

## **Integration of ICT in Early Childhood Education**

**Ivan Kalas**, *kalas@fmph.uniba.sk*  
Comenius University, Bratislava, Slovak Republic

### **Abstract**

Since 2007, our group of researchers has conducted a series of activities in integrating ICT into early childhood education (ECCE). We want to better understand the process of engaging ICT in the everyday play and learning activities of pre-primary children. Our early experience provided us with an excellent opportunity to extend our activities and lead a vast national project on the development of digital literacy for thousands of our ECCE teachers and for all centres in our country. We also conducted an international study for the UNESCO Institute for Information Technologies in Education on the potential of ICT in ECCE and on the growing interest of many countries to harness this integration.

Due to these activities, we managed to cooperate closely with several ECCE centres abroad and at home and, through collective case study and design-based research, obtain several valuable findings. In this study, we will present a synthesis of some of the outcomes that have emerged from the overall mosaic of our research activities in the field of ECCE. We will present and comment on a list of the risks involved in the process of establishing a successful course of ICT integration. We will also share some findings from our long-term study, where we analyzed the follow-up progress of the process after its initial stage.

### **Keywords**

early childhood education, integration of ICT, digital literacy, educational research

### **INTRODUCTION**

Today it is almost impossible to come across an educational institution at any level without an ICT presence. As Siraj-Blatchford and Whitebread (2003) point out, "Young children today are growing up in a world which not only contains but is also increasingly shaped by ICT" (p. 19). More and more children encounter a computer before they go to school. Their exposure to the influence of ICT becomes quite noticeable. Thus, early childhood care and education (ECCE) cannot disregard the impact on these children. Indeed, early childhood practitioners and researchers are looking for strategies to better integrate ICT so that the learning objectives of pre-primary children are achieved in a way that is closer to 21<sup>st</sup> century expectations and requirements.

An important contribution to the systemic process of integration of ICT into ECCE was a report by the New Zealand Council for Educational Research (2004). This became the foundation for the New Zealand government's ICT framework for early childhood education and influenced their new curriculum for ECCE (Ministry of Education, 2009). It also influenced several similar ICT frameworks in other countries. When used appropriately, the report affirms, ICT can be a productive tool for supporting young children's learning and development. However, practitioners must adopt new pedagogical strategies to harness its potential.

Our main research area, in a series of projects since 2007, is the development of new pedagogical strategies to exploit productively the various ICT tools in the ECCE centres. We have been studying which tools (software and hardware) and organizational forms the ECCE teachers employ when they want to use ICT to support play, learning and the progression of children in all developmental areas (not only in the cognitive domain). We have also studied the process of developing the digital literacy of (a) the ECCE teachers and (b) ECCE institutions.

An exceptional opportunity emerged two years later when we were invited to design the professional content and implementation strategy in a Slovak national project devoted to developing the digital literacy of the ECCE teachers. Launched in 2009, the project involved all (around 3.000) kindergartens. As we were planning and designing the project, we were able to take advantage of the early experience and findings from our own research. Over the next three years, the project provided us with an excellent opportunity to conduct a deep collective case study. Thus, in the long term we could follow the highly inspiring cases of several ECCE centres in the process of their transition. We used this unique situation to study which factors influence, support, or endanger the development of the teachers' digital literacy and the whole process of the integration of ICT tools and pedagogies into everyday activities.

Another significant encouragement for our research projects resulted from our long-term cooperation with the UNESCO Institute for Information Technologies in Education (IITE) in Moscow. In 2010, the Institute initiated an international study on the potential of ICT in ECCE and the growing interest of many countries to understand and harness it. To meet the goals of that study we collected a sample of 16 innovative ECCE centres from nine different countries, with different cultural, educational and economic backgrounds. This purposive sample constituted a rich representation of innovative trends. Based on in-depth analysis of the detailed reports from our sample centres, we identified and examined different aspects of the process of integrating ICT into pre-primary education. The key observation has been that the most productive way to harness the developmental potential of ICT and minimize all perceived concerns connected with ICT in early childhood education is to integrate different ICT tools into common everyday activities – instead of simply adding them to previous equipment. We published the findings of this project in detail in (Kalas, 2010).

In this paper, we focus on the goals, procedures, and some of the main findings of our long-term qualitative research activities conducted from 2007 until today. We focus on the findings, which have emerged from the composition of our partial inquiries and help to build a more holistic understanding of the process of integration of ICT into ECCE. Namely, we will present our findings (a) concerning the follow-up progress of the transition after the initial continuing professional development (CPD) program of the teachers; and (b) our conclusions regarding the risk factors, which may slow down or otherwise degrade the whole transition.

## **BACKGROUND TO THE STUDY**

Since the mid-1960s, a group of visionary researchers have been pondering the idea that computers should be at children's disposal. Those considerations soon led to the development of the Logo language, see Feurzeig, Papert, Bloom, Grant, and Solomon (1966), to become "...a powerfully expressive yet readily accessible language for construction, exploration, and investigation of ideas and processes in math, science, language, and music – to give children a lively learning environment," according to Feurzeig's (2007) memories.

In the early eighties, a Hungarian researcher, M. Turcsányi-Szabó, developed one of the first versions of Logo programming language modified for the needs of ECCE children. Due to its thoroughly designed interface, children were able to exploit some of the most powerful concepts of the Logo approach – distinguishing the

process (procedures) and the product (the drawing), creating their own procedures, giving them unique identifications, and reusing them and sharing with other children; (Turcsányi-Szabó, 1997a, 1997b). Another key development was due to a French researcher, R. Cohen (1988, 1994). Starting in the mid-80s, Ms. Cohen researched the application of "...new technologies in the acquisition of written language and/or foreign language at an early age level." In her research, she used computers equipped with voice synthesisers in kindergarten classes of children aged 3 to 6 (Cohen, 1988, 1994).

Clements (2002) later validated similar experiments: "...there is substantial evidence that young children can learn Logo and can transfer their knowledge to other areas, such as map-reading tasks and interpreting right and left rotation of objects" (p. 163). A decade earlier, Clements and Nastasi (1993) observed that computers were more and more a common feature of many young children's lives. In spite of that, at present there is still a surprisingly small body of empirical evidence on the effects of ICT tools by ECCE children. As observed by Brooker and Siraj-Blatchford (2003), few studies have described children's overall development (social, emotional, and cognitive) when using a computer at an early age. In their own study, they showed that when young children are given the freedom to play with appropriate software, they are active in constructing their own learning on the computer, and in scaffolding mutual learning as well. "Our observations show children engaged in learning processes with identifiable benefits in a range of curriculum areas as well as in their social, cognitive and linguistic development, and their acquisition of positive dispositions towards ICT" (Brooker & Siraj-Blatchford, 2002, p. 269).

### **Using ICT to support early learning**

Hayes and Whitebread (2006) study "...holistic development of the child's disposition to learn". Within this process, they examine the following areas of learning and how they could be enhanced by integrating ICT: (a) ICT and literacy; (b) ICT and mathematical understanding; (c) ICT and science; (d) Creativity, problem solving and playful use of technology; (e) Visual literacy and painting; (f) Media education (digital animation); and (g) Learning of music.

In order for ICT to support these areas in ECCE, it must be used by young children in ways which recognize and respect how they learn most effectively, and what is involved in helping them to become confident and creative thinkers.

### **Safety concerns**

While many educators point out numerous and productive forms of integrating ICT into preschool learning and play, there are several writers in ECCE who present an assortment of safety concerns. Based on (Byron, 2008), (New Zealand Council for Educational Research, 2004), and (Stephen & Plowman, 2002), most of the safety worries may be classified into groups of (a) harmful physical effects; (b) children's learning, cognitive, social, and emotional development; (c) exposure to harmful contents; and (d) new technologies displacing other important learning and play activities. However, most of the authors who warn us about all the risks and dangers, often have in mind solitary playing of computer games and may not have actual insight into current modern trends in many innovative ECCE centres. As clearly expressed by Adams and Brindley in (Hayes & Whitebread, 2006), "The model of the passive child in front of the computer screen only holds until one has actually experienced young children interacting with any form of technology... Immediately, one witnesses the engagement, the social interactivity and collaboration, the creativity that is stimulated and the potential of ICT for young children's learning becomes very clear" (p. xiv).

Although there is rarely clear evidence about the degree to which these concerns pose a real risk to children, most authors and practitioners agree that ECCE educators need to be aware of the debate about ICT use by young children, and the need

to safeguard children's health and development. A guiding principle here is the concept of the developmental appropriateness, which provides a useful general framework for teachers and decision-makers to develop their skills in recognizing and applying the most appropriate ICT tools, (Siraj-Blatchford & Siraj-Blatchford, 2006) and (Siraj-Blatchford & Whitebread, 2003). To understand all safety concerns appropriately, systemic research is required. However, the only efficient way to eliminate or minimize potential harm is a knowledgeable teacher.

## **PURPOSE AND RESEARCH QUESTIONS OF THE STUDY**

The topic of our research was the process of integration of ICT into ECCE: we wanted to understand how to design, conduct, and analyze the process in such a way that it productively supports ECCE children's complex development, as well as understand which factors shape the process.

Specifically, we wanted to know which ICT tools to choose and how to integrate them into children's play and learning in such a way that the potential of ICT to support standard play, learning, and developmental goals of early childhood children in all domains is fully harnessed. We studied how the teacher could organize the activity and manage the learning process practically, while working with an entire class of children. We were interested in new pedagogies and all of the possible concerns and risks which might arise as well as how to cope with them when designing and implementing an activity employing ICT.

We paid special attention to educational software for ECCE – we wanted to know what the properties of appropriate educational software are and how to develop such software tools. A member of our team spent several years engaged in iterative software development 'for children and with children'. The outcome of that research project is a collection of recommendations concerning the properties of such software and a new methodology about how to develop it in collaboration with a group of ECCE children and their teacher. Using the experience obtained in that research we continue with the development of a constructivist, open and interactive educational software environment. It is focused on the development of early problem-solving skills and skills of very young children to explore, discover, and construct 'programme' or 'plan of steps' externally representing future behaviour of an actor (in the virtual computer environment) who should solve a particular problem.

One of the key issues we studied is the professional development of the ECCE teachers. Before the process begins, the level of their computer and (more complex) digital literacy is often minimal. Therefore, we decided to (a) specify the competencies which any ECCE teacher should develop, (b) design content and a process of their relevant professional transformation, and (c) conduct the transformation as well as a parallel in-depth observation of the transformation, so that we can better understand the real needs of the teachers. We studied not only the initial stage of the whole process but the follow-up stage of the same teachers and centres as well.

Another important topic for us was the transformation of the ECCE centres into 'digital spaces for play, learning and development' as the process itself: to see how the transformation can be initialized, implemented and further supported in the later stages. We wanted to understand the factors which promote or endanger this process and we used this research to create certain recommendations for ECCE headmasters and other educational authorities.

We have already reported elsewhere on the findings obtained in our partial research activities, see (Pekarova, 2008), (Pekarova & Moravcik, 2009), (Moravcik, Pekarova, & Kalas, 2009), (Moravcik & Kalas, 2012), and (Kalas & Skodackova, 2012). In this study, we want to present a synthesis of some of the findings which have emerged from the overall mosaic of these activities. Namely, we have cumulated and will present a list of the risks to the successful course of the process. We will also share some findings from our long-term collective case study, which has analyzed the follow-up progress of the process after the initial stage – usually com-

prising of initial acquisition of ICT tools, a more or less intensive professional development program, and initial enthusiasm combined with certain concerns.

## **METHODS OF THE STUDY**

In our research activities, we have applied several qualitative research designs, in particular design-based research and collective case study. Let us briefly characterize what kind of data and their analysis we implemented and how we treated the quality issues, especially in the case of the design-based strategy, which the established literature on educational research has not yet recognized appropriately.

### **Design-Based Research**

Educational research, as we conduct it in the ECCE setting, has two broad goals to reach: (1) to better understand the learning processes of children; and (2) to design and develop innovative educational interventions, which support children's learning and development. To meet both of these goals in parallel is the ambition of a new paradigm of educational research called design-based research. It is an interdisciplinary approach, in which researchers and practitioners try to build pertinent theories of learning through designing, developing, studying and iteratively refining interventions for learning.

Based on Cobb, Confrey, diSessa, Lehrer, & Schaube (2003) and Design-Based Research Collective (2003), five key principles of the design-based research can be formulated:

- Designing interventions for learning and building theories of learning are two intertwined processes.
- Development and research take place through continuous cycles of design, development, deployment, use, evaluation, analysis, and theory formation.
- Research on interventions must lead to sharable theories that help communicate relevant implications to practitioners and other educational designers.
- Research must account for how interventions function in authentic settings. It must not only document success or failure but also focus on interactions that refine our understanding of the learning issues involved.
- The development of such accounts relies on methods that can document and connect processes of enactment to outcomes of interest.

In our research activities, we collected data from multiple sources, mostly through participatory observations, interviews with teachers and children, and through recording audiovisual materials. Thus we accomplished the criterion of the 'qualitative data triangulation'. We also assessed the quality of our approach in terms of concepts such as credibility, dependability, conformability, and trustworthiness, as specified by Lincoln and Guba (1985) and other seminal authors on educational research.

Let us conclude this passage by saying that in (Moravcik & Kalas, 2012) we put forward several arguments about why we consider the design-based research strategy a remarkably helpful approach when dealing with various problems concerning 'technology based learning' (TEL) and integration of ICT into modern education.

### **Collective case study**

Our intensive cooperation with several ECCE centres provided us with an exceptional opportunity to observe the transformation of the teachers' attitudes towards digital technologies. We came to deeply understand how the process of integrating ICT evolves and how the teachers' early digital literacy development transforms the whole centres' climate and everyday play and learning goals, as well as its pedagogy. Such circumstances are suitable for applying a 'collective case study', i.e. an in-depth exploration of several ECCE centres, based on extensive data collection. For this approach, we have collected data through participatory observations, inter-

views with teachers, collecting various audiovisual materials, studying mutual on-line communication and many kinds of products, as well as the centres' evolving web-sites. We analyzed each case in its complexity, thus obtaining deeper insight into the process of ICT integration in many other similar cases.

An important factor for us was the opportunity to work with the centres for several years. Our close cooperation with a group of 11 ECCE centres had already started before the digital literacy development project was launched, that is, in most of these cases exactly at the moment when the ICT integration was initiated. We then participated in building their digital space and their digital literacy (through an initial professional development program that lasted for several months). This long-term intensive cooperation gave us an opportunity to win the confidence of the teachers in our work and in us. After finishing the initial stage which was analyzing and interpreting the data, we purposely reduced our cooperation with all centres to in-depth continuous observations of only four of those centres, which represented different situations, attitudes, circumstances, and relationships. We obtained our findings by analyzing each of these cases, then comparing and consolidating all particular outcomes. We secured the credibility of these overall findings by various standard techniques, like member checking or peer auditing.

## **MAIN FINDINGS**

In this paper, we will concentrate on two results. First, we will summarize our findings concerning the follow-up progress of the process of integration of ICT into ECCE, i.e., the period after the teachers completed their initial CPD program. Second, we will review our conclusions, obtained through inductive generalization from the findings in all particular research activities during the entire research period, namely our conclusions regarding the risk factors, which may slow down the whole transition. We consider these conclusions important for those who are interested in the transition of ECCE centres into productive environments for play, learning and the development of young children, and those who respect the needs of contemporary society and benefits from opportunities offered by digital technologies.

### **Follow-up progress of the process of integration**

- We were pleased to observe that after the initial acquisitions sponsored and organized by the national project, the centres themselves are organizing further acquisitions of new ICT tools. These are mostly programmable digital toys, digital microscopes and cameras, various digital sound recorders for kids, and interactive whiteboards (IWB). We noticed that due to the CPD program, teachers and headmasters were much better prepared to argue and explain to the decision makers about the learning and developmental benefits of the new digital equipment.
- More important than convincing stakeholders about expensive purchases is the fact that teachers now much better understand the educational potential of ICT and are prepared to explain it to the parents. In one of our cases, parents did not agree with using computers in their children's classes. After the professional development program, the teacher invited them again and succeeded in explaining that the activities would be safe, appropriate and productive – and won their support.
- After the initial CPD, teachers create more opportunities to integrate digital technologies into many activities. Using a computer, IWB or programmable toy has become an everyday matter. It always happens through integrating new technology as an additional tool and extension of usual everyday activities, and not by displacing any other ordinary experiences. It is safe to say that ICT use is not at the expense of any other outdoor or indoor experiences of the children.

- We also noticed that teachers confidently use their new knowledge and skills to search for or develop their own new ideas and activities. Furthermore, they develop their own pedagogies and enrich the content and usual forms of play and learning. In several centres they willingly share new ideas with their colleagues in other centres.
- In some settings, teachers form groups to educate each other (applying a peer coaching strategy). They jointly develop new activities and prepare new scenarios, which are appropriate and aimed at productive integration of digital technologies. Thus, even the teachers who had not attended the initial CPD program witness the activities, which they are then able to adopt and implement.
- Some kindergartens independently organize various open demonstrations of their innovative activities and pedagogies for their colleagues from other centres in the neighbourhood – either in their own centre or in a special centre of modern educational technologies.

### **Risks to the process of integration**

During our research activities in Slovakia and during the UNESCO project, we managed to identify several risk factors which may slow down a successfully initiated process of integration of ICT into ECCE, or even completely degrade it. These include:

*Lack of professional development.* This results from: insufficient duration of the initial professional development program, improper focus on training basic computer skills instead of developing complex digital literacy, new pedagogies, new organization forms etc., incompetent mentors (from the perspective of their experience with ECCE and the pedagogy of ICTs).

*Lack of understanding and/or confidence.* Many teachers, parents, centre leaders, or educational authorities often doubt or misunderstand the educational potential of ICT. They often interpret it as 'learning about computers'. They may also fail to identify the educational potential of ICT to support the learning processes, play and self-expression. They may lack self-confidence in their ability to conduct the process of integration.

*Lack of support.* If teachers, after completing the initial CPD programme, are left alone to solve everyday technical and educational problems concerning ICT, they may lose their enthusiasm. The same disappointment may result from insufficient support, the isolation of innovative teachers from each other, or the absence of their own professional community.

*Lack of educational resources.* The lack of study materials, open learning resources or any other supporting instruments to share and use for learning and teaching is another serious risk factor.

*Lack of continuation.* We have to think thoroughly about children who have just graduated from a digitally rich and literate ECCE centre. Is there any danger that after their long-term technology-enhanced practice these children will find themselves in a digitally underdeveloped primary school? It is essential that their new primary teachers identify their digital and higher order skills, respect them and build opportunities to cultivate them further.

### **CONCLUSION**

Several recent research findings point out the extraordinary potential of ICT to enhance the learning and other developmental processes of children: digital technologies can provide children with new opportunities to engage in attractive and relevant play, learning, communication, exploration, and development. Properly in-

egrated digital tools can empower children by granting them a voice they have never had. Digital technologies also open new pathways to social interactions and change the learning relationships between children and teachers.

Our long-term research attempts to better understand the process of integration of ICT into early childhood education. We initiate, support, and observe the development of digital literacy of pre-primary teachers. We study which digital technologies they engage in and why, in the ECCE centres, and how the everyday play and learning activities of children are thus transformed. We also design, develop, implement, and analyse new software educational interventions, which productively harness the potential of ICT for the complex development of children. In this paper, we presented some of our findings about the on-site transformation of the ECCE centres, their teachers and their pedagogies after they had completed the initial CPD program. We have also presented several risk factors that may slow or otherwise endanger the whole process of transformation.

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## Biography



**Ivan Kalas** is a professor of Informatics Education. For more than 25 years he concentrates on developing Informatics curricula for preschool, primary and secondary stages, developing textbooks and other teaching and learning materials for Informatics and ICT in education. Ivan is also interested in strategies for developing digital literacy of future and in-service teachers and enhancing learning processes through digital technologies.

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