: PC hardware and software – the structure and functions of computers (44.5 %); Basics of information theory (35.8 %); Algorithm design and programming – developing algorithmic thinking (33.9 %).

3.3. Pupils’ ICT competencies development

In order to evaluate the development of pupils’ ICT competencies, we first explored the importance respondents attach to particular competencies for primary and lower-secondary school pupils’ ICT literacy development.
Competencies of both a higher degree of generality (total 13 competencies) and a lower degree of generality (total 10 competencies) were evaluated by means of two lists. Respondents expressed their opinion on a 0-100 scale.

Among the most significant skills from a standpoint of building up and developing primary and lower-secondary school pupils’ information technology literacy belong (A = arithmetic mean): Search for and obtain information (A=90.0); Respects of the code of conduct in digital environment (A=84.7); Evaluate and analyse obtained information and distinguish important information (A=81.6); Process and integrate information (A=78.4); Present information and store it for the given purpose and recipients (A=76.9); Communicate and cooperate in digital environment (A=76.4); Know how to use digital technologies (A=75.9); Think creatively, create your own products (A=74.8). The least important competencies are surprisingly considered from the skills of a higher degree of generality Think algorithmically, formulate instructions (A=53.3) and Understand technological principles and processes (A=47.3)

The following aspects are regarded as the most important skills from the skills of lower level of generality linked to concrete activities or applications: Create, edit and process documents in a word processor (A=85.4); Use various information sources for information verification (A=81.2); Navigate through various forms of information (A=79.9); Judge reliability and credibility of electronic information sources (A=78.3). The following aspects are regarded as the least important skills from the skills of lower level of generality linked to concrete activities or applications: Create www pages in HTML, PHP, JavaScript etc. languages (A=31.4) and Master the basics of algorithm design and programming (A=30.3).

Understanding the importance of information technology competencies and how demanding it is to acquire them correspond to the respondents’ attitude to similarly orientated thematic units of ICT-orientated subjects. The skills, which are considered demanding, are at the same time marked as little important for the development of information literacy in primary and lower-secondary school. On the contrary, the skills considered as undemanding are marked as important part of ICT literacy education in primary and lower-secondary school.

From the viewpoint of the environment for pupils’ ICT competencies development, respondents expressed their opinion on various statements and they compared their degree of agreement with the current situation of their school. They evaluated each statement on a 5-point scale (1=no, 2=very little, 3=partially, 4=rather yes, 5=definitely yes). In terms of characterising the current state developing information technology competencies, respondents put the greatest emphasis on the development of the pupils’ ability to search for and obtain information from electronic information sources (A=4.6). Among other abilities, which are from the viewpoint of the current state developed more than partially, belong the ability to Respects of the code of conduct in digital environment (A=4.1); Process and integrate information (A=4.0); Present information and store it for the given purpose and recipients (A=3.8). Certainly it is displeasing that likewise in the VIV06 research, the ability to know how to use problem-solving strategies and information orientated tasks (A=2.9), understand technological principles and processes (A=2.7) and think algorithmically, formulate instructions (A=2.5) received the lowest evaluation mark from the standpoint of the current situation.

3.4. Structure of teachers’ ICT competencies

In the area of teachers’ ICT competencies, the primary aim was to map their level from multiple viewpoints, chiefly to establish the level of respondents’ ICT competencies and simultaneously ascertain their evaluation of the competencies of other teachers at school. Respondents were presented with a six-level scale expressing the levels of teachers’ ICT competency development by means of various ways of using technologies in instruction with apparent gradation from Level 1: A teacher does not have a sufficient command of ICT, uses or employs ICT skills neither in the classroom nor in lesson planning, to Level 6: A teacher is able to use, administer and develop ICT. They are able to adapt themselves to new technologies. They encourage pupils to use advanced programmes and applications and create their own materials.

The first question inquired what level of ICT competency development can be on average assigned to teachers of informatics subjects in respondent’s school. However, the last 6 years have seen an increase in choices of level 5 from 40 % to 51 %. The highest offered level (6), which can also by marked as a production level to a certain extent, has also experienced a growth, from 19 % to 30 %. Differences are statistically significant. The second question examined the minimum level of ICT competency that a teacher of ICT-orientated subjects should acquire generally.
Respondents rating a current level of competencies of their colleagues lower scale levels (3 and 4) also generally stated lower requirements on minimum level of teachers of informatics subjects. The third question explored the level of technology competencies of the respondents themselves. Majority of respondents (53%) rate their current technology competencies a 5 and one third of the respondents (32%) rate themselves the highest level. 15% of the respondents scored a 3 and 4, thus not reaching even the minimum required level of competencies.

Besides the self-evaluation, a question on teachers’ preferences on teaching various thematic units was introduced to complete the information on respondents’ competencies. It was presumed that respondent’s attitude to teaching a certain thematic unit is significantly influenced by the respondent’s notion of their competencies in this unit. In the said question, the respondents were presented with 14 thematic areas. Their task was then to show their attitudes to the areas in terms of their willingness, or preference to stand in (teach) on the following scale: 1 - I want to stand in, 2 - If necessary, I can stand in, 3 - No, I don’t want to stand in.

Most respondents chose “I want to stand in” for thematic units: Word processing (79%); Searching for and retrieving information from the internet (73%); Creating and using presentations (69%); Working with spreadsheets (59%). Most respondents chose “No, I don’t want to stand in” for thematic units: Using databases, fundamentals of database systems (55%); Creating and publishing websites (40%); Algorithm design and programming, developing algorithmic thinking (28%).

3.5. Implementation of ICT competencies into educational activities

From a viewpoint of implementing ICT into school life and the educational environment, the following ways for using technologies prevail: handing in papers and tasks in electronic form by pupils in various subjects, preparing supplementary teaching materials, and using technologies outside school. ICT tools to organize, monitor and assess the learning process are rarely used and virtual learning environment are seldom used as well.

The extent and level of implementing ICT and information technology competencies into school life and educational environment develop mainly in the field so this does not place significant time and professional requirements on the teacher. The determining factor of the level of ICT implementation into school life and environment is not the significance of the implementation for pupils’ development of information technology competencies, but the time burden, which this way would place on the teacher. Teachers with a higher level of information technology skills require their pupils use ICT as a common tool for work and communication.

Conclusion

Overall, based on the findings of the first stage of the VIV12 research project we can say that ICT literacy education does not concern only the ICT-orientated subjects in primary and lower-secondary schools. Using ICT in the subjects that do not focus on informatics primarily and in a number of educational ICT activities which are not directly linked to subject contributes significantly to the development of information technology competencies. ICT literacy education realized in ICT-orientated subjects tends to focus only on user skills and mastering basic applications and tools. Informatics and algorithmically formalistic topics and problem-solving skills, supporting creativity and creative thinking in pupils and building up modern broadly understood ICT technology literacy are not considered important or are postponed to secondary school. The structure and level of information technology skills of informatics teachers fundamentally influence the conception and orientation of ICT literacy education realized in these subjects. Teachers consider the thematic units or skills which they cannot master themselves and consider them demanding of a lower importance for the development of information technology literacy in primary and lower-secondary schools and do not commit themselves to them. ICT competencies of teachers of ICT-orientated subjects range from basic or pre-intermediate user skills to the level of professional IT experts. Some respondents imply that they do not consider their ICT skills as sufficient for teaching ICT-orientated subjects in primary and lower-secondary schools. From this it follows that the realization of IT education in the Czech Republic is, compared to other fields of primary education, problematic to say the least. The structure and level of IT teachers’ ITC competencies fundamentally affects the concept and orientation of IT education realized in these subjects. Based on the comparison with the VIV06 results we may nevertheless observe a positive trend in a gradual shift of IT teachers’ ICT competencies towards higher levels.
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References


