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INFORMATICS EDUCATION: CURRENT STATE AND PERSPECTIVES OF DEVELOPMENT WITHIN THE SYSTEM OF FIELD DIDACTICS IN THE CZECH REPUBLIC

Miroslava Černochová
Faculty of Education, Charles University in Prague, Magdaleny Rettigové 4, Praha, Czech Republic
miroslava.cernochova@pedf.cuni.cz

Jiří Vaníček
Faculty of Education, University of South Bohemia, Jeronýmova 10, České Budějovice, Czech Republic
miroslava.cernochova@pedf.cuni.cz

Abstract

This study offers an overview of the current state in the field of informatics education in the Czech Republic. The new publication of a monograph focusing on field didactics showed that a complex analysis of the current state and future perspectives of developments in informatics education that has not yet been addressed is needed. This paper presents an overview of development in the discipline from the 1960s, defines the main goals of informatics education in the Czech Republic, namely the contents and methods of ICT and computer science education, the need to revise the content areas in official pedagogical documents, teacher education including training of primary teachers and methodology of research in the field of informatics education. The authors of the paper analyse current trends that have impact on informatics education and also refer to the dynamics of computer science education, gradual shift of computer science to lower school levels and introduction of new computer science topics into the area of information and communication technologies. In the conclusion the authors formulate the current problems that informatics education will have to tackle and indicate the possible dangers and perspectives of its future developments. In this article, we distinguish between informatics education as a school subject education and computer science education and ICT education which we understand as parts of this school subject in this context.

Keywords

informatics education, field didactics, computer science education, ICT education, school subject, curriculum, subject matter, computing

Monograph on field didactics

Currently the Czech Republic witnesses growth of field didactics. Until 1989 field didactics were underpinned by communist ideologies and were rooted in the context of building the communist society. They copied Soviet pedagogy and didactical approaches used in former Soviet Union. The changes in 1989 brought new impulses and revival. One of the milestones of this revival was the establishment of the permanent working group for field didactics of the Accreditation Commission of the Czech Republic. The core of the team of authors of the comprehensive monograph, which gives a detailed account of most Czech field didactics, is made of members of this working group. The new monograph comes out of the newest resources including foreign work, it builds on reviews and discussions in various communities of field didactics but also on more widely conceived discussions within the group of Accreditation Commission.

The main authors Iva Stuchlíková and Tomáš Janík (2015) present 11 different field didactics in the monograph. Each field didactics is presented in a separate chapter where the authors give an account of its historical development and current state, achievements, define the current problems and perspectives. Despite that fact that the monograph does not give an account of all field didactics it presents informatics education, which is very good news for the discipline as the monograph clearly supports emancipation of field didactics in the conditions of the Czech Republic. The authors of this paper were asked to prepare the chapter about computer science education for this monograph, which was an incentive for them to look into the issue of computer education and education with computers in the context of other field didactics.

The monograph opens with an introductory chapter in which the main authors give the reasons for establishment of field didactics, where they define the concept of field didactics as the amalgam of subject and pedagogical component of the discipline and explain the status of field didactics in the light of the concept of pedagogical content knowledge [Shulman]. The concluding chapter offers an overview of balancing and perspectives as perceived by the authors of the individual chapters and outlines the prospects of future developments in field didactics.

The aim of the chapter on computer science education is to introduce the discipline as a newly evolving discipline in our country whose ambition is to break free from the wide initial conception of "using computers at schools" to a fully-fledged field didactics. The chapter gives a brief account of the history of introducing technologies into schools on international and national scope, it describes the current state of teaching computer science at schools, it presents the impulses for establishment of this discipline and also the current problems, dangers and perspectives of future developments of the discipline. The chapter also defines informatics education terminologically.

Foundation of informatics education as a discipline in Czechoslovakia and the Czech Republic

History of informatics education on national level can be studied both in the perspective of development of this scientific discipline (informatics didactics) and in perspective of

development in the use of computers in school education. The terms informatics, computer science and computers are often blend in reality of Czech schools. A non-expert is likely to perceive informatics at schools as work on computers; and this actually was true when computers were first introduced to schools in the 1980s. As time passed this "arbitrary work on computers during lessons" was structured in a way that a general frame became a nest of fields of stand-alone areas of computer assisted instruction, educational technology, information and communication technology education and computer science education as the didactics of the discipline.

Computer assisted instruction (CAI) deals with teaching particular subjects using technologies, i.e. is closest the field didactics of the different subjects. Educational technology studies transformation of education in consequence to integration of technologies into teaching and learning processes. The discipline, sometimes referred to as e-pedagogy, focuses in more general pedagogical or didactical issues. In the context of Czech schools it is useful to distinguish two streams in informatics education with respect to the relation of a learner to technologies. **Information and communication technology education** (ICTE) focuses on competences in using and operating digital technologies on users' level. **Computer science education** (CSE) is a didactics of the fundaments of the scientific discipline computer science and puts emphasis on creative and authorial approaches to technologies.

There is one major difference between informatics education and other field didactics: it came into existence more or less simultaneously with establishment of its mother discipline. This means that didactics was accompanying computer science already at the time when its subject and methodologies were only evolving because the demands of society were that the evolving discipline should also be handled didactically. Naturally this meant that informatics education was from its very beginnings influenced by significant formative changes in the unstabilized mother discipline.

History of school informatics is relatively short in our country. At the beginning all the above mentioned disciplines blended into generally understood teaching with computers and of computers. The 1970s were the decade when computer science was introduced at technical universities. Pioneer works in the area of computer assisted education started to be published in 1960s and later, e.g. the work about programmed learning (Tollingerová et al., 1966), Kulič's publication (1984) Člověk – učení – automat (Human – learning – automat) in which the author looks into psycho-didactical aspects of computer science for the first time, and the works of E. Mazák (e.g. Kraemer, Mazák, 1986, Mazák, 1991).

Fans of computer technology started to meet in the division n. 602 of the organization Svazarm (Union for cooperation with the army) in the first half of the 1980s. This became an informal centre of leisure or afterschool activities in computer science. The division provided courses of programming for public. It was the place were methodological and teaching materials about programming were created, e.g. for the series Mluvíte počítačsky? (Let's talk computers), which was published in the magazine VTM (Pecinovský, 2009).

In the second half of the 1980s the government introduced a programme of computerization of schools and started to equip schools with eight-bit microcomputers produced in Czechoslovakia. These were used on upper secondary schools mostly in optional subjects, on

primary and lower secondary schools in afterschool computer clubs. Most of the teaching focused on programming. The teachers used not only the professional programming languages such as Basic and Pascal but also the so called children programming environments such as Robot Karel or Žofka, Czechoslovak version of the language Logo (Vosátka & Černochová, 2001). Also the first competitions in programming for children were organized. The subject *Informatics and computer technology* was introduced on upper secondary grammar school in 1990 (Vosátka, 1991). Students were allowed to take the subject at school leaving exam (maturita). The first upper secondary school textbooks of programming were published (Kroha, Mannová & Štulc, 1990).

In the 1990s when computers became easily available, the teaching gradually transformed into teaching users' skills, at first work with office applications, in the end of 1990s use of the internet and electronic communication, i.e. the areas that are nowadays understood as digital literacy. The curricula were reduced to use of applications and devices (Blaho, 2012).

The situation in elementary schools in the 1990s was that topics from computer science (non-compulsory) were taught in three different subjects: *Informatics* (using a computer), a theme *Work with computer* in the subject *Technology* (using applications, technical issues) and *Mathematics* (algorithmization using flowcharts taught without computers). There were a few exceptions outside mainstream ICT education in some schools where the basics of algorithmization was taught in the environments Baltík and Comenius Logo. Programming was taught at schools only rarely.

A project important for introduction of computers to secondary schools was the Comenius project established on the basis of intergovernmental agreement between the Netherlands and Czechoslovakia (Svoboda, 1992). Within this Comenius project, a number of original Czech educational software products were developed, e.g. remote laboratories ISES (Lustig, 1997) or simulation software for teaching physics Famulus, (Dvořák, 1992).

In the first half of the 1990s, methodological support to teachers was provided by the Institute for Information on Education (ÚIV), which served as an in-service training and methodological centre; it developed methodological approaches to teaching programming, e.g. (Berezovský, 1993), guides for work with technologies. Since 1991 the Institute was publishing the Bulletin of Informatics and Computer Technology for Secondary Schools and later the Bulletin of Information Technologies at Schools with the aim of mediating information on computing worldwide and computer-aided learning abroad to the teaching public and with the aim of publishing reviews of books that were milestones in the development of the use of computers in learning, e.g. the work of Papert (Miller, 1993).

At this stage we cannot speak of informatics education as a field of study. The pressure from schools stemming from gradual introduction of topics focusing on work with computers into school curricula resulted in creation of methodological materials and textbooks, e.g. *Práce s počítačem* (Work with computer) (Rambousek et al., 1997), of the first scientific publications on the potential of the use of computers in teaching (e.g. Černochová et al., 1998). In the 1990s and in the first years of the 21st century, the main expert centre of informatization of Czech schools was the national conference *Poškole* about computers at school (fifteen conferences were held in the years 1992–2007), where pioneers of introduction of computers to schools

from all types of schools could meet the representatives of the Ministry of Education, school inspection, non-governmental organizations and companies and where they followed and shared innovations and examples of good practice in different subjects in the area of the yet unclassified field of the use of computers at schools.

Methodological support of schools from universities, especially from departments of computer science or computing focused especially on (talented) secondary school students. High quality textbooks of programming were published, e.g. (Töpfer, 1995, Pecinovský, Virius, 1997) as well as articles focusing on problems for Mathematical Olympiad in Programming.

In 2000 the government of the Czech Republic approved the Conception of Government Information Policy in Education (abbreviation SIPVZ), within the frame of which all schools were equipped with computers and teachers trained in basic digital literacy skills. A part of this training was also in-service training for teachers of different subjects in the use of computers in teaching their disciplines. The success of this type of training was negatively affected by factual non-existence of research in the field and by a lack of teacher educators in this area. This situation clearly showed the practical need of addressing the issue of computer-assisted instruction in different field didactics.

The new Act of Education 2006 brought compulsory ICT education into all schools, both on primary and secondary school levels. However, the educational area Information and Communication Technology was given minimum time allocation of just one lesson a week in one grade of primary, and one grade of lower secondary school. With this allocation it is impossible to achieve the expected outcomes in the area as they are defined in the Framework Education Programme for Elementary Education, which Neumajer points out in the report from the Panel for Innovation of National ITC Curricula at the Educational Research Institute in Prague (Neumajer, 2009).

State curricular documents focus exclusively on the area of digital literacy and basically disregard all computer science topics both at primary, lower secondary and to a great extent also upper secondary school levels. Computer science topics have taken on the form of factographical discipline or are included in specialised subjects and study disciplines. The outcome is that graduates from upper secondary schools applying to study computer science at universities not only have not mastered the basics of the disciplines, moreover, in contrast to mathematics or natural sciences they have no idea what computer science actually is, what it studies. Their idea of computing is the idea of application control and use of computers (i.e. consumption of technologies).

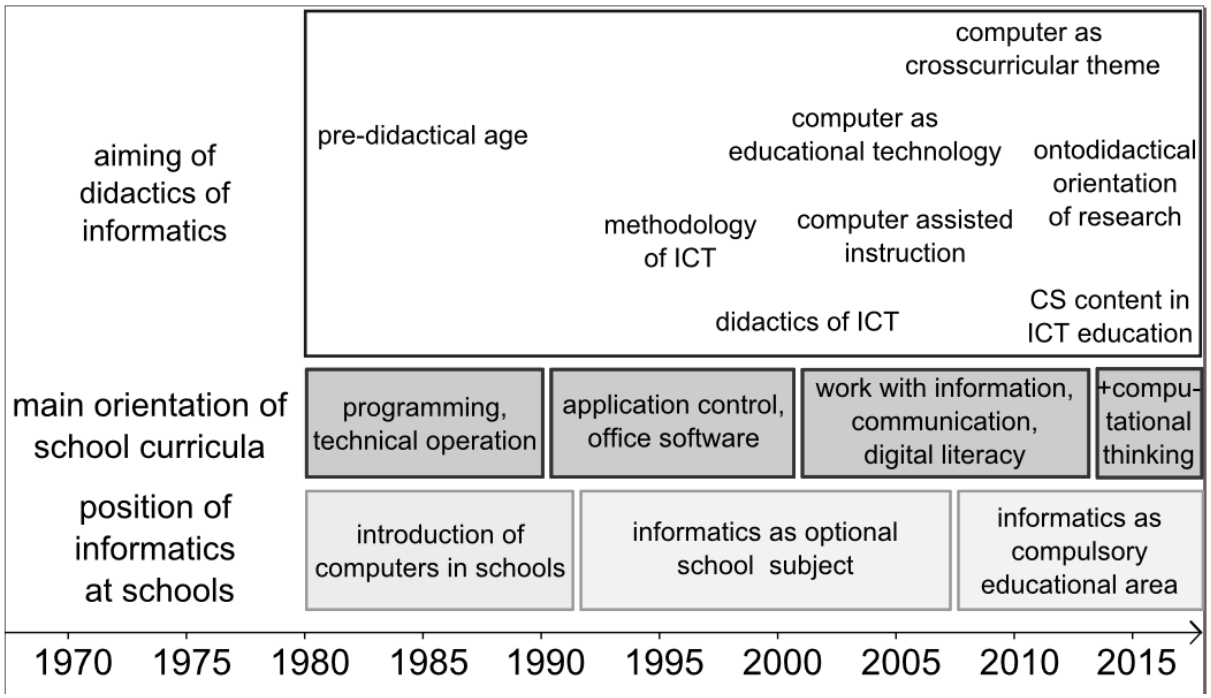

Fig. 1: Historical outline of the stages of development of teaching informatics and the focus of field didactics in Czechoslovakia, later in the Czech Republic

Incentives to develop of informatics education in the Czech Republic

This part describes current problems of school education (e.g. curriculum, international comparative studies, testing) and based on this information draws attention to the need of field didactics expertise. We could expect arguments saying that teaching topics from computer science is not compulsory at schools, that the subject ICT has minimum time allocation and that pupils only learn to use ICT in the subject, teachers are not able to teach topics from computer science and anyway, there are no prospects for improvement of the situation in the area, so why should computer science education be established as a scientific discipline in the Czech Republic. Let us focus on the reasons that speak for foundation of this discipline.

Focus of the educational area "ICT and informatics"

What is the position of informatics at Czech schools? The educational area *Information and Communication Technology* is compulsory on all school levels in the Czech Republic, which is positive. However, the position of the subject is abated by

- insufficient time allocation (e.g. it is 11x less than time allocation of history and civics on lower secondary school level),
- isolation (pupils use computers very rarely in other subjects, which is reported e.g. in the Annual Report of the Czech School Inspection for 2010/2011 (ČŠI, 2011, p. 46),
- quality of teacher training (teaching qualification of only 18 % of the respondents in a research survey among ICT teachers at lower secondary schools is oriented on the area of informatics or some closely related discipline, see Rambousek et al. (2013, s. 13),

- last but not least by the content taught although this is not perceived as a problem by in-service teachers, which is shown in research of Rambousek et al. (2013, p. 188–203).

Mainstream ICT education in Czech schools currently focuses on application control and office software and significantly plays down computer science. User approaches to ICT in the curricula defined in the *Framework Education Programme for Elementary Education* are reinforced in the chapter Use of digital technology, which belongs to the area of Humans and the World of Work. In other words Czech schools nowadays produce (with respect to computer technology) predominantly users, consumers. This can be easily documented in current framework education programmes (RVP ZV, 2013, RVP G, 2007).

Content and methods in teaching informatics

Digital technologies are reality and nobody doubts they will be used at schools. But do we know how a child learns to work with a computer, how it develops its ideas and concepts of how information systems work, what topics and issues from computer science a child is able to solve at different stages of its development and age levels, how it acquires concepts, language means and procedures used in computer science?

As Dagdilelis et al. (in Hadjerrouit, 2009, p. 229) point out, informatics is still taught "as if this subject is just a tool. As a result, informatics teaching does not provide understanding on a deeper conceptual level than memorizing details of the software, reproducing information about buttons, menu commands, and dialogue boxes". Most upper secondary school students learn informatics "by approximations and imitations, reproduction of information, and not by conceptual understanding" (Hadjerrouit, 2009, p. 229). "students know a lot about information technologies, but they do not possess a conceptual framework to organize them", Hadjerrouit (2009, p. 229) claims building on the works (Haberman, 2004; Nishida et al., 2009).

Even if we replace topics of application control and use of computers by topics from computer science, teaching might still be of instructional nature similarly to the way it is conceived now, either due to rigidity in approaches to teaching or due to insufficient teacher education. Blaho (2012, p. 8) describes the situation in Slovakia where computer science is often taught frontally with the aim of transmitting many facts, concepts and definitions without relating them to children's experience, disregarding the age and level of children. Moreover, these fact may be easily found on the internet.

Need of revision of the educational area in Framework Education Programmes

"School informatics builds its objectives on ICT skills but these skills are not the objectives of computer science" (Blaho, 2012, p. 11). This sentence seems to have captured the basic problem of Czech school informatics and its didactics. Our experience confirms that many upper secondary school teachers do not make a difference between teaching computer science and teaching ICT and when teaching computer science they focus on teaching application and technology control. And it is also the authors of textbooks and curricular documents who are responsible for the focus of ICT area on work with office applications. Teachers, who very often lack training in teaching informatics and are "self-made", find it difficult to "decipher"

framework education programmes that are too vague and incomprehensible for their needs (Rambousek et al., 2013).

Another incentive for systematic building of informatics education was preparatory works on state maturita (high-school-leaving exam) in ICT and Computer Science as one of the compulsory elective subjects. These works showed that the contents and structure of the educational area ICT as described in the Framework Education Programme for Secondary General Education (2007) are not sufficient for preparation of the exam of this importance. Moreover, test items prepared by in-service teachers were very often fact-based, memory-based and very rarely problem-based.

The demand to include ICT and Computer Science into the common part of state maturita is an expression of the importance of ICT competences in the profile of an upper secondary school graduate. However, the question is whether Czech schools were ready for the challenge. The decision not to prepare state maturita exam in this educational area in fact prevented a very dangerous situation. Taking into account how unanchored, fluid and unspecific the contents of this educational area are, the maturita exam would have only reinforced the conception of the subject as teaching application control, which would become the main trend in ICT education for years.

Need of qualified teachers of informatics on all levels of schools in the Czech Republic

A major shortcoming of education in the area of ICT is that it is often taught by teachers whose undergraduate studies did not focus on teaching computer science or related disciplines. Research of Rambousek et al. (2013, p. 13) shows that the teaching qualification of only 18 % of respondents (informatics teachers at lower secondary schools) is oriented on informatics or some related discipline (which does not mean they actually studied computer science). ICT competence of most teachers is on the level of advanced users of ICT. Only 40 % of informatics teachers evaluated their competences as better than is actually needed for teaching the subject well. The same research also shows a number of negative pupils' comments doubting the expertise of their informatics teachers (p. 13).

A teacher whose education in the discipline is not sufficient might have very distorted views of the discipline as such. In a survey of preferences of thematic units of informatics curriculum, preservice teachers of ICT see application control, work with the internet and teaching of software and hardware as the most important topics; themes from computer science are on the periphery of their interest (Vaníček, 2010, p. 199). The same survey showed that teachers prefer pupils' **activity of user or consumer nature** to creative activities (e.g. editing digital videos). They also tend to prefer the areas in which they perceive themselves as experts (p. 200).

Unqualified teachers tend to pay attention to topics in which they excel, which is very often control of basic applications for editing texts and browsing on the internet. Czech teachers of ICT disciplines find it important to teach what they can do really well (Rambousek et al., 2013, p. 10). The topics Czech primary and lower secondary informatics teachers find least important are databases and algorithmization, i.e. topics from computer science (Rambousek et al., 2007; Rambousek et al., 2013, p. 11).

Another important issue is how to educate future teachers in the area. According to Hadjerrouit (2009, p. 229) "teaching methods based on traditional epistemologies are still dominant despite the fact that informatics as a school subject requires a new pedagogy that goes largely beyond the use of IT as a tool". "Teachers need a new vision of informatics that goes beyond the use of IT as a tool. A new approach to informatics should rely on learning theories, conceptualizations, and pedagogical principles rather than imitation, approximation, memorizing, and interaction with the computer." (Hadjerrouit, 2009, p. 230)

Focus and methodology of research in computer science education

The focus of research in the Czech Republic is connected to the position of informatics in Czech primary and secondary education. No attention was paid to this field didactics in the 1990s. The whole area was perceived as using computers in the classroom. Zounek (2004) claims that there was an absence of papers dealing with current issues of teaching computer or informatics oriented topics in journals for the teaching public. A change comes with the turn of the century and the beginnings of e-learning and online education (Lustigová & Zelenda, 1999).

Research in the last decade has focused predominantly on ICT and its use at schools. E.g. Zounek et al. focused on questions of where exactly technologies are used at schools (teaching, management) and what obstacles block its larger expansion (Zounek, 2006; Šeďová & Zounek, 2007). Neumajer focused on school webs (2005), Mašek and his colleagues on new open technologies in education (Mašek, Michalík & Vrbík, 2004). Rambousek et al. (2007) conducted research in the area of development of ICT competences of pupils in the area of teaching activities, thematic units, studied the state and structure of primary and lower secondary pupils' and teachers' competences. No distinction was made between the terms ICT and computer science as there are references e.g. to computer science teaching activities of cross-curricular nature (p. 9).

Another sphere of interest is the field of e-safety while working with technologies, i.e. issues of interpersonal relationships, communication, cyberbullying etc. These topics are studied e.g. by (Kopecký et al., 2013; Szotkowski et al., 2013). Another area of interest is personalization of e-learning and its adaptive mechanisms (Šarmanová et al., 2009, Kostolányová, 2012). Significant attention is paid to investigation of digital literacy of adult population.

The change in the focus of research towards computer science is relatively recent. This research focuses on how preservice primary school teachers perceive topics from computer sciences included into the ICT area, namely basics of algorithmization and work with information (Vaníček, 2013). There are pilot projects for teaching algorithmization on primary school level based on cross-curricular cooperation, e.g. with art or languages (Černochová & Komrska, 2013).

Computer science education currently faces the problem of lack of empirical research, especially lack of didactic experiments. With respect to methodology, the existing research is predominantly exploratory – probes. There is a shortage of research focusing on situation in the terrain, at schools, based on lesson observations and reflection. However, taking into account the unanchored nature of the topics of the school subject this may not necessarily be a drawback.

Czech research focusing on education in subjects related to informatics and computer science on primary and secondary schools is very scattered, lacks coordination and is very haphazard.

An example of involvement in international cooperation is the cooperation of more than 30 countries in the Bebras Challenge (in Czech Bobřík informatiky, Beaver of Informatics), which focuses on algorithmization, comprehension of information and its representation, coding, understanding structures, problem solving, social contexts of ICT and everyday use of computers. It takes in account that "understanding and handling the basics and foundations of computer science is more important than knowing a lot of details" (Dagienė, 2008, p. 217). Within this cooperation research focuses on computational problems as the basic components of curriculum, the criteria of their quality and their taxonomy (Vaníček, 2014).

Overview of journals published in the Czech Republic with focus on informatics education

- *Journal of Technology and Information Education* (JTIE): the journal focuses on publication of results of research surveys, theoretical studies and papers dealing with technical education, teaching computer science and computer science education. The journal is published in Czech with abstracts and some articles in English. URL: jtie.upol.cz
- *International Journal of Information and Communication Technologies in Education* (ICTE): The mission of ICTE Journal is to mediate new findings and approaches of experts in the field of ICT application in education. The main topics of interest are integration of ICT in education, didactic principles of ICT supported instruction, eLearning, computer based instruction and examination with the use of ICT. The journal is published in English. URL: https://periodicals.osu.eu/ictejournal
- *Matematika – fyzika – informatika* (MFI) [Mathematics – physics – computer science]: journal of a didactic nature focusing on issues of teaching at primary and secondary school levels and innovation in education. The journal is published in Czech. URL: www.mfi.upol.cz/index.php/mfi/index

Current trends with impact on computer informatics education

Currently informatics education is affected by the following:

- Dynamics of development in the field of ICT and computing,
- Shift of teaching informatics to lower school levels, even to preschool education,
- Introduction of computational topics into the educational area ICT.

Dynamics of the discipline

Dynamics of the discipline is a substantial obstacle that impedes transformation of informatics education from the stage focusing on selection of relevant topics, its didactic transformation

and methodological support to teachers in the teaching process to the stage of proper basic research and development of methods unique for the discipline that would enable to establish informatics education as a true science. Use of digital technologies in contemporary society accelerates, which is reflected in emergence of new issues, e.g. internet safety, cloud solutions, mobile technologies. This is closely connected to privacy and the so called e-safety in online communication and in data sharing on the internet (Kopecký et al., 2013), to issues of relativization and virtualization of relationships.

The fact that dynamics of computer science surpasses dynamics of other disciplines makes it difficult to handle it didactically. According to Schubert and Schwill (2011), the content of the subject at schools should be directed towards the foundations of the discipline, towards building a conception of basic principles, ways of thinking and methods of computer science.

The need to react to the never-ending technological innovation and new applications is exhausting for teachers and does not result in any progress in their teaching. This atmosphere is reinforced by the myth that pupils can use computers better than their teachers. Social demands put pressure on educational institutions to react to these changes and in these turbulent changes it is very difficult to pinpoint the anchoring fundamental concepts, long-term competences overcoming this dynamics, to differentiate between topicality and fashion, to tell what important is etc. Informatics education is not able to break free from its utilitarian conception, from creating tutorials and manuals for basic control without any ambition to guide the learner to deeper understanding of the discipline.

Shift towards younger pupils

Availability of technological devices and facility of their use have made it possible to start teaching informatics at primary, and even preschool levels. Of course this must be reflected in preschool and primary school teacher education. It is only since 2012 we have been able to say that any pupil leaving lower secondary school in the Czech Republic has had a compulsory subject within which they were taught the basics of work with computers. This change has brought many difficulties, the most significant of which is inadequate teacher training in this area.

What informatics education in Czech primary schools is like can be documented by the following findings. A 2013 survey at schools participating in the Beaver informatics contest showed that 59 % of teachers of informatics at primary school level are lower secondary school teachers and only 40 % primary school teachers. This is potentially dangerous as a lower secondary school teacher may be transferring curriculum intended for older pupils to primary school level. Research in exclusively primary schools (the so called incomplete schools – a complete “elementary” school in this country has both primary and lower secondary school levels) shows that not every primary school in the country includes the compulsory subject ICT in its school education programme and sometimes is taught only as a cross-curricular subject (i.e. within the frame of other subjects). E.g. there are 48 % of such primary schools in the Ústecký Region where ICT is not taught as a stand-alone subject and 32 % in the Zlín Region (Pyszko, 2013).

This trend brings questions of how pre-primary education should respond to this situation. A UNESCO study that maps situation in pre-primary education (Kalaš, 2010) draws attention to the potential of technology for children's creative work and collaboration. Undoubtedly there are many dangers involved as well, e.g. overuse of technology. According to Siraj-Blatchford (2006) the concept of developmental adequacy is of key importance in this respect. Preschool teachers need support to be able to assess critically age appropriateness of digital technologies, to understand their role and the potential of their integration into kindergarten environment (Kalaš, 2010).

Introduction of computational topics into school education

We can observe some other recent changes related to digital technology in the world that have impact on school curriculum. It is the trend of including computer science topics into teaching work with computers, i.e. the trend to teach more than digital literacy. Already in 2003 Allen Tucker from Association for Computing Machinery (ACM) declared in the Report of ACM K–12 Task Force Curriculum Committee that one of the objectives of computer science K-12 curricula must be "introducing the fundamental concepts of computer science to all students, beginning at the elementary school level" (Tucker, 2003, p. 10).

All these recent efforts are based on the need to **develop computational thinking**; this concept was defined by J.Wing (2006) and is very closely connected to other universal fundamental concepts that go beyond contemporary technology: algorithm, structures, representations of information, information systems, coding, principles of operation of ICT. The shift from the concept of digital literacy to computational thinking can be perceived not only as broadening of the educational area but also as a parallel of transformation of transmissive teaching methods to approaches developing pupils' critical thinking and ability to solve problems, i.e. a trend that can be observed in other field didactics.

One of the basic concepts of computer science is the idea of algorithmization, language and structure decomposition (Schubert & Schwill, 2011, s. 89). However, we do not come across these concepts when informatics is taught as technology use and control. Thus ICT education is an inadequate background to later teaching of computer science.

Currently a number of countries are undergoing curricular reforms in which the position of computer science is redefined and changes, e.g. in Poland (Sysło & Kwiatkowska, 2013), in Slovakia (Blaho & Salanci, 2011), in England (CAS, 2013), in the USA (Seehorn, 2011) and other. We hope these trends will be taken into account also in the Czech Republic, since the government approved the document *Strategy for Digital Education until 2020* that will affect future modifications of Framework Education Programmes. This strategic material speaks of development of pupils' computational thinking as one of the three priorities (MŠMT, 2014, p. 14). This trend could be supported by the fact that the Czech Republic came 1st among all the studied countries in the international survey of information and digital literacy ICILS 2013 (Basl et al, 2014), which could result in the fact that focus of teaching on the area of digital literacy will not be perceived as most important part of the strategy.

Current issues in informatics education

Informatics education (informatics didactics) as a pedagogical discipline bears the signs of an emerging field that must respond to sociocultural factors, that must on definition of its educational content in relation to the relevant disciplines and interdisciplinary links, that must define research areas connected to the results of research of how people learn, communicate and think. There are many problems informatics education will have face. Let us list several of them:

- **Narrow base of informatics educators**. There are very few university departments with focus on computer science and ICT education in the Czech Republic. The departments that do focus on the discipline very often developed from departments specialized in technology education that later turned their attention to information education and digital literacy. Their research papers on Czech conferences were very often included in the sections Technical and information education (see e.g. Janík et al., 2004). These very few university departments employ one or two computer science educators, who very often have to teach also other subjects. In consequence their focus on informatics education is not clear-cut and the time demands of other duties do not allow them to be in everyday close contact with schools. There is no institution in the Czech Republic, whose only specialization would be informatics education.
- **Low involvement of university departments specialised in informatics and computer science**. Computer science education unfortunately attracts little attention of departments training informatics teachers. Usually there will be only one member of the department focusing on computer science education, the key research and training activities will be focusing on computer science, not on computer science education which is perceived as a "soft" science without strictly defined outlines. Informatics educators are then isolated or involved in research of non-didactical nature.
- **Non-existence of a habilitation institution or postgraduate** oriented on computer science education (unlike neighbouring countries like Germany, Slovakia). Dissertations focusing on computer science education or ICT education can only be written in the study fields Information and communication technology in Education, Applied Informatics and Pedagogy. The non-existence of the didactical field of the study means that university lecturers of computer science education have to study the discipline itself or didactics of a related discipline. This is probably the reason why there in no major research conducted in the field.
- **Nascent platform for cooperation** and exchange of knowledge and information. A conference in this field didactics and a place where teachers could meet and share their expertise did not exist for many years. From the 1990s its place was taken by the conference *Poškole* whose scope was much wider – it focused on any use of computers at schools and was not a purely scientific event. At the field of in-service teachers preparation, it was then replaced by the conference *Computer at school* (2003), which however also focuses on the use of computers in all school subjects. The traditional conference *Information and Communication Technologies in Education* (ICTE)

in Rožnov pod Radhoštěm exceeds the scope of informatics education. The future will show whether the conference DidactIG which has so far been organized three times will be able to take on the role of platform answering the needs of Czech community of informatics educators. Up to now this role was played by the Slovak international conference *DidInfo* with its more than twenty year tradition and focus exclusively on informatics education.

- **Teacher education of primary and secondary pre-service teachers of informatics and professional development and in-service support to informatics teachers** are equally as fragmented and scattered as its educators: on national level there is no system of in-service teacher training or a conference for teachers focusing on ICT and computer science, there is nobody to guarantee quality. One of the reasons for this lack of cooperation among informatics teachers might be that most of them are self-learners, they do not know where to seek help, support and advice. There is lack of really good textbooks of ICT and computer science, most teachers have to develop their own teaching materials.

Dangers and perspectives

Informatics education as field didactics in the Czech Republic is a newly established discipline. The prospects of its future developments can be summarized in a few points. The discipline will have to undergo the process of emancipation into a fully-fledge field didactics. It means its subject and methodology will have to be developed and precised in a narrow cooperation between Czech and foreign experts in the fields of informatics and computer science. We believe that developments in informatics education will have effect on the focus of government information policy and strategy of education.

Computer science education will have to face the pressure of the current situation and upcoming turbulent changes in schools, educational institutions, policy and teacher education (introduction of informatics education to primary and preschool teacher training). The need of permanent answering to the changing situation will always affect the space and time for base research and specialization of the field, which will always be limited, and methodological applications of applied research in school practice will be expected.

One of the risks for the disciplines is that school informatics will still focus on teaching user approaches to digital technologies, which will always put pressure on directing attention of computer science education to these ends. In the light of observed trends, this directing must be perceived as a route without perspectives. We hope that international cooperation with the aim of including computer science topics into ICT education at schools and the related research will bring fruit.

Emancipation of informatics education will definitely be supported if pedagogy takes over responsibility for the area of use of information technology in education (including e-learning) and other field didactics will address computer assisted instruction in their subjects. If computer is becoming an everyday object in our society, research in various fields of pedagogy should

incorporate computers as an everyday classroom tool and not to set aside and isolate technologies at schools, teacher education and education science as such.

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