United Nations
Educational, Scientific and
Cultural Organization

UNESCO Institute
for Information Technologies
in Education

# ICT in Primary Education

Analytical Survey. Volume 2
Policy, Practices, and Recommendations

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*Analytical survey*

***Volume 2***
***Policy, Practices,***
***and Recommendations***

UNESCO Institute for Information Technologies in Education

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When writing first part of this report in 2012, we significantly profited from the close cooperation and personal visits to an initial sample of nine innovative primary schools, which we worked with during the first year of the project. In the second period of the project we extended the initial sample to 39 primary schools from 20 countries, situated literally around the world, representing different kinds of schools, large and small, urban and rural, state and primate, from less or more developed regions[1]. It is more than natural that our first thanks and appreciations belong to them, for their continuous support, productive cooperation, enthusiasm, and expertise, namely:

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[1] complete list and contacts of all sample schools can be found in Appendix 2

collection and subsequent analysis, and also for productive cooperation in producing the final part of our analytical survey report. I also appreciate my colleagues' institutions for kindly supporting this project, and our cooperation with IITE.

All visual materials and photographs are reproduced with the consent of the cooperating schools, which also obtained permissions from the parents of the pictured students and their products.


Image 1: Best computer award: S35, Arlington, USA

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# List of promising practices

# Foreword

The UNESCO IITE Analytical survey Volume 2: Policy, Practices, and Recommendations is a continuation of the first report of the Institute's Project "ICT in primary education" launched in 2011. The first results of the project were published in the Volume 1 of the Analytical survey subtitled Exploring the origins, settings and initiatives (appeared in 2012) and contained the results coming from reviewing the literature, searching the web sources and mainly from the close cooperation of the authors with 9 innovative primary schools of the initial sample. In Volume 1, the authors presented: the sample 9 schools and their activities, a brief description of various national approaches and policies to ICT in education, and some initiatives and projects, which connect primary schools and invite them to collaborations and networking.

In the second stage of the project, reported in Volume 2 of the Analytical Survey: Policy, Practices, and Recommendations, the set of sample schools was extended to 37 schools from 20 different countries. The schools were addressed with an extensive questionnaire and then vast amount of collected data was analyzed. The resulting findings support initial goal of the project, namely, to facilitate the policy dialogue and build a foundation for effective primary education through ICT usage or use.

The authors of the report describe a number of emerging technologies and new pedagogical methods which are worthwhile of consideration, e.g. flipped learning (for instance as a new approach to special needs students), BYOD strategy which can help schools to transform classes into 1:1 environment, and programming and informatics for all students. The issues analyzed in the Volume 2 are quite important for all school systems, since they rather depend on the global technology "behavior" than on particular national settings.

I hope that this publication, and recommendations included therein will help the governments and stakeholders to understand the evidence-based reasons for ICT integration into the learning processes of children; and will contribute to the development of national educational policies and programmes in the field of ICT in primary education.

Dendev Baradch,
UNESCO IITE Director, a.i.

# Introduction

> Children's ability to revisit their work in a collaborative way, get instant feedback, and refine it is very different now. They have access to wide range of tools, not just access to knowledge but also people and cultures and resources, etc., and this facilitates children to be more independent self-learners, which encourages the lifelong learning skill of independent learning. They get engaged with what they are learning and take it home. They are in touch with the world. S32, Broadclyst, UK

The ICT in Primary Education analytical survey was initiated by the UNESCO Institute for Information Technologies in Education (IITE) in 2011 with the goal to better understand the phenomenon of ICT[2] in the first stage of institutional compulsory education. We published our initial outcomes of the project in the first volume of the report[3] in 2012, subtitled Exploring the origins, settings and initiatives. These resulted particularly from reviewing the research literature, searching web sources with various official policies, but most of all from our close cooperation with 9 primary schools of the initial sample. In volume 1 we presented each of those schools in its Chapter 4 Vignettes of innovative primary schools.

However, through our cooperation with the first year sample schools we gained much more: we managed to identify various dimensions and aspects of the process of ICT integration and use them in the second period of the project to build an extensive questionnaire[4] and distribute it to our considerably extended sample. Our intention for the second and the third years of the project was to cooperate with the broader sample of primary schools, better representing different situations, cultural and social backgrounds, locations etc. Again, we used purposeful sampling of leading innovative primary schools (often combined either with early years stage or with one of two higher stages in one institution). Extended sample thus incorporated 35 schools from 19 countries, representing different kinds of schools, large and small, urban and rural, state and primate, from less or more developed regions. The complete list of the sample schools together with their contact information can be found in Appendix 2.

The questionnaire consists of eleven groups of questions, in which we wanted to learn as much as possible about each school, how they manage and organize their ICT, which ICT is being used and for what, what kind of digital content they use and how, how the use of ICT fits in the curriculum, what types of limitations they face, what type of concerns they (and other participants involved in the process) have, and how they provide for equal chances for every student. We also asked them to characterize the change that has happened inside and outside the school. In the last part of the questionnaire, we asked the teachers to provide us with one or two short narratives documenting their particular everyday experience, activity, best practice... in the context of ICT in primary education. We decided to call these examples promising practices and use them to illustrate the book[5].

In the questionnaire, we also asked the teachers to ask (some of) their students how they perceive the role of ICT in their lives and how they would describe the difference in the use of ICT inside and outside school. Thanks to their answers, we could learn about their perspective of the process of integration and transformation of primary education due to ICT.

In most of the cases, the questionnaire was collaboratively answered by a group of primary teachers, often together with the ICT coordinator and the school principal. While doing so, they closely cooperated with a member of our team, who in many cases visited them several times in person in that period

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[2] alternatively, we will often say digital technologies

[3] see Kalas, I. et al. (2012) ICT in Primary Education. Analytical Survey. Volume 1: Exploring the origins, settings and initiatives. IITE UNESCO, Moscow. [can be retrieved from web] http://iite.unesco.org/pics/publications/en/files/3214707.pdf

[4] see Appendix 1: The study methodology

[5] although not necessarily corresponding to the text around them, which we found impossible due to various aspects covered in almost each narrative

of 2012 and 2013. On one occasion, a single teacher, in the name of her school, answered the whole questionnaire.

In that way, we managed to collect more than 500 pages of texts and large folders of visual materials, products of the students – either photographed or scanned, photographs from various events, scores of video recordings, audio files, documents, presentations, mind maps, etc. Then we divided collected data into eight segments and analyzed them by standard qualitative process of data analysis. Eight chapters of subsequent Part 2 of this volume correspond to our final interpretation of the qualitative findings and competently present the process of ICT integration into primary schools from various perspectives. In addition to that, we selected five of our sample schools and conducted deep analysis there. Those findings are presented as a collective case study in a separate UNESCO IITE publication[6].

Because the findings of our analysis were numerous and unexpectedly extensive, we decided to insert their abridged version as a separate Part 1 of this volume, where we decided to concentrate on such findings, which may inform the development or revisions of the national or regional strategies and approaches to ICT integration into primary education, being inspiring for school leaders and managers when formulating, elaborating or implementing their local school ICT strategies, or to the teachers and other direct actors in the process to help them reflect on the process and plan its following steps. We believe that Part 1 will be helpful for those who are already deep in the process of integration, as well as for those who seek for an initial inspiration. Most of the findings are presented here as well informed observations and useful recommendations from various perspectives.

After studying Part 1, we recommend to continue to much more complex presentation of the findings in Part 2, where each chapter is further supplemented by dozens of sophisticated and real experience based quotations from our sample schools.

Two appendices conclude this volume. Appendix 1 explains the methodology of the study and presents the exact wording of the questionnaire. Appendix 2 presents complete list of our sample schools, together with their full names, addresses, contact persons and school websites. All sample schools expressed their agreement to be identified in this way.

[6] LIM, C. P. et al. (2014) ICT in Primary Education. Analytical Survey. Volume 3: Collective Case Study of Promising Practices. Moscow, Russian Federation: UNESCO Institute for Information Technologies in Education

# Part 1: Policy and recommendations

> We did not expect to do so much in such a short time, that we would be able to change so much, not only in primary education but also all around the school.
>
> S12, Taurage, Lithuania

> Technology has been the key element in transforming education from the traditional model to a more interactive, hands-on, student-led, product-oriented, exciting, learning experience.
>
> S13, Nuevo León, Mexico

The outcomes of the qualitative analysis of the data collected from our sample schools are presented in this part of our report in a condensed collection of main findings and recommendations, structured in eight sections. For each of these sections there is a corresponding chapter in Part 2 of the report, in which the reader will find a complete and detailed presentation of the findings, supported by a collection of interesting and inspiring quotations from the questionnaires.

Abridged sections of this part cover:

- The 21st century primary schools: setting the context – here we present a picture of what a primary school is in the second decade of the 21st century; why our primary schools have started using ICT; what their IT infrastructure is and its provision for teaching and learning; how the teachers are supported, in terms of personal, pedagogical and technical aspects; and what lessons the schools have learned during the process.
- Technology opportunities – how ICT is selected; what technologies, software tools and digital content is chosen; how the teachers are involved in the development of their own content; how the schools manage and use their own learning management systems; and what their expectations are, their limitations, concerns and plans for future growth in this context.
- Technology and pedagogy – how the integration impacts the teaching and learning styles and activities; how ICT helps teachers meet curriculum objectives and students' skills development (including computational thinking and digital literacy, cross-curricular skills, skills for the 21st century learning, and others); how schools pay attention to assessing activities with ICT.
- Limitations and concerns – what the limitations and concerns are, the obstacles and problems teachers face while integrating ICT; how they and their schools can prevent or overcome some of them; how the schools cope with the safer children in the digital world issues.
- Equal chances for everybody – examining the critical factors that support or hinder the effective use of digital technologies in primary settings in the education of students who are at any kind of risk of exclusion; what the key pre-conditions of the effective ICT use are in the education of students with special needs.
- Major changes – how the everyday practices of the teachers are being changed; how aware the teachers are of those major changes; what really happened and what did not; and what happened unexpectedly.
- Students' perspective – how they perceive the use of ICT in their school, and in their life, and how they use it.
- Sharing promising practices – the usual activities happening on an everyday basis in classes and in schools in the context of ICT; the basic message of these practices and how other teachers and schools can inspire from them.


Image 2: This is what I created. S35, Arlington, USA

## The 21st century primary school: setting the context

If we want to help primary schools – their leaders and their teachers – harness the potential of ICT in order to better support their students' learning, we need to have a better picture of what defines a primary school in the second decade of the 21st century. Therefore, as the first step of our study we tried to learn how ICT came to be integrated into our sample schools and why, its origins and the process of development over the years, and the lessons they feel they have learned from their experience. We wanted to learn about the management and organisation of ICT in the school, in terms of the classroom environment, computer access, links between home and school, and the schools' continuing requirements as technologies and opportunities changed.

The schools have given us different reasons as to why they started using ICT in the primary education, some of them being external (including government or IT company initiative, educational policy makers, parents, or young people with their new digital lifestyle), some others being internal (most often including school leaders or teachers initiative). However, the over-riding motivations they indicated are educational reasons, as school leaders and teachers became aware of the range of opportunities being opened up for improving teaching and learning with technology.

Our schools were proud to describe the range of IT infrastructure, hardware and software they had now established now for their learners, teachers and parents. These were not especially privileged schools,

in the main. However, by recognising the value of ICT for their learners they have established impressive environments for learning, comprised of IT infrastructure; ICT provision for teaching and learning; and provision of access for students, including one-to-one learning opportunities, computer rooms to provide access for independent learning and project work, before- and after-school computer clubs for students who have no access to computer and Internet at home, school WiFI network, which students can access in school even using their own computers[7] (Bring Your Own Device strategy), etc.

An important component of the school's ICT infrastructure is its learning management system (LMS), which facilitates creating a virtual learning environment. When accessible from homes, it supports a continual two-way dialogue with parents, keeping them informed about activities in the school, establishing a relationship with the child's teacher, enabling them to track their child's progress and integrate their homework with their school work, and even contributing to the work of the school or the class.

In the schools we surveyed, innovation in teaching and learning is driven by the school leader and the teachers. To do so, teachers must be well supported, in terms of personal, pedagogical and the technical aspects: they must have necessary equipment (at their full disposal), personal and unrestricted access to a collaborative environment for experimentation and learning together, pedagogic support for developing the best ways of working with students, and technical advice and guidance. One of the distinctive features of our schools is the emphasis on collaboration between the teachers, recognising that the very difficult task of working out how best to use technology in a primary school is more manageable if they do it together. In this context:

- Leadership is important for creating the culture of collaboration.
- The school leaders must acknowledge and encourage those who are able to use ICT tools on a high level within their daily teaching practice.

Although there are many types of possible scenarios for providing pedagogic support to teachers, it is clear that teachers will always need help with exploring new forms of pedagogy, because technology innovations will continue to produce a wide variety of opportunities for improving teaching and learning. It is also vital that someone in the school has responsibility for supporting both actual technology, but also preparing for tomorrow's technology as well, and helping the teachers to do the same. The technical team of the school must discuss technical support with the teachers, and make sure that their questions are answered. In our schools technical support usually includes the assurance of proper functioning of any electronic device, operation of the different modules of the school's technological platform, connectivity and access to content via the network and school LMS system.

In our survey schools were reflecting on the origins of their use of ICT, sometime decades ago, as well as their current practice, therefore they were in a good position to be aware of the lessons they had learned. Their reflections and recommendations include these principles:

- Remove external constraints on the teaching where possible, to enable innovation to be carried through more easily.
- Set out to learn from the successes in other schools.
- Put ICT devices in the library and access halls because it is important for everyone to see the children working on computers.
- Give a greater role to ICT in development and assessment, as it is very motivating for learners to get immediate feedback.
- Provide more mobile devices with wifi. Fixed equipment is expensive and their scope of use is limited, while mobile devices plus wifi allow more flexible use of ICT.
- Give teachers and students one-to-one access as soon as possible.
- Equip teachers prior to engaging them at school with students.

[7] although some schools operate certain kinds of restriction on the use of computers or the Internet

- From the earliest opportunity, provide consistent and frequent professional development for staff members, so that they feel comfortable incorporating the technology.
- Give teaching staff good conditions for their work, open, give them opportunities to take part in conferences to share their experience.

## Technology opportunities

One of the key factors of the integration is the process of selecting new technologies, acquiring them and deploying them at school. The selection process (in the broadest sense) is carried out either at the school level, at the local or regional level or at the centralized (governmental) level. In any case it is crucial to apply a well thought system of criteria, which would guarantee appropriate decisions. Our study shows that to implement the selection process, schools find it important to thoroughly consider and respect:

- Expectations at the school level. These are often shaped by the stage of the ICT awareness and experience of the teachers. An important role should be played here by the school leader and its ICT specialist or coordinator as well.
- Teaching/learning goals of the teachers and the needs determined by them. New technologies must be compatible with the school's values and pedagogy (although carefully selected technologies with appropriate professional development can help teachers and schools re-think their goals).
- Safety standards, ergonomics issues, developmental and physical appropriateness of selected technology. It is recommended to select a wider range of technologies, which may help to meet students' individual needs, different instructional and learning styles, possible, learning barriers, different mental structures and representations, skills level etc.

Some schools run their own internal seminars or conduct their own research on a continual basis in order to better understand the trends and development in ICT, and the real needs of the 21st century learners. Teachers often mention that properly selected ICTs can help to diminish growing gaps (of various kinds) among students of different needs, giving them better chances to find a way and a format how to express themselves. In the process of selecting technologies it is also important to consider the position of parents as far as schools need their support in the process if integration.

When selecting hardware, schools choose standard[8] as well as less frequent technologies[9]. In our study we noticed evident tendency to move (or plan to move) from desktop computers to notebooks and netbooks, and to tablets and smartphones. We also noticed that the further the schools have reached in the process of integration, the more they want to achieve the state of having a technology rich environment. It usually means to have an IWB in every classroom, have each student (and teacher) equipped with a tablet, and have enough technology to support all teaching and learning practices – wherever and whenever it is requested and appropriate. Some schools are considering the possibility of implementing a 'bring your own device● (BYOD) strategy, as apparently there is a growing recognition are digital technologies supporting mobile learning.

When selecting software and other digital content, we should not underestimate its importance[10] and price, quality, developmental appropriateness, licensing and policy of future upgrades, ease of use, or language issues[11]. It must also be sensitive to the cultural and religious values of the community and individuals. It must be compatible with the national curriculum (by the quality of the content

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[8] including computers, data projectors, IWBs, notebooks, tablets, scanners, printers, cameras, digital visualises, digital microscopes, microphones and sound recorders, headsets, smartphones etc.

[9] including voting devices, video studios, more complex audio equipment, video games consoles, motion sensing input devices, audio players, educational robotics sets, data logging devices, sensors and measurement equipment, digital programmable toys, floor robots etc.

[10] several teachers noted that when equipping the schools, hardware is often being preferred... as if software were less important and less costly...

[11] we should carefully ask questions like: Does the software environment interact with students in their own language? If not, will it mean any inconvenience? Will it be localized? Will it be possible to adapt it?

and its appropriateness for a particular purpose) and it must comply with the ethical and moral values of the school.

In the process of selecting software schools usually choose general creative tools and environments like music editors, photo editors, text and graphics editors, storytelling tools, brochures editors, writing practice tools, mind-mapping editor, web blogging tools, various content sharing tools and platforms, and authoring tools for creating learning materials, presentations, quizzes and tests, interactive activities and games.

When selecting digital content, schools most often focus on digital libraries, multimedia resources (pictures, videos, animations, sounds, songs), educational applications (simulations, microworlds, sequencing programs, subject-specific apps, games, interactive microworlds for developing skills), textual documents, presentations, web pages, activities for IWBs, comics, puzzles, animated fonts for pupils' presentations, web sites, e-books, audio books, professional content for literacy, numeracy and science etc.

A significant part of digital content is being developed or adapted on an everyday basis by the teachers themselves. Therefore, an attention must be paid to support this effort in the form of organizing corresponding professional development, providing schools with proper authoring tools, access to adequately licensed libraries of the digital resources etc. Most of the teachers believe that such approach should be supported intensively. Some teachers also want to develop their own software applications.

Our study also shows growing concern of the schools about the copyright issues of the digital content they use. The schools are increasingly interested in open content, as well as open educational resources (resources distributed under non-commercial and verbatim licenses).

Schools apply various strategies for sharing experience and ideas of how to get digital content and how to use it. Some innovative leading schools organise workshops, conferences, and open days for teachers from other schools, some of the teachers present their experience at the regional, national or international teacher's conferences, or travel to visit other schools and disseminate their practice. Supporting such activities is considered by our schools to be appropriate and efficient.

Our study reveals that deeper understanding of the potential of ICT to enhance teaching/learning processes manifests in seeking and demanding higher functionality of the supporting ICT, including technical infrastructure and LMS, learning management system. Four levels of development can be recognized here: (1) only few of our sample schools do not use any LMS and are not aware of its need so far; (2) some schools are still not using any particular system but already practise some of its basic functionality – like simple file-sharing and e-mail communication; (3) some schools have already started using an LMS, mostly for posting home works and teaching materials, and for communication with their pupils; (4) many schools are profound users of wide functionality of an LMS.

Schools use their learning management systems:

- for teachers to post the assignments, manage, store, spread, and share primary and supplementary digital content, to collect students' work, and to support and administer the teaching and learning process (with e-portfolios, e-record books, e-diaries, grading lists, webinars etc.),
- for students to help them administer their learning and development, to facilitate their cooperation and collaboration in projects, to get and post their work, to communicate with teachers and with peers etc.,
- for parents to monitor the contents and progress of their children, to observe their e-portfolios, and to get into home-school communication.

For our schools the most frequently listed challenges are financial issues (with most of the finances being spent on hardware); incompatible hardware; quality issues of the content, for example, the lack of software to support creativity and learning by exploring and constructing; compatibility of the content and curriculum; high time demands; safety issues; developmental appropriateness; licensing; accessibility to the content; the language of the content issues etc. The urgent need to equip teachers themselves with powerful technologies is often emphasized (which is not always what really happens).

Most of the schools have an acute awareness of the ever-growing need for upgrading, developing, and extending the equipment and environment. They have plans to further strengthen the functionality of their LMS, improve their infrastructure, widen the spectrum of technologies used, improve the accessibility of technologies and significantly move towards mobile learning.

## Technology and pedagogy

Our study shows that the integration of ICT into primary education has a major impact on the teaching styles and on a variety of students' learning activities, by encouraging more personalized, differentiated, and customized pedagogical approaches to cater for different conditions or even special needs. Regarding the pedagogical approaches, ICT enables teachers to create their own digital teaching materials and deploy them in a variety of teaching scenarios. Consequently, ICT is being exploited in subjects and across subjects. Therefore, it is important for teachers to understand new educational, didactic, cultural and social potential of ICT at their disposal.

With regard to learning activities, teachers extensively use technology in the production of their lesson plans as well as learning material and learning activities, often initiating the production of digital materials by the students themselves. Students are also given the opportunity to present their understanding in different ways, showing their learning according to the way they understand it, developing different products and learn to collaborate as well as to use the technical skills of their mates. When they present their projects in the class, the audience has the chance also to learn, according to their own learning styles.

The study shows a broad variety of learning activities with ICT for either tackling different topics or developing different skills, including spatial skills, orientation, hand writing skills, autonomous development and independent study, reading, critical thinking, academic writing, note taking, reference management, time and task management, decision making, planning, etc.

As already indicated in Book 1, most governmental and schools' policies highlight the importance of integrating new technologies into the learning environment and using them to meet curriculum objectives and students' skills development (including ICT qualifications themselves). Our study shows much evidence of ICTs fulfilling different curriculum objectives in different subjects such as language, writing and grammar, mathematics, science, programming and robotics, geography, music, entrepreneurship, etc.

Some schools also denote explicit focus on computational thinking and skills development, either integrated into various subjects or being taught as a separate subject, in which the major skills targeted include data handling and processing, elements of programming, advanced research skills, e-safety, presentation techniques, creating podcasts, video editing and audio recording, and graphic design.

In most schools, we notice an explicit emphasis on cross-curricular skills development[12], often integrated in ICT based projects, as a way to boost creativity, critical thinking, problem solving, learning-to-learn and cooperative ability. We also noticed that ICTs, when used in the proper way, have a major impact on independent learning and the development of autonomy[13]. The use of technology as an opportunity to develop communication skills is also highly supported: students are participating in learning communities and on-line collaborative projects. Citizenship, personal and social responsibility development is also supported through multiple, interconnected, transversal learning approaches, often exploiting technologies.

Our study reveals that schools pay close attention to planning, preparing and assessing activities with ICT, in accordance with the objectives of national curriculums. In general, they use ICT equally for whole class work, group-based learning (sometimes in pairs), as well as individual self-directed learning activities, depending on the objectives and the type of activity, and the problem to be solved. Project-based learning takes an increasingly important part of the activities in the classroom or informal education. Beyond the class itself, ICT clubs are also popular, as an after-school activity involving teaching staff as well as parents, as a way to strengthen community engagement. In all cases, there is generally more emphasis on student's activity even in the context of whole class work.

When groups of mixed age are involved, teachers create cooperative learning environments by helping students of different levels to determine group goals, and teaching students cooperative learning skills. We also found many examples of students being engaged in solving real world problems in the context of activities that are only possible with the networking capacity, data collection and analysis, simulation capacity, and social dimension provided by ICTs.

Teachers usually select the learning objectives and choose the best activities for the students, which will properly suit their age and needs. Teachers often note that, due to technologies, they can choose from broader variety so that it is easier to support the development of all levels of Bloom's taxonomy. Differentiated activities are planned ensuring that expected learning is accessible to all. Teachers will ensure that they have a strong grasp of what needs to be taught and how to use it and also the expected results and criteria of evaluation have to be foreseen.

When it comes to evaluation and assessment, ICTs provide new opportunities for testing knowledge and skills, or automatic nominative feedback sent to the teacher from pupils' tablets when an activity is completed. However, we have often seen that students are not directly assessed in ICT-based activities unless ICT, or rather Informatics, is a dedicated subject in the curriculum. Otherwise, teachers would usually provide extra praise for students using ICT tools in their solutions for assignments and might raise the given grade for the extra work emerging in the resulting submission.

## Limitations and concerns

The following themes resulted from the study in the context of limitations and concerns: obstacles and problems teachers face while trying to integrate ICT; concerns expressed regarding different dimensions of the use of ICT; recommendations and strategies how to overcome some of the challenges; and prevention and protection of the primary students when using ICT.

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[12] We saw many cross-curricular projects involving teamwork, investigation, inquiry and exploration, as well as internationally networked projects.

[13] contributing to shift from a Teaching and Learning philosophy to a more Learning and Teaching one

Most of the teachers face some or most of the following obstacles:

- lack of funding, which often results in considerable decrease of expenditures on software and digital content, in favour of hardware purchases;
- lack of leadership, as it is the innovative role of the school administration that is considered the key to the successful integration. When the principal of the school together with her or his team are not sufficiently involved in supporting technological and pedagogical innovations, they become major obstacles;
- lack of technical staff to support teachers;
- insufficient infrastructure, including the quality of Internet connection and proper infrastructure for servicing the school LMS, many notebooks, tablets, and mobile devices with different communication protocols and requirements, etc.;
- lack of time and professional development opportunities;
- lack of the parents support, sometimes caused by big social or cultural differences among families, insufficient extent of their interest, or low level of some parents' digital literacy;
- lack of quality digital content and educational software, as already noted earlier;
- lack of teachers' experience and confidence regarding the integration of ICTs, which may result in their resistance to get involved in the integration.

Besides these obstacles, teachers also express other concerns regarding the integration of ICT, often linked to the issues of pedagogy and its quality. Some of them warn that students may receive considerably unequal ICT experience – depending on their teacher's attitude to new technologies. Thus, the impact of the use of ICT on education and student's learning can be at very different levels. Others point out that their timetable structure does not allow to accommodate project based learning and other modern teaching and learning formats.

When asked to formulate suggestions of how to prevent or overcome some of the challenges and concerns they have faced in the process so far, teachers most often refer to:

- Professional development: all schools underline the importance of the staff professional development as the key aspect to overcome the difficulties and problems. They find it important to respect the fact that there are different strategies of the professional development and it is always important to carefully select the one, which is suitable for the actual needs and situation.
- Quality and complex infrastructure: some schools mention the importance of the quality of the infrastructure that has to be well thought out and supported in order to maintain high level of quality, which will ensure that all participants are kept involved and motivated.
- Parents and community: some schools mention the role of parents (and other members of the community) who are important collaborators and must be involved in the process and support it.
- ICT Culture: the transformation should be implemented as an integral part of the school culture, fully integrated in every dimension of the educational process.

All schools in our survey pay close attention to the issues of safer children in the digital world. Several schools decided to collaborate on prevention together with the parents of their students. For that, they use different means, which include organizing workshops or discussions for parents on safer Internet and cyber wellness, producing special newsletter on e-safety in different languages and sending them to parents, etc. Some schools have developed strategies to control what the students can do and what they can access. Others try to engage the students in the prevention actions, for example by making them partners in organizing discussions on cyber bullying or detecting unacceptable content. All teachers want their students to know what to do in any case of an e-threat. Some teachers believe that the most efficient supplement to all preventive and educational measures is... •when teachers live together with the students in their digital world'.

## Equal chances for everybody

In our study, we also wanted to identify good practices and critical factors that support or hinder the effective use of digital technologies in primary settings in the education of students who are at any kind of risk of exclusion, including:

- students with special educational needs, including those considered to have emotional, behavioural, sensory, physical, or mental disabilities,
- girls and boys affected by any kind of gender issues,
- ethnic and faith minority groups, travellers, asylum seekers, and refugees,
- students who need support in learning the language of instruction (being their second or later language),
- gifted and talented students,
- children in need, including those in public care, orphan children etc.

Some schools are conscious of the fact that technology can have its greatest effects for students with the greatest needs. If well designed, it can transform the lives of learners who find normal tasks and learning activities unusually difficult, whether for physical or conceptual reasons. As formulated in the UN Convention on the Rights of Persons with Disabilities, promotion of inclusive education of persons with disabilities means not only physical access to IT infrastructure, but also the full range of educational support, including (adaptation of standard hardware and software, using different kinds of assistive technologies[14], curriculum adaptation, individual support, teacher training, etc.). Learners with conceptual disabilities can use interactive game-like programs that enable them to take all the time they need to practice hearing the composition of words, or to practice estimating the size of a set of objects.

Indeed, at some of our schools we have observed that:

- Special equipment, tools, and devices are purchased for students with SEN or accessibility needs.
- Programs that can be used for independent learning by the students are especially valuable, as this increases their sense of self-efficacy.
- Students with special needs have differential support, and are allowed to use digital tools to help them with their work.
- Teachers plan each student's work with special programs and resources to ensure they have a balanced education, and achieve their learning potential.

However, in most of our schools these are only pilot initiatives, which cannot be considered complex inclusive strategies in educational policy. In general, the study reveals that there is only restricted understanding among educators of the value of ICTs and digital content in the context of inclusive education for different categories of students with special educational needs. Despite the fact that the majority of the schools highlighted the importance of equal approach concerning access to education, only a few of them described compound vision of such approach. In general, we see that a number of requirements of various international regulations (mainly, the UN convention mentioned above) are not yet implemented in everyday practice of the sample schools.

The analysis helped us identify key pre-conditions of the effective use of ICT in education of students with special needs, namely (i) systematically increase the awareness of the ICT potential in education for students with various needs, and (ii) promote further teacher capacity building and networking in this context.

[14] i.e. technologies that counter a physical disability, such as special keyboards or input tools for learners who cannot use their hands, or audio interpretation of text and graphics for learners who are blind or partially sighted

## Major changes

The survey showed that ICTs are significantly transforming the way in which teachers work, interact, prepare, create things, and think. We wanted to learn whether they are explicitly aware of all the major changes, whether they purposefully observe them and how they perceive them.

Most teachers identify major changes in the following areas:

- teaching profession, the teachers themselves: teachers nowadays cooperate, communicate, share ideas and experiences, help each other in learning, exploit ICTs to find resources for their students, prepare lessons, organise students' work, evaluate their results, and administer learning records,
- pedagogy, updated learning goals, new teaching and learning forms, which have transformed and expanded, and due to new technologies are more efficient and attractive, projects-based and cross-curricular oriented, more interactive, hands-on, and support student-led, product-oriented, exciting learning experience,
- learners, whose motivation to use ICT has triggered their skills, feeling that they moved away from routine methods. Currently, they have much better opportunities to become competent in new 21st century skills, working collaboratively in teams, solving more real world problems, communicating with anybody and anywhere,
- relations and roles in the school (relations between students, teachers, students and teachers, between the leaders and the staff) and beyond it,
- administration and paperwork.

We also asked our teachers and school leaders to ponder about what did not happen and what happened unexpectedly. Many teachers expected that the quality of the new learning outcomes – supported by new technologies – would manifest quicker and more apparent. Instead of occurring in traditional achievements, however, these outcomes usually materialize in other, often new but equally important issues. On the other hand, many teachers and school leaders did not expect that their role would change so abruptly and considerably. They also did not anticipate that big differences in the social status of the families of their students would pay such strong influence on the access of the students to ICT and thus to the learning performance and achievements. Many also noted that the success and outstanding outcomes – their own and of their school – transformed their lives considerably.

## Students' perspective

> I like to create stories or images from the series. Sometimes, the teacher sends the e-mail tasks. Mail, then the teacher communicates virtually, it's interesting and quite simple. I especially like to ... create movies. I know a lot.
>
> 3rd grade student, S18, Moscow, Russian Federation

In our study, we decided to enrich the educators' and experts' perspectives on ICT in primary education by listening to students themselves about how they perceive the use of ICT in their school and in their lives. We found that the most common attitude is enthusiasm: students perceive technology as entertaining, even if related to traditional school subjects. For them, technology has an important effect of making schools more attractive. Some students explicitly articulate that due to technology they are able to learn more and understand complex concepts. Even some students with strong interests, which are not directly related to technology, seem to find in it a way to connect and enhance their personal interests.

Surprisingly, even in some highly innovative schools, there are students who associate the use of technology at school mainly with writing assignments and making presentations to their classmates. Word processor and presentation software tools are mentioned as the main tools for schoolwork. For younger students who are learning to read and write, the use of keyboard is perceived as an important scaffolding tool since ...it has the letters. Simulations and explanatory videos are perceived as a contribution to learning concepts,

especially in Science. Some teachers use educational games to teach and practice some specific contents (particularly in mathematics). The gamification of these activities seems to provide high doses of enthusiasm end engagement.

Technology allows students not only to be consumers of multimedia material, but also to be producers and publishers of their own creations. Many students adopt these types of activities with high enthusiasm, even though not always they recognise them as actual school activities. Many students like to tell stories using modern multimedia languages. They use special software for producing comics, create videos with characters made of clay[15] and produce their own radio or video programmes. Technology also allows a completely new experience through digital music and drawing. The introduction of new portable digital devices has allowed a natural use of mobile technology to capture the world. The eruption of touch devices has also allowed direct painting or drawing with students' own fingers.


Image 3: A 4th grader created a mind map to express the role of a computer in her life, mentioning educational programmes and games, YouTube and Google, computer, Facebook, and presentations on different issues. S22, Bošany, Slovak Republic

Some students have participated in projects that take their learning beyond the walls and boundaries of their school. They use Web 2.0 tools to communicate with people in different parts of the world or even out of the Earth in communication with the international space station. Communication skills of today are hardly understood without digital interaction. Students have the possibility to learn such skills through actual interaction with other students and adults located in remote places.

When we asked students how they would describe the difference in the use of ICT inside and outside of school, they often noted that technology in school is for learning, but at home they use it for doing things they like, such as chatting or playing games – they rarely regard what they freely do at home as learning.

[15] using technology called stop motion

At school we have to finish work within 1 hour, at home we can work as long as we like.
Student from S15, Torun, Poland

## Sharing good practices

We found it important to know the usual activities that are happening on an everyday basis in classes and in schools in the context of ICT. Therefore we collected a sample of short narrative descriptions documenting teachers' and students' particular everyday experience, activities or good practices, using ICT to support the learning processes. We identified several categories of such activities, including the following:

- activities directly focused on supporting subject learning goals, including language and literature, mathematics, science, art, design, technology, geography, music, history, physical education, and all others,
- activities focused on supporting foreign language lessons, as far as ...digital technologies enable students to learn and use foreign languages in an authentic contexts,
- activities focused on supporting Computing, Informatics, Computer Science or ICT learning goals, e.g. controlling programmable digital toys; creating various digital products (animation, video, drawing); or using an educational programming environment to develop (program) their own game-like projects with multiple actors and interactions,
- activities focused on cross-curricular development (as noted by several teachers, such activities are particularly natural to be implemented at the primary stage),
- activities focused on the development of 21st century learning, either within the subjects, or anywhere in the school environment or beyond the school,
- examples of regional, national or international collaboration[16], e.g. videoconferencing with other schools or other partners; learning about other cultures; developing common products; or exploring and solving real world problems,
- examples focused on collaboration with local community, parents etc. Some schools play active role in supporting the development of the digital literacy of the whole community, certainly including parents of the students, sometimes even their grandparents,
- examples of productive cooperation between schools and academic partners, e.g. to run an innovative project; conduct an educational research; or better exploit ICT to support special educational needs of the students.

We believe that a rich selection of activities affords productive opportunities for primary students and supports their complex development. Therefore, we recommend creating opportunities for all or some of them in every primary school.

Image 4: Creating Escher tessellations by rotating, reflecting and transforming some elementary pieces. S2, Rio de Janeiro, Brazil

[16] we presented several of them in Book 1

## Geography and History of Rio de Janeiro

The 4th grade pupils (9 to 10 year old) study Geography and History of Rio de Janeiro city. The learning goals of this unit are:

- Important topics about maps and mapping: different perspectives, scales, legends, representing different information in maps, cardinal directions etc.,
- City history and geography: how is the space occupied, green areas, building areas, rich neighbourhoods and favelas, the growth of the city since its foundation etc.
- Activities in the city. Transportations: main streets, subway lines, trains; daily transportation of workers from suburbs to the centre, the huge problem of traffic jams. Residential, commercial and industrial areas. Public services: health care and public education.

Rio has lots of mountains and lagoons, thus the whole city is organized according to its nature. When we observe the city, the deep relation between natural conditions and human activities become obvious.

We decided to use Wikimapia site – a Wiki Google tool that gathers satellite photos, street maps, and pictures posted by users etc. Users can also draw polygons over the map and name the places they have located. It is quite inspiring and useful, as we may find each neighbourhood, condominiums, our school, universities, shopping malls and other well-known places. Polygons may be inside other polygons or they may partially overlap. We can see Escola Parque inside Gávea district, inside the South Zone etc.

We began by looking at the maps and finding well-known places: What kind of information can we find here? What kind of information can we not find?

Then we started to build connections between information contained in different maps: Why there are no streets in this area? In order to find out, it is necessary to see the relief map, vegetation in satellite photo, and also a street map. We asked pupils to suggest new questions and to answer questions like that.

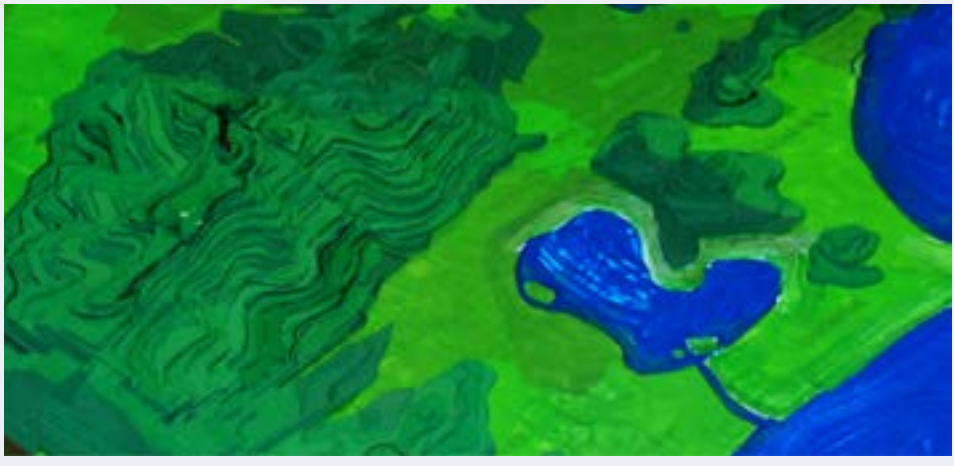

Figure 1: Detail of the concrete model. It is possible to see kids' painting in Lagoon and drawing of each foam slice.

After this, we took a deep look into the relief map, in order to understand how the lines in the map could represent mountains. Gávea district is located on a mountain and pupils were surprised

to see that in the street map it is not pos sible to see that we need to move up to go to school. The teacher coloured and printed a relief map, and asked kids to cut slices of soft foam to build a Rio de Janeiro model, using proper scale.

Then we located several points of interest in the model (such as Copacabana, Ipanema and Leblon beaches, Sugar Loaf, The Christ, Rodrigo de Freitas Lagoon, Rocinha favela). Pupils then visited the Corcovado monument with their families, where they took many pictures of the city, and observed real landscape, located places in a map etc.

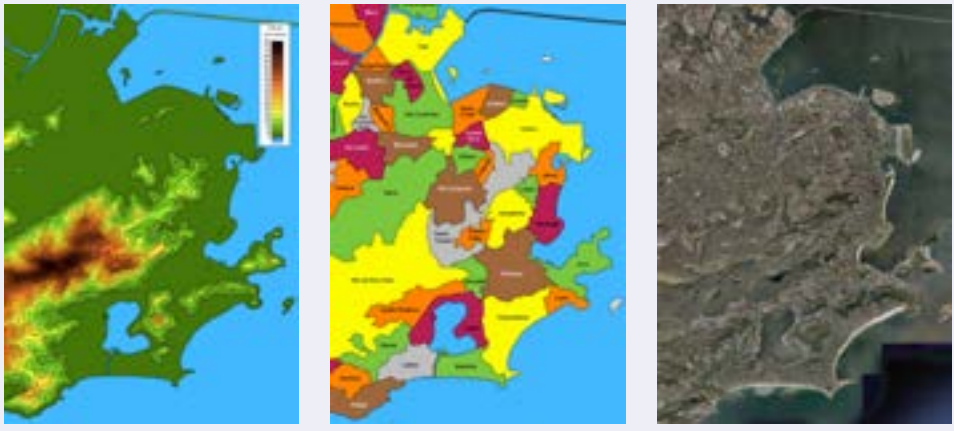

Figure 2: We used a regular projector pointed to the floor from above and projected different maps (districts division map, street map, relief map, satellite photograph, amount of the rain that falls in a year etc.) over the concrete 3D model. We presented this also to the parents of our pupils. We invited them to locate important places in the city and answer various interesting questions.

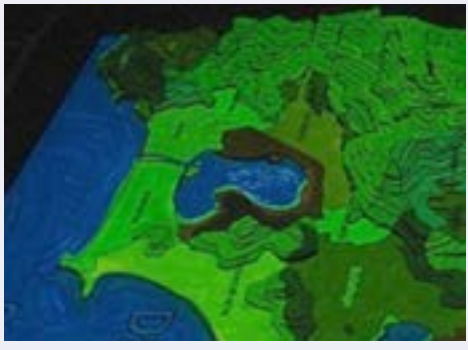

Figure 3: Projecting a district map (see above, in the middle) over our 3D model made of many slices of the coloured foam.

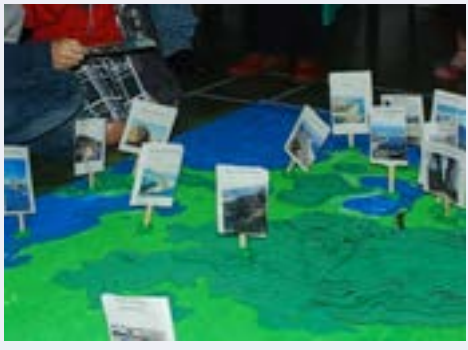

Figure 4: It was highly rewarding for us to see how pupils understood the city and were very proud to show parents their work.

# Part 2: Learning from the 21st century primary schools

This part consists of the actual outcomes of our analysis of all collected data from 35 sample schools. Although the questionnaire, which served as our main source of the data, was organized into eleven groups of questions, after reading the collected material and obtaining a general sense of the answers of the teachers we decided to analyze it from eight – slightly rearranged – perspectives, namely:

- setting the context – addressing the reasons why we should consider using digital technologies in primary schools, presenting the 21st century school environment, studying different forms of support for teachers, and reflecting on the lessons learned in general;
- technology opportunities – studying how schools choose new technology and for what, if and how they use school LMS, pondering about choosing, developing and using digital content, identifying main challenges which schools and teachers face, and characterizing their future plans and needs in this context;
- technology and pedagogy – studying how technology is integrated into the teaching and learning processes, pondering on how ICT is used to support meeting curriculum objectives and skills development, how is it used for preparing and conducting learning activities, studying differences between learners and their needs, and addressing the ways in which assessment methods are being transformed in the context of new technologies;
- limitations and concerns – identifying various obstacles, problems, and limitations of the teaches in our survey, sharing strategies for overcoming some of the challenges, and pondering on how to handle various safety issues and protection of students;
- equal chances for everybody – identifying good practices and critical factors that may hinder effective use of ICTs in education of students who are at any risk of exclusion;
- major changes – studying how ICTs are transforming the way teachers teach and students learn, how they all interact, create things, and think, analyzing how relations at school have changes, reflecting on what did not happen and what happened unexpectedly;
- students' perspective – investigating how students perceive the use of digital technologies in their learning, in their school and outside it, in their lives;
- sharing promising practices – analysing collected short narratives documenting teachers' particular everyday experiences, activities or promising practices, understanding what types of activities they conduct, and sharing some of them throughout the book.

Each of these perspectives is supported by a selection of inspiring quotations coming directly from the answers of the teachers.

# 1 Setting the Context

## 1.1 Overview

The questionnaire to schools began with three questions to set the context, and this chapter summarises the schools' responses. The first question 'about your school', enabled us to establish that we had a mix of schools that are large and small, urban and rural, and from primary only to broader age ranges. In all cases we asked for a main contact person, so that we could return to ask for further information, if there were any gaps in their responses.

The next set of questions asked about how ICT came to be integrated into the school, its origins, the process of development over the years, and the lessons they feel they have learned from their experience. The final set of context questions asked about the management and organisation of ICT in the school, in terms of the classroom environment, computer access, links between home and school, and the schools' continuing requirements as technologies and opportunities change.

The schools' responses are summarised in this chapter, together with direct quotes from questionnaires in the form of highlights within the boxes to illustrate the aggregated responses.

We end this chapter with a visual summary of how ICT is used in primary schools from the perspective of the teachers and students themselves.

## 1.2 Why should primary schools use ICT?

### Objective

To understand why we should consider using ICT in primary schools

### The questions asked[17]

We asked this question directly: Do you think ICT should be used in primary education? Why? (2.1) – to which all the schools responded yes, and there was one over-riding reason why they agreed – for the sake of the children's education.

To find out why they first started using it, the rationale, and the circumstances around their initial work, we also asked: Who started the process? (2.7) Why did you integrate ICT? (2.6) What role does ICT play in parent involvement at your school? Are parents somehow involved in the process of integrating ICT into education? (2.12)

### External reasons

The schools identified several different kinds of immediate cause, including government, principals, teachers, and parents. These are the external reasons.

- There was a government push to use technology in primary schools.
- Digital technology is an increasingly important part of our society.
- Children use technology as a lifestyle now
- Some argue that children's brains are wired towards technology and its use.
- The school was part of a collaborative project using ICT
- An IT company provided the opportunity to begin using ICT.
- There was a mandate from the governors and the parents association in the school, to be a 'future' school.

[17] numbers indicated after each question refer to the original questions of the questionnaire, see Appendix 2

## Internal reasons

Some of the reasons given originated from the school leaders and teachers themselves, because they were becoming aware of the value technology could bring to their own work. We identified these as 'internal reasons' because the pressure was not coming from outside the school, but from the staff themselves.

- New leadership in the school focused on strategic development of ICT.
- Informatics/Computing/Technology teachers introduced it as part of their approach to 'thinking skills' development.
- Teachers were discovering research and development on digital technology innovations for schools.
- There was recognition that ICT improves the effectiveness and efficiency of the teacher's work.
- It was clear that ICT could speed up the process of writing grades for students in descriptive form, and this meant it was necessary to use computers for editing.
- Younger teachers were pushing the limits of what can be done in class.

## Educational reasons

However, the most powerful statements were the many educational reasons the schools put forward, as teachers and leaders became aware of the range of opportunities being opened up for improving teaching and learning with technology.

- A group of teachers saw what it could do for the curriculum; others followed or used interdisciplinary projects, and explored what could be done in different aspects of teaching the curriculum
- The potential of ICT and the benefits to children and their families.
- It serves so many aspects of the curriculum and the skills of lifelong learning and powerful tools to learn, create, communicate, collaborate, and think.
- ICT is relevant in all of our lives and children must understand how to use it well, e.g. to gain a deep understanding of something because of the interaction with ICT; not to trust media without criticising it; to understand the responsibility of saying something in a social network.
- ICT improves the quality and effectiveness of the learning experience for all children.
- It makes possible access to some learning experiences that are otherwise not feasible (e.g. through virtual worlds and digital simulations).
- Children can use communications technologies to interact with children from all over the world.
- It supports and encourages children to develop independent learning skills.

## Highlights

> We are equipping children for a society where technology is increasingly prevalent. Our children are using various forms of technology at home and it is important that they understand their use and are safe when doing so. S37, Hackney, UK

> ICTs should be used in primary school as they are widely used in all fields of person's life. To properly apply ICTs is one of the major and necessary outcomes of primary education.
> S18, Moscow, Russian Federation

> ICT teaching material can be more visual and experimental; useful information can be found more easily; it strengthens students' motivation; and better results are obtained using ICT.
> S12, Lithuania, Russian Federation

> It motivates learners to be active and learn independently, it motivates children, and allows them to progress in a personalised way. S10, Budapest, Hungary
> It is very important for fostering students' creativity, cooperativeness, self-esteem and for self-directed learning toward future learning environments. It enhances the learning opportunity by providing indirect experience where direct experience is not feasible.
> S16, Jeollanamdo, Republic of Korea

We show children that computer technologies can be used not only for games but also for creative and thinking activities, for learning and for transforming their ideas and dreams from a real world into a digital reality. S7, Prague, Czech Republic

We read Papert's research on Logo language, and were incredibly surprised by the idea of using computers in a constructivist way. Logo was amazing: a very powerful tool that seemed to fit all the ideas we had about kids interacting with knowledge. The first results were so encouraging that we used Logo language in primary school classes.

S2, Rio de Janeiro, Brazil

## 1.3 The 21st century school environment

### Objective

To be aware of the technological sophistication of the modern primary school

### The questions asked

To clarify what kind of ICT schools are using, and how the environment is organised, we asked: How is the space, classroom, environment at your school organized to facilitate the integration of ICT? (3.1) Do you allow children to take technology from school home? (3.7) and Do you allow children to bring their own technology to class? (3.8)

All the schools we consulted were primary schools, although some took children from 3 years, and the broadest range included children in upper secondary school.

Our schools were proud to describe the range of IT infrastructure, hardware and software they had established now for their learners, teachers and parents. These were not especially privileged schools, in the main, and often had a diverse intake of learners with different nationalities, first languages, and a range of special needs served within a philosophy of inclusiveness. However, by recognising the value of ICT for their learners they have established impressive facilities, typically making a strong link from the pedagogy to the technology, as in the quote here from one of the schools.

### Highlights

The innovative use of technology enables teachers to implement a rich and rigorous academic curriculum focusing on meeting students' individual social, emotional, and learning needs. Students are engaged in challenging learning empowered by interactive and mobile technologies inspiring higher order thinking, creativity, communication and collaboration, and solving real-world problems. The classroom learning environment has a blended digital toolkit that includes iPads, iPod Touch devices, MacBooks, Nintendo devices, and IWBs. This digital toolkit enables them to select their preferred tools for learning, individualizing how they access information, collaborate, express themselves, and share knowledge.

S35, Arlington, USA

We have put in bold the forms of thinking and practising that build the 21st century skills that many countries have now recognised as critical for all learners.

### Types of IT provision that are common

We have aggregated the most common forms of ICT provision under the headings of IT infrastructure, ICT for teaching and learning, and the varied ways in which schools provide their students with access to ICT.

IT infrastructure

- Server technology is in place.
- IT is used for management and administration.
- Email and diaries are shared across all staff.

- Schools use high-speed Internet access and wifi.

ICT for teaching and learning

- Classroom hardware includes: interactive whiteboards, desktop PCs, visualisers, digital audio and video equipment, Easi-speak microphones, iPads, iPod Touch devices, MacBooks, tablets.
- Types of educational software include: 3D animations, films, virtual experiments, digital educational games.
- IT infrastructure for teaching and learning provides a virtual learning environment (VLE) or learning management system (LMS), which are commercial products specifically designed for teaching and learning.

Access for students

- One-to-one provision is offered in at least some classrooms; most schools aim for 1-1 tablets for at least some of their students.
- Most classrooms have computer access.
- Rooms with computers are available for students to access for independent learning and project work.
- Many students have computers at home for study, so before- and after-school clubs are made available for children who have no access.
- Schools also try to motivate families to provide home access by setting tasks with ICT use for homework
- Many schools have a Learning Resource Centre with computers available for booking by teachers and students.
- Notebook computers and tablets are used in learning spaces within the school to allow learners to continue using their own computers (BYOD[18]) and the wifi network during lunchtime and breaks.

[18] Bring Your Own Device – recognised now as an important enabling feature of a school's technology provision.

## Using the Virtual World Minecraft in the learning environment

Burnt Oak Junior school is a two form entry school based in Sidcup in outer London, UK. The age range is 7 to 11 years.

Minecraft is a game about making and placing blocks in a 3D world, which the player can navigate as an avatar. The blocks can be made of all kinds of materials and textures, representing all kinds of objects. Students can be players in an existing game, or they can design their own, working together to create wonderful, imaginative scenarios in a virtual world. The school has its own Minecraft Server which means that only pupils and staff on the school network can access it. The strength of Minecraft is that it is a "real time" synchronous networked environment https://minecraft.net/.

This means that:

- all the pupils are in the same virtual space at the same time and can interact with each other and see those interactions happening from different viewpoints.
- their tacit knowledge and ideas are made more explicit.
- pupils can see what others are doing and it is easier to demonstrate how to build objects.

The natural extension of this is that the classroom is, in effect, extended into virtual space and the pupils through avatars can roam and interact in a complex environment virtually.

Figure 1: A Year 5 pupil creating a maze in Minecraft.

Figure 2: Making games, Year 3.

Using the virtual world, learning can be moved on in specific areas such as Maths and English where these fit into Minecraft activities so that the learning is focused on the curriculum through the medium of Minecraft. For example:

- Geometry and shape are two obvious areas which can be explored in Minecraft.
- Pupils have made Maths games for other students consisting of tutorials and questions where they have to answer a maths problem to move on through the game, or see a tutorial if they need help.
- Pupils have also created theme park worlds which were explored by other classes who have written newspaper reports about them.
- Large numbers of pupils are able to interact with each other to solve problems in Minecraft.

The first event where all the classes took part was an exploration of the virtual world of King Midas populated by a group of real actors. The event can be seen here: https://vimeo.com/

user24773172/videos. Pupils used Minecraft to explore the kingdom of Midas and talk to the King, Apollo, and other characters from the tale, gathering clues about the story along the way.

The King Midas world was built for the students, who then worked with actors to build a live show, with characters such as Apollo with Digital Leaders giving instructions to each class on how to find out about the story using the clues in the game. Some of the children then presented to the whole school what they had found out, with others writing up the story as a news report, all of them using the environment to develop their literacy skills in a way that was meaningful to them.

Figure 3: Exploring a rainforest.

Figure 4: Building a virtual world.

The students have also designed games in Minecraft that have specific learning outcomes, such as a problem to be solved or a concept to be learned.

One example is creating a game with blocks in different ratios, and setting interactive tasks that test whether the player can construct other blocks in the same ratio. They also create tutorials to help those who cannot do it, so testing their own knowledge and understanding. Other pupils are then using these games to support their learning.

In this way the students can use the virtual world to set up problem-solving activities or modelling scenarios for other students, and both consolidate and pass on their own knowledge and skillsets.

Figure 5: Playing an educational game designed by older pupils.

### Less common provision

Some schools were well ahead of others in terms of the types of devices and software they were using, including:

- Hardware: interactive tables, Nintendo devices, handheld digital microscopes, flip cams[19], roamers[20], beebots[21], scanners.
- Learners' own mobile phones for using calculator tools, GPS[22], etc.
- Tools and resources: Digital grading-books, digital maps, task editor program, language lab, movie maker, Photoshop, blogs, Facebook, a repository of sound material, the school's own Radio and TV system, Mozaik Kiadó's digital learning materials[23], Touch Pads.

### Restrictions in operation

A few schools operate certain kinds of restriction on the use of computers or the Internet, but these were less common.

- Computers are available only in computer labs in some schools.
- Access to the Internet is forbidden in some schools, which provide access to digital tools and resources only through the LMS.

### Blending ICT as a natural part of the learning day

The word 'integration' is often used to characterise the way a school conceptualises its ICT use. As equipment becomes more ubiquitous, ICT is no longer a separable part of the curriculum, in a special place, but enhances all aspects of the curriculum in every classroom, in every subject.

### The school philosophy as a context for learning technology

Where the use of learning technology is harnessed to a strong and distinctive school philosophy, the school contributes to its community in impressive ways.

### Highlights

> School-based sport / Intensive English / entrepreneurship, programmes suitable for children with moderate disability; 11 micro-enterprises of which 6 are run by boards of students and operated entirely by students according to the entrepreneurial approach. Primary school is a great time to equip students with ICT skills: they have a predilection for learning so we put ICT in their hands and present a multitude of educational activities to be realized with them.
> S6, Magog, Canada

> Grades 1-4 Primary; we try to follow the Dalton principles: liberty with responsibility, independence and cooperation. From 1st grade we include Informatics, English language, and Drama. We were chosen to become a training centre in the project Club of Modern Teachers. We organized courses for the public (retirees, minorities, women on maternity leave, Primary school pupils) and provided Internet to the public.
> S23, Lieskovec, Slovak Republic

> Our school has its own educational program named Active school. It focuses on active learning, with active students who want to discover the world and gain knowledge through projects, games, other activities, contests etc.; students should be learning mostly at school; what makes us different from other schools is our emphasis on active approach of students at school; we involve parents and public in the school life. We give high priority to using ICT in all subjects.
> S22, Bošany, Slovak Republic

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[19] Small digital cameras for photos and video.
[20] Educational robots
[21] Programmable robots for schools
[22] Global positioning systems.
[23] http://hu.wikipedia.org/wiki/Mozaik_Kiad%C3%B3 (in Hungarian)

A focus beyond the school to the community is common for these schools, so they are also likely to have an IT-supported relationship with the parents as well.

### Links to parents

The school LMS linked to the children's homes supports a continual two-way dialogue with parents, keeping them informed about activities in the school, establishing a relationship with the child's teacher, enabling them to track their child's progress and integrate their homework with their school work, and even contributing to the work of the school or the class.

- The VLE is accessible to parents and students at home.
- Parents Associations fundraise for technology devices and financially support further expansion of the ICT equipment in schools.
- Parents see their child's work through the school website used to display student products.
- Parents' can access the VLE means to track their own child's progress through the digital grade-book, participate in surveys, and follow the school's activities through the online journal, weekly neswletter, and teacher and student blogs.

### Highlights

> We keep parents informed through our website, and school blog, for which we won an award for 'Best Whole School Blog Site' and which had 84,000 hits!! We survey parents about what ICT we do well and what we could improve. S34, London, UK

> ICT is incredibly important for letting parents know what is happening and for showcasing what we do, whether it's a text messaging service, or a website it has to be updated and have a consistent message. S37, Hackney, UK

> I recently held a Parent Information Evening explaining to the parents how we intend to extend learning beyond the classroom and how they can become involved in this. The response was very good and I keep responding to any queries that the parents may have in this regard. S25, Johannesburg, South Africa

> The introduction of the Internet-based digital grade-book was a big step in making parents accept ICT in school life. S9, Szeged, Hungary

> Year group and class blogs are used to share learning with home and parents are encouraged to comment and respond on the blogs. S31, Dubai, UAE

> Parents can contribute to various projects in the classroom, offering service to the school website. S3, Québec, Canada

## 1.4 Support for teachers

### Objective

To be able to plan for supporting teachers in the use of ICT text

### The questions asked

To understand how schools set out to support their teachers in the process of innovating with learning technologies we asked: How do you keep the staff motivated to integrate ICT and to keep learning new technologies? (2.11) What type of technical support is available? (3.3) Who is looking after the technology? What type of daily support is available to staff when they want to try "something new" in their classrooms? Is there any help available? (3.4) Do you share technology with other teachers in the school? (3.5) What access do teachers have to ICT after school hours? Who provides them with this access and why? (3.6)

Innovation in teaching and learning is driven by the teachers in the schools we surveyed, and they are well supported to do so, in terms of personal, pedagogical and the technical aspects: they have personal access, a collaborative environment for experimentation and learning together, pedagogic support for developing the best ways of working with students, and technical advice and guidance. Here we summarise these responses from the schools.

### Common forms of personal access

There is a variety of ways in which teachers are provided with their personal access to computers:

- Every teacher is given an iPad, laptop, notebook, or PC, for shared diaries, VLE, email, and skype to work collaboratively, provided by the school, with online access from home.
- VLE and software is accessible to teachers and pupils 24 hours a day via the Internet provided through a private company.
- Teachers can borrow a laptop or an iPad to experiment with using the apps and to plan lessons after school hours.
- A VLE or LMS is provided for teaching and learning, through which teachers assign work to students, respond to their queries, do Instant Messaging with students, and give students access to resources and homework at home.

At worst they provide their own access through discounted provision.

### Highlights

> All teachers need to use computers after school hours. They plan, write exercises and evaluation, communicate to their coordinator and pairs using computers. Teachers have their own equipment, provided by themselves, with a discount from an IT company.
>
> S2, Rio de Janeiro, Brazil

### A collaborative environment for working together

One of the distinctive features of all these schools is the emphasis on collaboration between the teachers, recognising that the very difficult task of working out how best to use technology in a primary school is more manageable if they do it together.

- Leadership is important for creating the culture of collaboration.
- The leadership acknowledges those who are able to use ICT tools on a high level within their daily teaching practice.
- One school is part of a three-school hub to share resources to communicate, collaborate and create.
- Skype and network tools enable teachers to work collaboratively.
- Team teaching helps teachers learn from each other, share resources they have found or developed, and prioritise their work between innovating and engaging children.

- There is an emphasis on sharing exemplary projects and integration ideas at staff meetings and at grade level meetings.
- Teachers create support systems and facilitate idea sharing across grade levels and vertical teams.

### Highlights

> We demonstrate ICT tools and emphasise their use across the curriculum, and invite the teachers to give additional ideas of where these tools could enhance their teaching and learning, encouraging a spirit of competition. The the teachers all shared their ideas, which was a big awakening to them. S25, Johannesburg, South Africa.

> To motivate staff, sharing information through teacher training plays a critical role, e.g. methodologies of ICT use, applying appropriate educational methodologies for each level of students with differentiated strategies. Teachers also participate in self-directed online-training. S16, Jeollanamdo, Republic of Korea.

### Pedagogic support

Our schools reported different types of scenario for providing pedagogic support to teachers. There are many ways of doing this, but it is clear that teachers will always need help with exploring new forms of pedagogy, because technology innovations will continue to produce a wide variety of opportunities for improving teaching and learning.

- New ideas are introduced through staff who are already confident or enthusiastic, assisting other teachers when technology is being integrated in a lesson.
- A designated lead ICT teacher attends workshops, or conferences, whenever possible and then disseminates the new ideas to the other teachers.
- The school invites staff members to attend outside ICT workshops and conferences to develop their interest in ICT integration.
- The lead teacher swaps classes with teachers who do not yet have the technology in their classrooms, to let them use the technology and expose their learners to the resources.
- The digital learning coach scaffolds teachers, 1-1 and through team coaching, to facilitate skill building and pedagogical modelling.
- A consultant works with year group teachers who need support, or who want to target specific pupils for their encouragement and enthusiasm.
- The school supports teachers to develop project-based lessons and exposes them to the various IT company competitions into which these projects can be entered. It is good for the school when teachers' projects do very well in these competitions.
- Teachers and students use Dropbox to share work between home and school.
- A school may set up a Virtual Classroom, to enable the creation of a new interdisciplinary pedagogical approach for each project, using computers for research, Web-quests, production work, presentations, and the co-construction of knowledge.

### Highlights

> As more ICT was integrated, the students were more excited, which started a cycle of exploring more ICT and the many uses for it. S35, Arlington, USA.

> To be self-motivated teachers they have to be updated with the latest technologies, and applying the latest software. This keeps teachers on their toes! S26, Dubai, UAE.

> Mutual aid between colleagues is faster and more efficient. We change groups' places to help a colleague use a digital whiteboard, or use co-teaching to help a colleague to achieve results with an application. S6, Magog, Canada.

> Every year the school organizes 4 Professional Development Days of workshops to assure school wide progress in diverse teaching-learning goals. Teachers who have mastered the adoption of different strategies and tools provide workshops to share best practices with their peers. Each teacher has a weekly 40 minutes small group session, for training and support from Techno Coaches. S13, Nuevo León, Mexico.

## Technical advice and guidance

The continual advances in technology innovation mean that teachers are unable to keep up with all the latest opportunities for enhancing student learning, so it is vital that someone in the school has responsibility for supporting not just today's technology, but preparing for tomorrow's as well, and helping the teachers to do the same.

- Schools provide a well-trained technical support team to support staff who are not confident, sometimes in after school sessions, so they can work together over what the intended outcomes are and how to achieve them.
- The technical team must ensure that everything works, discuss technical support with the teachers, and make sure that their questions are answered.
- Technical support includes the assurance of proper functioning of any electronic device, operation of the different modules of the school's technological platform, connectivity and access to content via the data network.
- Recruit the learners themselves as 'digital leaders' (pupil monitors) to take a lead and show staff how ICT can make things easier.
- Develop a technology integration professional development plan, including large group project and skill training, grade level project planning and skill development, classroom modelling, and personal mentoring.
- The instructional technology coach should plan and implement the multitude of professional development sessions to move towards ubiquitous technology integration.

Example of a promising practice 3, S13, Nuevo León, Mexico

## Technology in Grade 1 English

Reading, Writing, and Oral Communication are strands in the English curriculum that are covered over the course of the whole school year at American Institute of Monterrey (AIM). The following exemplars will demonstrate how various technological methods, tools, and applications are used throughout these strands to provide enriched and meaningful learner-centered ways for students to achieve their learning goals throughout the school year.

Being on the forefront of technology in education for some years now, AIM has always utilized ICT integration through the use of mini-laptops, iPods, cameras, video recorders, a Windows Technological Lab, and an Apple Technological Lab.

Having already completed initial DRA Reading Tests (AIM's base reading assessment method across Lower Development), as well as the set-up of our Accelerated Reader program in our Grade 1 classroom, students were already intrinsically motivated to read; having the opportunity to complete comprehension and vocabulary tests online in the Technological Lab every Thursday in our extra Tech Class, as well as on the mini laptops in class, they got to monitor their own reading progression in real-time. The teacher utilized the iPhoto Application on the teacher's MAC laptop to record a video of each individual student's DRA reading test. This video not only acted as evidence of learning and reading, but also became a revision tool for the teacher, should they need additional viewings to complete the test score. This video also serves as a progression tracker, being able to compare and assess progress formatively and summatively. The teacher also added these recordings to each individual student's online portfolio, to burn to CD at the end of the school year, as examples of their learning and take-aways.

Students initially started building their reading goals (i.e. vocabulary, flow, comprehension, expression, etc.), by taking the Star Reader test in the Windows Tech Lab, assessing their reading levels, and then recommending a reading level based on a point system wherein they move up the scale based on their test accuracy. Students were already very eager to read more and more each week, as they wanted to increase their reading levels, and frequently rotated through our five mini-laptops taking specified reading tests through the Accelerated Reader program during guided reading sessions, reading workshops, center rotations, and free-time if students took that initiative. As the iPADs were introduced, we downloaded the Accelerated Reader APP across our 6 iPADs. We also added the teacher's personal iPAD into the learning-tool bucket, increasing exposure and technological learning opportunities for as many students at any given time, as possible.

Teachers have extensively used the Key Note Application to pre-plan a grammar lesson to facilitate through the classroom projector. This application allows teachers to copy and paste images and text into Key Note's slides, as well as to create images, text, etc. The slide provides an excellent example of how the students' learning objectives and success criteria are clearly stated at the top of the lesson slide, here being to identify and use personal pronouns accurately in sentences, as well as having examples below for hands-on practice application.

This activity also allows students the opportunity to practice other English skills such as reading, reading comprehension, grammar practice of previously acquired rules (i.e. identifying the subject), handwriting, spelling, and oral speaking (reading the sentence aloud). Sentences could also be created cross-curricular by basing them on a theme being covered in any of the other subjects, such as Math or Science, always reinforcing themes, concepts, and vocabulary, to help students integrate knowledge and skills more frequently and effectively. The use of the Key Note slide allows the teacher the flexibility to sit with students as an integrated

member of the classroom community during the lesson, as there's no teacher-whiteboard-writing required, and/or movement around the room to help with behavior management or lower ability fillers whenever needed. As there is no real-time wasted on the teacher scribing that information on the whiteboard every lesson, the teaching contact-time is maximized all for student-centered learning and practice. Students are eager to participate as everyone wants to volunteer to go and scribe on the whiteboard, meaning that everyone is engaged all of the time. This type of activity also provides immediate formative assessment of how students are acquiring and integrating the new information.

Part of our Non-Fiction strand in Grading Period 2 was to learn how to look-up and form definitions for vocabulary. The first part of the lesson is independent, where students are reading their non-fiction Accelerate Reader books (already differentiated based on their reading levels) independently for 10 minutes.

Students were then asked to make a list of 3–5 new vocabulary words that they didn't know the meanings for. At that point, students were asked to work in small groups, using the iPAD's and mini-laptop's Dictionary APP and/or the www.wordreference.com online dictionary to research definitions.

Figure 1: Students using various dictionary

Figure 2: Student publishing

Technological Integration across the English curriculum has mounds of options with regards to activities for various communication skills, as well as mounds of applications to choose from (here we sketched only some of them ). The above examples exemplify how teaching English with technological integration can not only take a load off the teacher's work load, but also spike intrinsic motivation sky-high in meaningful ways for students.

### Highlights

> A key point was the creation of an ICT team, made up of members of staff from different key stages within the school. This ensured that we were meeting the national curriculum programmes of study for each key stage but also that there was a member of staff with experience of teaching in the different age ranges. S34, London, UK.

> The Techno Coach team has planning sessions with teachers around their curriculum and the integration of technology within their lessons. Therefore before implementing the new technology in the actual classroom, in any subject or learning area, teachers have tested it in a supportive, safe environment. S13, Nuevo León, Mexico.

## 1.5 The lessons learned

### Objective

To be able to apply the lessons learned in other schools in the use of ICT

### The questions asked

Our schools all have considerable experience in the use of ICT, so we asked them: If you could restart the process of integrating ICT at your school or in your classroom, what would you do differently? (2.10) and How would you like to change the environment where ICT is used to make it more supportive for teaching and learning? (3.9) – which enables us to collect the lessons they learned.

Because the schools in our survey were reflecting on the origins of their use of ICT, sometime decades ago, as well as their current practice, they were in a good position to be aware of the lessons they had learned. Assuming that there is the basic provision of sufficient technology support to make sure it all works, these fell into the principal categories of what the leadership should take responsibility for, and what teachers need.

### Leadership issues

- Recruitment is important, so aim to attract teachers who can work like with learning technologies.
- Remove external constraints on the teaching where possible, to enable innovation to be carried through more easily.
- Set out to learn from the successes in other schools.
- Unlock sites like YouTube, Facebook, Google, as otherwise it is not possible to teach a consciousness of appropriate ICT use to the students.
- Put ICT devices in the library and access halls because it is important for everyone to see the children working on computers.
- Instead of a one-off large entrance fee to pay for ICT at the school there should be a lower cost annual fee per student, to allow more mobility in the application of funds. This would enable them to serve the distinctive needs of classes over time.
- Give a greater role to ICT in development and assessment, as it is very motivating for learners to get immediate feedback.
- Provide more mobile devices with wifi. Fixed equipment is expensive and their scope of use is limited, while mobile devices plus wifi allow more flexible use of ICT.

### Lessons learned about what teachers need

- Give teachers and students one-to-one access as soon as possible.
- Teachers should have received much more attention: they should have received Notebooks prior to engaging them at school with pupils.
- We should have inspired teachers more, by helping them understand that ICT is not necessarily evil, but one of many opportunities to enable the growth of the child's mind and soul.
- From the earliest opportunity, provide consistent and frequent technology training sessions for staff members, so that they feel comfortable incorporating the technology, which can be uncomfortable or overwhelming, making some teachers hesitant to use the technology.
- Provide professional development for teachers to be better trained by external trainers.

- A technician oriented towards pedagogic innovation is needed more regularly in the school.
- Recognise teacher leaders for their contribution to the training of their colleagues.
- Give teaching staff: good conditions for their work, open, public acknowledgement of their activities, a special financial bonus, opportunities to take part in conferences.

### Highlights

> In our experience it takes a cycle of support and inspirational activities to keep staff motivated to integrate digital resources and to keep learning in the ever-changing field of technology for teaching and learning. The cycle begins with inspiring teachers with ideas for student learning and project examples, collaborative planning time for the teacher and instructional technology coach, classroom mentoring and modelling, support for teachers with professional development, the opportunity to reflect on learning and share successes and challenges.
>
> S35, Arlington, USA

> It is a waste of time to search for web sites, evaluate educational software, or offer teachers suggestions. The best way is to talk to the teacher, to understand the critical curricular topics they want to explore. Then present some suggestions and build a learning unit, or a project the teacher feels is important and really fits their needs. It takes some time, because you work with a single teacher or small groups, but gives the best results. This teacher will repeat this experience again, will explain and show it to other teachers, and the process develops much better than if we were doing "our research" for teachers.
>
> S2, Rio de Janeiro, Brazil

## 1.6 Concluding points

We asked our schools and their students to list 5 – 10 key words or expressions to illustrate the use of ICT at your school (2.2). The best way to summarise these is to show the range and also the similarity of their ideas, as a Wordle expresses very well. Figure 1.1 shows their collective response.


Image 5: A Wordle for the words that pupils and teachers used to describe the use of ICT in primary schools. It shows that the most frequent word is 'learning', followed by 'creative'.

From these over-arching descriptions of the context of ICT use in our sample schools, we can now move, in the following chapters, to the detail of what teachers and students do, and what ICT means for their experience of teaching and learning at primary level.

# 2 Technology opportunities

We wanted to learn how schools choose new digital technology and for what. We wanted to see if, in that process, they respect differences in students' learning styles and issues of ergonomics, if and how they use learning management system, how they choose, get, develop, use, and share digital content, what the main challenges are which schools and teachers face, and what are their future plans and needs in this context.

## 2.1 Choosing technology

### Objective

Understand how schools and teachers choose ICT – and what they choose.

### The questions asked

Who is involved in the selection process, what is being preferred, and what is the procedure? How do you choose what technology will be used at your school or in your classroom (4.1) List the categories or types of technologies you are using (4.3)

The study shows that ICTs are being chosen either (a) at the school level, or (b) at the local/regional/city authority level, or (c) at the centralized (governmental) level – particularly for the large supplies. However, teachers often state that if the decisions are being taken outside the school, they are ... less respectful of real and individual needs and ... teachers and school staff have limited influence on the selection process. If it is chosen outside school, it usually concerns hardware (as if choosing software was less important, less costly... some teachers note). When the selection process takes place at the school level, there are often quite elaborate processes to ensure appropriate decisions – carefully considering its values for teaching and learning, respecting the school ICT strategy...

We have noticed that, in the selection process, most schools respect and thoroughly consider the age of children; the safety standards and ergonomics (preferring IWBs with ultra short data projector; considering the weight of the notebooks – if students carry them home; looking for proper, adjustable and comfortable furniture and proper lighting in the classroom...); possible upgrades of software; ease of use... etc. Many schools pay extra attention to 'special education needs' students, sometimes providing them with more powerful and specialized digital technologies. When technology is being chosen at the school level, usually the school management, school board, ICT specialist, ICT coordinator or ICT department, other teachers or sometimes also external specialists are being involved. They usually discuss various options and choose from several competing proposals etc. Teachers who would like to have particular hardware in their classes are first asked to put forward good arguments to get it (explaining how it is going to support their teaching and learning goals). We have also noticed that the selection process often involves... achieving support from the Parents Association.

Some schools run their own internal workshops and seminars or conduct their own research on a continual basis – to understand the trends and development in ICT, and the real needs of the 21st century learners. Thus, they feel competent to choose. Exceptionally, we have also noticed that schools ... try to buy what children may be familiar with or want to use, e.g. Nintendo for reinforcing mathematics teaching.

When observing what is being chosen (not focusing here on any digital content, LMS and administrating tools, or any infrastructure technology which is being treated later in this document), the study shows that most often schools choose:

- Standard hardware including computers, data projectors, IWBs, notebooks, tablets, scanners, printers, cameras, digital visualizers, digital microscopes, microphones and MP3 recorders, headsets, smartphones (some teachers note that... unfortunately, mobile phones are still banned at our school...).

- Standard software including office tools for processing text, tables or presentations, drawing tools, video editors, general or subject oriented educational software, various educational microworlds and applications.
- Less frequently, technologies like voting devices, video conferencing systems, video studio and video editing software, more complex audio equipment and software, video games consoles, MP3 players, educational robotics sets (Lego NXT, Lego WeDo, Knex, Vex...), data logging, sensors and measurement devices, software environments for educational programming and computational thinking development (EasyLogo, Logo Worlds, Living Pictures, Imagine Logo, Visual Basic... ), digital programmable toys and programmable floor robots, software tools to support the teachers' development of their own materials (The Cards, Imagine Logo, Hot Potatoes, Memory Game Maker, Matching Game Maker...), midi keyboards and supporting software etc.

Some final comments and notes:

- We clearly recognize the tendency to move from desktop computers to notebooks, and further on to netbooks, tablets and smartphones.
- In many schools some of the ICT resources are located (and used by pupils) in the school libraries.
- Most of the schools either want to achieve (or have already achieved) the state of having 'technology rich environment', which usually means to have an IWB in every classroom, have each pupil equipped with a tablet, and have enough technology to support all teaching and learning practices.
- Very rarely teachers mention the bring your own device (BYOD) strategy.
- Apparently there is a growing recognition that digital technology is supporting mobile learning.

## Highlights

> ... any ICT tool (a) must be compatible with our pedagogy, support exploration, and encourage thinking, (b) must be flexible to satisfy different age groups and different teaching/learning goals – different age groups share the same premises and equipment, so it´s important that the adopted solutions meet the needs of all age groups, (c) must support working with different kind of data – text, image, music and sound... (d) if possible, should be similar to what children have at home, (e) must have reasonable price, or be free and easily available online, if possible... If these criteria are satisfied, it is easier to meet the needs of all children. S2, Rio de Janeiro, Brazil

> Our technology teachers and IT Department conduct research on a continual basis in order to keep at the forefront of technological tendencies and trends as well as of the needs of digital natives for successful participation as global citizens in the 21st century.
>
> S13, Nuevo León, Mexico

> In deciding the software or hardware, it is a case of meeting with the ICT team and thinking how is this going to support the learning and teaching in a particular subject area. If we don't think it will, we don't buy it. S34, London, UK

> ... we are a leader in the deployment of iPad devices and appropriate apps for personalized learning for SEN students. S35, Arlington, USA

> Seminars and trainings to test new technologies are organized at our school. When the staff has enough information, teachers start discussing it in their methodical groups and consult about the most important needs of students and teachers. After coming to a common agreement and having a plan according to which the new stuff will be used purposefully and effectively, the directress approves the decision to purchase these technologies. S18, Moscow, Russian Federation

> When choosing appropriate ICT, an important factor is... our awareness that learning occurs 24/7, under both formal and informal settings. S13, Nuevo León, Mexico

... we use a blend of different technologies. We use the tool that is best fit for a specific task. The classrooms have access to a set of ... laptops, a class set of tablets with apps for curriculum reinforcement, creativity, communication and expression of learning. We use the built in cameras of the laptops and tablets and a range of multimedia apps to create movies, e books, comics, slideshows, and other multimedia products. Each classroom has an interactive whiteboard. All classrooms have Wi-Fi to access online applications, search engines and applications for communication and collaboration.

S35, Arlington, USA

Example of a promising practice 4, S30,Dubai, UAE

## Space – Digital Learning in Action

As a novice user of iPads within the classroom, I recently made the decision to use a hook day for our new topic 'Space' to explore the potential of these devices and their capacity to engage and enhance the learning of the children in my Year 1 class. Several teachers in KS1 had been talking about a new online platform for sharing learning called Padlet so I took this and tried to incorporate it in a creative and interactive way, where the iPads were not the purpose of the activity, more a vehicle to support and showcase the learning. Here is a Captain's Log account of how it went...

### Padlet – Mission Control!

After the children had completed the various challenges set by NASA, they had to report back their learning to Mission Control. This took the form of a Padlet wall designed to represent NASA. The children in class are very familiar with using QR codes to assist their use of the Internet – typing lengthy URLs is not feasible with 5 and 6 year old children – and so getting to our Padlet wall was quick and easy. We discussed the importance of passwords on the Internet to keep our information safe and finally the children were ready to post online. A simple double tap on the screen and they were ready to write their messages. The great benefit of Padlet is that the messages show up instantly online through the class IWB. This is incredibly rewarding and motivating for the children, as well as a great incentive for boys to write. The children's reaction was incredible. They were encouraging each other as their learning popped up before their eyes. Mission Control has become a regular part of our class and a Command Centre is available to the children who want to share

Figure 1: Scan the QR code and you will find http://youtu.be/8K3XthpXK3c, which leads to a video about this activity.

Figure 2: A spaceship landed in our classroom.

their experiences online at any point. This has been possible because of the children's exposure to QR code reading apps and their awareness of QR codes around school and even on their snacks. Listening to them use this vocabulary so freely and easily is impressive and is a step in the right direction to create a digital learning environment in which technology is embedded and a natural medium for teaching and learning.

I personally have thoroughly enjoyed attempting to make the integration of technology exciting and, more importantly, a natural part of the learning process. I have attempted to use various apps on the iPads before and it has proven difficult for the children to stay focused on that specific app independently. However, during this process, the children were more interested in seeing their communications on the IWB than the actual iPad itself. A success in my opinion.

The children generated ideas and questions, calling on our previous digital learning experiences without any prompting. This included a suggestion to Skype NASA. I was impressed that they understood intuitively that Skype was a possibility despite our previous experience with this being completely unrelated to our new topic.

### Tuesday 20 February

7.30am: A message from NASA is received by 1RH. It is delivered to the teacher at morning collection time. What could it say? Why would NASA write to us?

7.40am: The children arrive at the classroom and are confronted by a silver rocket ship in pieces in the middle of the room. Caution signs and warning tape covers the doorway and various activities are laid around the room. The conversation starts... 'What has happened?!'

7.50am: Mission Control at NASA have made contact. They have lost a rocket. They have no idea where it is. They do not know where Earth is. What order are the planets in so they can tell their astronauts in space where Earth is? What will 1RH need to rebuild this rocket? What will you need to take with you to help you in space?

8.00am: Collaborative brainstorm and problem-based learning activity, using the Padlet app on the iPads to communicate with Mission Control and share ideas to solve the challenges set by NASA. The clock is ticking… can we save the day and set the astronauts on their way?

Figure 3: NASA needed help to find the planets.

Figure 4: How can we rebuild the rocket?

## 2.2 Integrating LMS

### Objective

To understand how teachers perceive LMS and how they use it or plan to use it?

### The questions asked

Does your school make use of a Learning Management System? Could you provide details of how is it used and why? (4.4)

The study reveals that a deeper understanding of the potential of ICT to support learning and development of the pupils manifests in seeking and demanding higher functionality of the supporting ICT, including technical infrastructure and learning management system. Four levels of development can be recognized here: (1) few schools do not use any LMS and are not aware of its need so far; (2) some schools are still not using any particular system but already practise some of its basic functionality – like simple file-sharing and e-mail communication; (3) some schools have already started using an LMS, mostly for posting homeworks and teaching materials, and for communication with their pupils; (4) many schools are profound users of wide functionality of an LMS. They most often use it:

- For teachers – to post assignments and homework; to manage, spread and share primary and supplementary digital content; to collect the pupils' work; to support and administer the teaching/learning process (engaging e-portfolios, e-record books, e-diary, grading lists, weblogs, webinars...); to post and share school news and achievements etc.
- For pupils – to help them administer their learning and personal development; to facilitate their cooperation and collaboration in projects; to post their work, solutions, and products; to communicate with teachers and with peers etc. Younger pupils often have one common class login; older pupils usually get personal login and password.
- For parents – to observe the learning content and progress of their children; achievement and assessment (e-portfolios); to get into home-school communication etc.

Most often schools use standard LMS platforms; sometimes they develop their own solution: The school has a very extensive LMS developed in-house by our IT Department, in response to our student-centred philosophy.

### Highlights

> Here, pupils and their parents can find the homework as well. If anybody is missing, he or she can see what is going on in the classes and what the pupils are asked to do or bring from home. Parents can also see the assessment of their children or any comments from the teacher etc. S22, Bošany, Slovak Republic

> Everybody has his or her login and password. I publish there all assignments with the solutions that they did in the class on the IWB. In the class the assignments are usually being solved by all of us together, children can re-do the same by themselves at home and thus deepen their knowledge. They can also find all presentations that I have used in the lessons, there; they can use them to practise for the next lessons. Electronic record books are also available there. S22, Bošany, Slovak Republic

> Students are able to administer their learning and parents may participate in this process. One of the modules is the Child Achievement Tracker, where timely information on student performance is stored, including Numeracy, Literacy and Social-Emotional Growth Charts, the Student Development Plan, Educational Progress Reports, Standardized Testing Results, etc. Students are able to access their personalized schedule, homework and project modules, wikis, etc. Each teacher also has his/her own webpage with course content information. S13, Nuevo León, Mexico

> Primary pupils know how to enter the virtual learning environment, use the educational materials that are posted there, write comments and evaluate them... That is why we are aiming

to create convenient virtual educational environment and in this way help pupils and students learn in a more interesting way. S18, Moscow, Russian Federation

## 2.3 Respecting differences

### Objective

Identify how schools and teachers respect different learning styles, learning barriers and issues of ergonomics.

### The questions asked

To what extent do the learning styles or learning barriers of students play a role when selecting technology to be used? (2.2) Ergonomics look at what impact the use of technology has on the human body: In what way does your school take this into consideration when selecting equipment? (2.5)

The study shows that most schools and teachers are aware of the importance of respecting the individual needs of their pupils, and to consider these when choosing ICT. They know that digital technology facilitates respecting the differences in learning styles and multiple intelligences. However, some of them admit that current economic factors deprive them from doing so at present... the goal is to get basic technology into classrooms first.

By selecting a wide range of technologies, schools respect diversity and individual differences: they encourage pupils to manifest their learning through text, music, graphics, audio, or video formats, individually and collaboratively. ... in addition, software is purchased to support pupils' learning according to their readiness level, whether the pupil is high end, low end, or average. Rich selection of technologies also facilitates multiple... languages and representations. Schools prefer to select technologies, which stimulate attention of the learners, like ... presentations provided with audio support. As we observed, many schools try to verify their instructional styles to meet their pupils' learning styles and multiple intelligences. They tend to combine video presentations, pictures and diagrams (for visual learners), auditory activities (for aural learners), hands on activities (for physical or kinaesthetic learners), common group work (for social or collaborative learners), and individual assignments (for intrapersonal learners).

Some schools have extensive experience in implementing particular digital technologies (for example tablets) for supporting and motivating differentiated personalised learning for pupils with special needs. Teachers often mention that digital technology can help diminish (growing) gaps among pupils of different needs, giving each of them better chance to find a way, and a format, to express herself or himself.

The age appropriateness is also comprehensively considered when:

- Selecting furniture – schools prefer adjustable tables and chairs,
- Building a digital environment in the classrooms and schools – especially considering the lighting of the rooms... protecting children's sight, the way data projectors and IWBs are mounted, the weight of the notebooks, the size of the keyboards and the mice, preferring wireless mice, keyboards and headsets... because younger children often forget and walk off from the computer with their headsets on, breaking wires and frightening themselves.
- Respecting health and safety issues – we make sure that children experience a wide range of different activities and spend the time in front of a computer efficiently.

However, teachers are aware that it is difficult to meet all those requirements if... equipment and premises are shared by kids from 7 to 15 years old.

### Highlights

The same criteria applied to any other learning materials and activities that are applied to ICT tools: whenever possible, we try to use different representations of the same concept, different languages to express the same idea. When pupils are "translating" from one language to another, and authoring something while learning from different sources, they achieve better understanding. The variety of tasks, languages, materials and examples also play an important role for teachers to meet the needs of all kids in one classroom: usually kids have different learning styles. S2, Rio de Janeiro, Brazil

All our students have Arabic as their first language and they all learn in English. Careful consideration towards the bilingual nature of our school is made when selecting hardware and software. S30, Dubai, UAE

Jamestown is a leader in the deployment of iPad devices and appropriate apps for differentiated, personalized learning for students with special needs. Students with autism are able to make choices, communicate needs and to demonstrate what they know and are able to understand using the iPad. Jamestown's success with iPads in special education is now replicated across the county. S35, Arlington, USA

Inherent in our pedagogy is the choice for students to access resources that meet their learning needs and different learning styles. The use of technology to differentiate learning gives students more choice in how they learn and what tool they will use for that. There is also freedom in how students select to express themselves and their learning with a flexible setup of multiple technology resources. S35, Arlington, USA

Equipment is chosen that will limit negative effects on the human body. Tables, keyboards, etc., are tested many times before implemented in our school.
S8, Santo Domingo, Dominican Republic

Given the nature of mobile devices we regularly use, they are flexible enough for students to be comfortable and mobile, so the issues are not so obvious. S31, Dubai, UAE

The administration buys its equipment and furniture from [removed]. A lot of conditions are considered to prevent any harm to the users. For example, chairs must fit every student to feel relaxed at class. Tables must be at a height that helps students write properly. Computers are placed on desks where users can easily type at the correct height. Science Labs are provided with safety tools. Fire alarms/extinguishers and digital cameras are placed in every school section. S28, Dubai, UAE

Special equipment is provided for pupils that need a larger sized keyboard, input devices for communication, and furniture arrangements are appropriate for each grade level. As technology is available in the classroom, the adjustments are done according to personal needs.
S35, Arlington, USA

## 2.4 Digital content: Choosing and using

### Objective

Understand how schools and teachers choose digital content, and what they use it for.

### The questions asked

How do you choose the digital content for use at your school? Do you have a set of selection criteria? (5.2) Which kind of digital content do you use? (5.4)

Only rarely do schools have an explicitly formulated system of selection criteria; they often rely on the previous experience and critical judgement of their teachers – new content should achieve

their objectives (although, a few schools have a sophisticated formalized set of rubrics). The school leaders and ICT coordinators often play an important role. Most of the schools carefully consider the learners' needs and skills level, and whether the tool or the content will support their learning and development; they always respect the age and particularly the developmental appropriateness of the content to be selected. The selection process must always be sensitive to the cultural and religious beliefs of the community, must follow the ethical and moral values of the school and, must be compatible with our pedagogy, S2, Rio de Janeiro, Brazil. It always has to fit properly and clearly into the national curricula – by the quality of the content and its appropriateness for a particular purpose. Some teachers complain about the attitude of their educational authorities or school administration, which considers... only hardware to cost money and it is often up to us to get the content. In some cases, the content is selected centrally for the whole country or at a regional level. Some schools report that for them the possibility to localize and adapt the content is of high importance. Some schools also consider whether the content also includes additional... audio-visual stimuli that will allow pupils to retain the information by engaging several senses.

When asked which kind of digital content they use, teachers most list digital libraries, multimedia resources (pictures, videos, animations, sounds, songs), educational applications (simulations, microworlds, sequencing programs, subject-specific apps, games, interactive microworlds for developing skills), textual documents, presentations, web pages, activities for IWBs, comics, puzzles, animated fonts for pupils' presentations, web sites, e-books, audio books, professional content for literacy, numeracy and science etc. They also name general creative tools and environments like music editors, photo editors, text editors, (collaborative) story telling tools, brochures editors, writing practice tools, web blogging tools, or various content sharing tools and platforms.

## Highlights

I learn about new content through networking on Facebook, Twitter and LinkedIn and also by attending conventions and courses. ... I always try to keep the learners' needs and skills level in mind and also whether the tools or content will help their learning or not. It does not matter if I am personally impressed with it, but if the kids won't be able to use it, it won't assist in teaching and learning. S24, Bloemfontein, South Africa

It is certain that we often rely on the critical judgement of teachers in the choice of the digital content to select. S6, Magog, Canada

If we have a need to be met or a recommendation of excellence from colleagues or from other schools we will investigate and assess its usefulness to us. S29, Dubai, UAE

Digital content... must be compatible with our pedagogy. It means that software should be interactive, should allow different actions, and kids should be inspired to explore without having to give only correct answers. S2, Rio de Janeiro, Brazil

There are not enough high-quality materials so I use whatever appears in my hands and what I manage to design myself (videos, self-programmed software applications, database stuff, analysis of questionnaires etc.). S7, Prague, Czech Republic

... we also use more than 250 apps for iPods and iPads for students to work with in all subjects; and also a myriad of web sites discovered, shared and verified by our teachers... S13, Nuevo León, Mexico

All of our new textbook implementations come with digital textbooks, video resources, shared documents, and shared resources for IWBs. S35, Arlington, USA

## Developing computational thinking

1st grade students experienced a pleasant event: at the beginning of the school year they were matriculated and welcomed as 'new students of our school'. School management gave them a precious gift – a programmable toy Bee-Bot. 1st graders were already familiar with the toy from their kindergarten. They were really pleased not to get one or two Bees – they got the whole beehive!

Last year I taught 2nd grade students who did not know the Bee-Bot from kindergarten. I was glad we could borrow the toys from 1st grade. At the beginning, my students played with the toys intuitively, by trials and errors. They built hideouts and parking lots; they tried to program the Bees to get to a designated place.

Figure 1: One team builds the maze, the other team programmes Bee-Bot to get through a maze from Š (Start) to C (Goal).

This stage helped me a lot since the students themselves discovered how to use toys and how to programme them. I just helped them to fill-in few blank spaces. After the initial lesson, I prepared a mat for the Bees to move on. During the reading lesson, the Bees were supposed to help us read carefully and comprehend the text. Most of all, Bee-Bot toys help students to develop their algorithmic thinking and therefore it seems that it is intended to be used at Informatics only. However, they are suitable for every 1st grade topic. With Bee-Bots, students can train various skills related to many different subjects, develop logical thinking and learn how to work in teams.

Figure 2: Digital programmable toy Bee-Bot develops reading skills.

At first, students helped themselves with pen and paper where they noted the commands. One student moved the Bee-Bot on the mat; other children in the group decided which

command to enter to make the Bee move along the track. Later we played a game of riddles. Students worked in groups. First, they noted down a sequence of buttons to push on the paper and other group guessed the corresponding path of the Bee. After guesses were made, they checked if the other group was right by entering the commands and releasing the Bee. The biggest problem was to master the turning commands since children expected the bee to turn AND move to the next field as well. However, they soon discovered that another command is needed to move the Bee to the next field. We did not even notice when and how the children established their own system how to program the Bee without pen and paper. And it was ingenious indeed – they moved the Bee over the mat and simultaneously pushed the buttons. All worked well. We had a lot of fun with Bee-Bots. We have used them during various lesson many times.

This year we are already in the 3rd grade. Bees grow up with us. Together we discover the space, we learn how to read, write and do arithmetic, we navigate through mazes, we look for and correct bugs in various assignments. Students are naturally competitive and they enjoy challenges. For example, the challenge is to get the Bee to a designated place in the shortest possible time. Now we do not need to move the Bee by hand anymore and enter one command at a time, we enter the whole sequence in advance.

Programmable Bee-Bots are very popular among primary school students. When they use them, they are playing and they do not even realize the enormous amount of skills and knowledge they acquire. Even the lower achievers experience success. It is incredible to observe how the vision of J. A. Komenský "Schola ludus" comes true.


Figure 3: Students create various pictures with a drawing program and use their products in the next activities.

## 2.5 Digital content: Getting, buying, sharing, and developing

### Objective

To understand how schools and teachers get, and share, digital content.

### The questions asked

From where do you get your digital content? (5.1) Do you share ideas of how to get the digital content you are using with other schools? (5.6) Are you, your colleagues or your students involved in the development of any digital content? (5.9) Do you use any open source content (like open courseware, open resources, digital content distributed on creative commons licence etc.)? (5.5) Who pays for the digital content used at your school? (5.3)

The study shows that concerning the source of the content, four different models can be identified (and their combinations): (a) schools, school districts or school networks purchase or subscribe from different digital content vendors, (b) schools get general access to on-line libraries of digital resources provided by the government or regional/local educational authority, (c) teachers (or pupils) develop their own content (presentations, tests, flashcards, worksheets, texts, games, interactive programs – microworlds ... ) then share it with other teachers and other schools (some of them note that this is the only choice for them to have what they find appropriate for their pupils, some others say they do that because of the lack of financial resources), (d) teachers search for free Internet content (educational portals), sometimes configuring what they find to their own needs.

If we examine in detail the issue of developing their own content, it is mostly done by teachers, sometimes also by pupils themselves (under the guidance of their teachers).

By teachers: when preparing for their classes, teachers create new learning materials for learners, then they often post this into the school's digital library or school LMS to distribute and share. Then they often share their product with other schools... I share my own sets of photos, Scratch programs, TV news, and movies for parents, mind-maps, videos, podcasts, presentations, tests and quizzes, games... Some teachers are involved in an initiative or a project focused on the development of the digital content sponsored by the government. Most of the teachers believe that such approach should be supported even more intensively. Some teachers also want to develop their own software applications. I run a workshop to demonstrate to other teachers and students how to make their own podcasts and vodcasts. S25, Johannesburg, South Africa

By learners: in some schools, pupils develop their own e-books, animations, videos, and presentations... and then publish them on the web. Such development can be used as a communication vehicle for home-school connections as well (S35, Arlington, USA).

Another important issue is the financial model for getting the digital content. These are the most frequently mentioned sources:

- School budget (school academic budget, library media budget, ICT budget, student fees... ), the Parents community budget etc.
- Budget of the school project or projects.
- Regional school district, local or state government.
- It is free, available on the web or developed by us teachers, S2, Rio de Janeiro, Brazil,
- Sometimes, a small fee is paid by the teachers themselves (S15, Torun, Poland),
- Social, educational or development funds and programs,
- Free of charge from a publisher.

Our study also shows a growing concern of the schools about the copyright issues of the digital content they use. The schools are significantly interested in so-called open content[24], a neologism coined by D. Wiley in 1998 (see L. Grossman, 1998), as well as open educational resources[25] (resources distributed under non-commercial and verbatim licenses).

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[24] In its short existence, the term has already shifted in meaning considerably, currently being characterised by the so-called 4R framework for assessing the extent to which any particular content is open:
1. Reuse – the right to reuse the content in its unaltered / verbatim form (e.g., make a backup copy of the content)
2. Revise – the right to adapt, adjust, modify, or alter the content itself (e.g., translate the content into another language)
3. Remix – the right to combine the original or revised content with other content to create something new (e.g., incorporate the content into a mashup)
4. Redistribute – the right to share copies of the original content, your revisions, or your remixes with others (e.g., give a copy of the content to a friend)

See Grossman, L. (1998) New Free License to Cover Content Online. http://web.archive.org/web/20000619122406/http://www.time.com/ time/digital/daily/0,2822,621,00.html. Retrieved 2013-05-22.

[25] Open Educational Resources (OERs) are any type of educational materials that are in the public domain or introduced with an open license. The nature of these open materials means that anyone can legally and freely copy, use, adapt and re-share them. OERs range from textbooks to curricula, syllabi, lecture notes, assignments, tests, projects, audio, video and animation. http://www.unesco.org/new/en/communication-and-information/access-to-knowledge/open-educational-resources/what-are-open-educational-resources-oers/ Retrieved 2013-05-22.

Schools apply various strategies for sharing experiences and ideas of how to get digital content and how to use it. Some innovative leading schools organise workshops, conferences, and open days for teachers from other schools; some of the teachers present their experience at the regional, national or international teacher's conferences, or travel to visit other schools and disseminate their practice. Some schools share their experience mostly inside their institution; some others have a partner school with which they cooperate and share practices, sources, ideas, and the content, if developed by them. Many schools are active members of one or several national and international initiatives and projects, which were presented in Book 1, like ISTE, Microsoft Partners in Learning, Shout, eTwinning, iEARN, etc. and share and learn through those structures. Teachers are often active members of various virtual discussion groups focused on certain topics, including open educational resources or digital content. Sometimes local or regional educational authority runs a learning blog where teachers share their projects and experiences using ICT and digital content

Many schools are members of smaller or wider networks or clusters of schools (like GEMS ICT Network or Digital learning leaders' initiative, RQÉEE – Quebec Network of Environmental Entrepreneurial schools, Independent Schools ICT Integration Cluster, The British Schools of the Middle East etc.) where they share ideas, experience, and resources.

## Highlights

Future Informatics teachers and special education teacher students often develop educational applications especially for our needs in form of various course projects or master theses, which we then integrate into our teaching. S10, Budapest, Hungary

In addition, we build many games and programs in Imagine Logo, and some activities in Hot Potatoes. S2, Rio de Janeiro, Brazil

... we tend to use as much free and open source software as possible, for example Scratch and Pivostickman, Wallwisher, Prezi etc. S34, London, UK

We have started working with creative commons with our students and teachers; we are in the process of adaptation. S13, Nuevo León, Mexico

We are working towards developing iTunes U courses. S1, Aubin Grove, Australia

We use iTunes U for open course resources, videos, interactive books and documents on our iPads. Students create their own interactive books that they share with a global community for others to use and learn from. S35, Arlington, USA

We also make use of on-line software to enable the students to continue their schoolwork at home. We use Britannica online for research and Purple Mash which is an on-line creative tool allowing students to create newspaper articles, pamphlets, drawings, etc. As an online learning platform we use Obami where students can complete tasks set by their teacher, blog and socialise with their classmates.

S25, Johannesburg, South Africa

We create, for example, our own videos on the model situations of human behaviour etc.

S7, Prague, Czech Republic

This is a priority for students to create their own content and share it on the learning blogs.

S31, Dubai, UAE

Our own interactive, multimedia digital content (for example, textbooks or ebooks...) is shared so that students, teachers and parents can download it and use.

S35, Arlington, USA

We receive the content from a publisher free of charge as we provide them with a broad spectrum of testing opportunities and other co-operations. S9, Szeged, Hungary

We organize peer coaching for our teachers, open days for teachers from other schools, trainings, workshops where teachers can share their experience.

S23, Lieskovec, Slovak Republic

Our teachers take part in several web discussion forums. They are members of various virtual communities and clubs. They regularly present at conferences and inform about our activities and projects. Our teachers share their experience with other schools, and they visit schools abroad etc. S22, Bošany, Slovak Republic

... we collaborate in discussing the digital content that we use and share ideas, experiences, and best practices in determining our needs of digital content and the way we get it.

S28, Dubai, UAE

My task is conduct workshops each term with all the schools in our cluster and at these meetings I will present a topic e.g. 'Extended Learning Beyond the Classroom using ICT' and often it ends up with different teachers sharing their experiences using different types of content.
S25, Johannesburg, South Africa

## 2.6 Main challenges

### Objective

Identify the main challenges schools and teachers face while getting, and using, digital content.

### The questions asked

What challenges do you face when selecting and using digital content? (5.7) Do you experience any language issues when selecting and using digital content? (E.g. software in English used in other countries) How do you solve such issues? (5.8)

Schools list the following challenges most frequently:

- Financial issues – costs, time restricted licenses (must be renewed each year or every third year...), most finances spent on hardware... is digital content cheaper?
- Incompatible hardware – sometimes schools have old hardware which cannot run new digital content, multimedia etc.
- Quality issues – some teachers note that the content often lacks real interactivity, is more instructive than constructive and creative, often does not allow students to explore; sometimes its interface is not user friendly and intuitive, ... often only memory games, not developmentally appropriate, simulations and creative tools are rare
- Creativity issues – some highly experienced teachers note they would appreciate more creative software tools and editors for youngest primary children; environments to work with semi-tangible mathematics objects (fractions, numbers... ); supporting tools for teachers (map builder, game creator with imported children images, voices, texts etc.).
- Compatibility with curriculum – lack of high quality digital content compatible with the curriculum, needs of pupils and their learning goals.
- Time demands – it takes too much time to work through the large amount of content available to find the correct bits, often with rather superficial description.
- Sensitivity and respect – sometimes the content does not respect cultural and religious issues.
- Digital safety issues and security of students.
- Suitability of technology and content – digital content and ICT should be selected on the school, class and teachers' level, not anywhere else.
- Language issue – see below,
- Accessibility for learners – students should have access to the content anytime, from anywhere.

The other important issue is the language of the digital content as far as... English language is omnipresent, indeed (S3, Québec, Canada). The study revealed three different conditions and attitudes in schools where English is not the first language of the students:

- Restrictive: For the primary education classes, the digital content has to be presented in the local language... We use software only in Russian... Since my students are functional only in French, my choices are limited only to French content...
- Pragmatic: Because we are a bilingual school (English and Spanish), teaching predominantly Mexican children, digital content in English enhances the educational process for us by reinforcing the use of the English language in all types of educational activities. Our main challenge, however, is finding software for classes that are given in Spanish (Spanish Literacy and Social Studies, in some grade levels)... When using software in English, we need to prepare at home even more thoroughly. We need to make sure that we can handle the software in an appropriate way. We prepare at home so we do not spent time on technical things inside the classroom...
- Positive: Our teachers are trying to work at their English and looking for the ways to overcome the barrier of language...

In native English speaking areas, some minor problems have been reported as well:

> Our issues around language involve accents. Most digital content uses an American accent and some of the really good content is Australian, which also has a different accent to ours. This applies a lot at the lower levels where the children are still learning to read and spell and they are hearing different pronunciations of the sounds and words.
>
> To overcome this we find that we have to keep to material that is British as that accent is closer to a South African accent. We are also getting the children to create their own content: for example, the Grade 4 students created eBooks on the Solar System for the Grade 1s. The books had both text and voiceover so that the younger children, who could not read the more difficult words, could listen to it.
>
> S25, Johannesburg, South Africa.

> Many schools identify considerable lack of resources in other languages: It is not easy to teach in Afrikaans. There are no resources. S24, Bloemfontein, South Africa.

> Actually, we are an American oriented school where English language is the medium of instruction. Therefore, we don't have such a problem. However, we encounter such a problem with the Arabic language course for the sources in the Arabic language are very rare. S28, Dubai, UAE.

## Highlights

> While choosing content for the youngest students, we usually find resources with very superficial texts or very difficult ones. It´s hard to find movies, texts, animations and other resources which have the correct balance of depth of information, details, and the appropriateness of language. ... While choosing games and simulation, sometimes we would like them to have better interactivity. S2, Rio de Janeiro, Brazil.

> A challenge that we are facing and ... that we have been working at with our teachers and students is Creative Commons so that they use digital contents respecting authoring and co-authoring. There is still a long way to go, but every day our students and teachers better understand the sharing, mixing and remixing in their learning process.
>
> S13, Nuevo León, Mexico.

> A challenge with using digital content is ensuring that things such as Java are up to date and that staff have been able to play around with it and train themselves, with support from the ICT team. S34, London, UK.

## Using iPads in the classroom

In August of 2013, I was given an iPad to use in my classroom. Not knowing the potential of what I had been given, I have been researching ideas on how to implement this new piece of technology within the walls of room 4C at the American Institute of Monterrey. It is now January 2014, and I have been successful in using an iPad and helping my students use their iPads throughout the learning process. After looking through many websites, reading dozens of articles, watching a plethora of videos, and of course using iPads in my classroom, I have come up with four general ways that iPad applications (most of which are free) can be used in the classroom: instruction, assessment, differentiation, and as a resource database.

Figure 1: Educating young learners in the 21st century.

### Using an iPad for Instruction

One of the things that we, as educators, know about today's students is that they learn differently from how we did. What worked for us as students, a teacher reading off of a slideshow while we took notes, doesn't work for many students in 2014. Give your presentations life! Use Prezi to create non-linear presentations that allow you to follow the presentation in any order that you wish. Instead of students copying notes, use QR codes to have your students scan information. Engage your class with technology!

### Using an iPad for Assessment

High-stakes testing, whether we like it or not, has made teachers and schools accountable for what students have learned (or not learned). Technology has given us the option to assess students quickly and creatively. Use Nearpod to insert quizzes into your presentations or Socrative to create a quiz and get immediate results. If you are looking for a way to actively assess your students, try Padlet. Create a virtual bulletin border to see what students have learned.

### Using an iPad for Differentiation

With a student population that is more varied than we have ever taught, many teachers are scratching their heads about how we can differentiate for every student's learning needs. The iPad has made this much easier. Differentiating for multiple intelligences allows teachers to take advantage of the students' strengths by providing ways that they can show their learning. Do

you have any intrapersonal students? Have them draft a journal entry about what they have learned using Maxjournal. Interpersonal students? Have them collaborate to create a drawing using Talkboard. Visual spatial students? Have them put together a collage with Frame Magic. Musical students? Have them compose a song using GarageBand. Linguistic students? Have them write and illustrate a story using Story Buddy. Students that just love to talk, talk, talk? Have them explain and record their thinking on a virtual whiteboard using Educreations.

## Using an iPad as a Resource Database

At its core, the iPad is a storage device. Many iPad owners use their personal device to store music, photos, and games. In a classroom, students and teachers can use their iPads to store a multitude of resources. Store digital books or PDFd books in iBooks. Upload notes or documents and have your students write in Evernote, a digital notebook. Listen and watch books come to life with Tumblebooks. Practice math problems with IXL. Create digital flashcards with one of the many Flashcards applications. Build a digital portfolio in Google Drive. Access a dictionary or a thesaurus with a Dictionary application. Record yourself with the digital whiteboard application, Explain Everything.


Figure 2: Using different applications to respect different learning needs.

Students in the 21st century live their lives surrounded by technology. Using technology in the classroom engages students and allows teachers to do many things: to instruct in a way that interests students, to assess learners and get immediate feedback, to differentiate with ease using a variety of applications, and to give access to resources so students can review.

All of the applications mentioned in this essay are free (at the time of this writing). Many of them have paid versions, which cost money. The only exceptions are Tumblebooks and IXL (requires a subscription) and Explain Everything (use a similar free application called Educreations).

## 2.7 Future plans

### Objective

To understand teachers' and schools' plans and envisioned needs.

### The questions asked

Which new ICT would you like to have? What do you plan to get and why? (4.6) What digital content do you wish you had? What dreams or hopes do you have for digital software – which may even not exist at present? (5.10)

Very few schools declare that... generally, we have all ICT equipment we need. Most of the schools have an understanding of the ever-growing need for upgrading, developing, and extending the environment. They have plans to further strengthen:

- Functionality of the school LMS – having more powerful tools to support the management part of the process; to better support pupils so that... we will be effective in getting rid of the heavy books and avoid heavy bags, improving... assessment system, so that surveys could be more uniform and fast.
- Digital infrastructure – extending and upgrading wireless connection in the school.
- The spectrum of technologies – for example, by filling in a missing element like educational robotics; supporting... the high end creative work (like developing iBooks); installing more... gesture based control (with Kinect and X-Box),
- Availability of technology – we would like to introduce tablets to the foundation stage.
- Moving towards mobile learning – to be more flexible.

Focusing on the digital content, most schools wish to have attractive and stimulating learning material for pupils to support their learning; recognizing and respecting individual differences and needs (for talented pupils, for SEN pupils, supporting different learning styles...) – brainteasers, puzzles, crosswords, anagrams, interactive exercises, topic based materials; digital textbooks (which students would be able to annotate and use interactively, at any place) integrated with printed material, (to save time of the teachers, helping them to prepare better for lessons), content that could be easily delivered to pupils via school LMS.

Many teachers would also appreciate digital libraries of multimedia resources (pictures, sounds, videos, presentations), online access to encyclopaedia like Encarta or Britannica, resources of good quality which will comprise materials to be used also on the IWBs. They also mention:

- Developmentally appropriate, intuitive and comfortable versions of general software tools and editors – text editor, picture editor, presentation editor, video and sound editor, comics maker, story book editor, digital musical instrument simulator and composer.
- Developmentally appropriate tools to support and facilitate collaboration and communication (with academic or other partners, national or international), to conduct their own research and thus develop sustainable awareness; to facilitate better online networking between pupils and their teachers (so that they could ask questions, submit assignments, polls, blogs...).
- Specific interactive software tools for pupils to experiment, explore, manipulate (e.g. mathematics and science concepts, objects and relations, using a 3D drawing editor), and discover new "bits of knowledge" easily and intuitively,
- (free) tools supporting teachers to teach, assess, organize, and prepare (develop, build, create) their own content with... map editor, game creator, media and movie editor etc.

Finally, we present a list of short observations and notes revealed by the study:

- costs and licences issues pose a serious problem to teachers in their everyday work,
- many of them struggle with the lack of non-English digital content (as treated in detail earlier),
- if all pupils have tablets with effective access to high quality digital content, they would not have to carry the books and heavy school bags,

- some teachers call for permission for their pupils to use mobile phones in their classes in a productive educational ways (which however is not permitted in most of the schools),
- most teachers call for rich digital environment – with a scanner, a printer, digital microscopes and educational robots in each classroom,
- often the urgent need is highlighted to equip teachers themselves with powerful digital technology (which is not always the case),
- most of the schools go through similar 'stages of priorities': desktop computers – data projectors – notebooks – one to one rich digital environment – IWBs – digital content – LMS – tablets and mobile technology – complex, rich, flexible and omnipresent digital learning environment. Naturally, what some schools and teachers are planning or dreaming about, some other schools have already implemented it, all of it or some parts of it, emphasising and specialising in certain directions.

## Highlights

We would like to build a mobile tablet classroom. We already have experience with one to one teaching/learning, we are satisfied and it works well.

S22, Bošany, Slovak Republic.

As we are initiating the third year of the current lease, we are analyzing the tendencies for the next three years in order to determine the equipment we will need to purchase. Important factors in our decision-making will be our awareness that learning occurs 24/7, under both formal and informal settings. Our objective is to try to assure complementarity and continuity among both.

S13, Nuevo León, Mexico.

I will also be purchasing 20 iPod Touches to be used for outings and to make podcasts.

S25, Johannesburg, South Africa.

Our nearest goal is creating the virtual learning environment at school.

S18, Moscow, Russian Federation.

I would like to have some editors for teachers, like a map builder, where I could draw my own map and overlay different legends and information on it: it would be like using transparent paper to write down different kinds of information into my map. It would be a kind of "my" own wikimapia. I wish I had an easy "game creator", where I could insert children images, voice and text to create puzzles, memory games, matching activities and other simple games.

S2, Rio de Janeiro, Brazil.

We would love to have a cloud based solution that would allow us to share all of the digital products that our students and teacher create so that we can be fully paperless, and have access to a range of interactive, high quality, multimedia books and course materials which are engaging for students while providing a multitude of ways that students can learn.

S35, Arlington, USA.

Image 6: Building an animated Lego movie, frame by frame.
S23, Lieskovec, Slovak Republic

# 3 Technology and pedagogy

We wanted to know how technology is integrated into the teaching and learning processes, how it is used to support the meeting of curriculum objectives and skills development, how teachers use it for preparing and conducting teaching and learning activities, how ICT can help teachers support the development of various learning styles, and how the assessment methods are being transformed in the context of new technologies.

## 3.1 Integration of ICT into the teaching and learning process

### Objective

To understand differences in teaching and learning styles, and the importance of providing a variety of activities for students to choose from.

### The questions asked

How is ICT integrated into teaching and learning? (6.1) We are also referring here to chapter 3 of Book 1, which explored the question What does the literature say about ICT in primary education?

Information and communication technologies nowadays play an important role in the everyday life of a growing part of the world population, and have become an essential professional competency for the teaching profession. While welcoming the open approach to the world allowed by ICTs, it is important for teachers to understand the educational, didactic, cultural and social issues at stake. ICTs are not, of themselves, generators of innovative educational change. They serve the behaviourist, cognitivist and constructivist approaches equally well, and they are conducive to individualistic confinement as well as to more cooperative forms of teaching. The nature and quality of teaching and learning will therefore depend on the epistemological orientations to structure ICT use (Aubé, 1996)[26]. It is clear from our study that an appropriate use of ICT in elementary schools contributes to the development of cross-curricular, as well as subject-specific, competencies. The use of effective work methods and information and communications technologies (ICT) by pupils involves the development of attitudes, such as a sense of responsibility, pride in work well done, discipline and rigor as well as the ability to organize activities and persevere in them and in a form of creativity in action, thus enabling pupils to enjoy the pleasure of work well done (Quebec MELS, 2001)[27].

The study shows that the integration of ICT into the teaching and learning process has a major impact on the teaching styles and on a variety of learning activities. Regarding the pedagogical approaches, ICT enables teachers to create their own digital teaching materials and, as a consequence, is used across all subjects to personalize teaching and learning. Although some teachers struggle to adopt new technologies and accept that they would contribute to enhance the learning experience of their pupils, most answers denote a positive impact of the integration of ICT on the teaching styles, by encouraging more personalized, differentiated, and customized pedagogical approaches to cater for different learning styles (visual, auditive, kinaesthetic), or even special needs. The generalized dissemination of interactive whiteboards often connected to individual mobile devices is also an important element for increased interactive teaching (use as a presentation tool increasing clearness, accessing knowledge, interactive games with pupils, and interacting with concrete and virtual objects, for curricular topics that involve operational thinking). Project-based teaching takes an increasingly important part of the activities in the classroom or informal education (some schools in Canada refer to this approach as entrepreneurial pedagogy). When it comes to evaluation and assessment, ICT provide new opportunities for testing knowledge and skills (e.g. new style of evaluation based on e-diaries), or automatic nominative feedback sent to the teacher from a pupil's tablets when an activity is completed.

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[26] Aubé, M. "Sur l'autoroute électronique, les voyages formeront-ils la jeunesse?" Vie pédagogique, 98, 1996.

[27] Teacher Training: Orientation – Professional Competencies, Gouvernement du Québec Ministère de l'Éducation, 2001 – 01-00868 ISBN: 2-550-38257-9

With regard to learning activities, teachers extensively use technology in the production of their lesson plans, as well as in the learning material and learning activities (e.g. online games, handwriting, typewriting), often involving the production of digital material by the pupils themselves (e.g. video and audio presentations, audio books, interactive stories and animations). Students are also given the option to present their understanding in different ways. Students show their learning according to the way they understand it, developing different products and they learn also to collaborate as well as to use the technical skills of each member in the team. When they present their projects in their class or other classrooms, the student audience has the opportunity also to learn, according to their learning styles.

The study shows a broad variety of learning activities with ICT for either tackling different topics. All topics are affected by the integration of technologies, including PE and diving, since underwater games can be performed on iPads. Experimental science becomes much more accessible through simulations in the absence of science laboratories, while teaching of science becomes a situated and collaborative activity. We saw many cross-curricular projects involving teamwork, investigation, inquiry and exploration, as well as internationally networked projects using Skype conferences] or developing different skills [spatial skills, orientation (up, down, left, right), hand-writing skills, autonomous development and independent study, reading, critical thinking, academic writing, note-taking, reference management, time and task management, decision making, planning.

## Highlights

In ICT education, with more than 25 children in a computer lab, there is predominantly a traditional frontal teaching approach combined with interactive questions and problem-solving tasks. Even though the computer lab is equipped with a data projector, when it is necessary to present or demonstrate some examples, I proceed to ask pupils to come close to my PC station and surround it; to be close to me and to follow my explanation. In such moments, I not only explain a procedure, such as how to solve the given task, but also I ask questions, or I ask the children to prompt, or to suggest how and what I would have to do for the next step. Children can say what they think – being active and thinking about the problem is vital in such cases; for me, it is more important than giving a "right" answer. Some of my questions are very difficult: I very often ask questions that are interlaced with humour with the aim of allowing children to laugh and to relax. I understand primary school pupils are able to concentrate for a short time. I very often ask children to vote about next steps or to guess what to do.

After the teacher's explanation and demonstration, children go back to their PC workstations to continue solving the given task. Each child works independently and individually on his/her PC station. If s/he followed the teacher's explanation attentively, s/he would be able to understand and remember what to do. If anybody doesn't know how to continue, s/he must not ask me "WHAT have I to do because I don't remember what to do?" but s/he must ask another question.

In ICT lessons, the pupils can help each other. A pupil who helps his/her schoolmate can help him/her only verbally (in words) how to proceed without touching a schoolmate's mouse or keyboard. It is also permitted that pupils can verbally (orally) warn his/her schoolmate that s/he has made a mistake in his/her work. If anybody doesn't know how to continue, s/he can leave his/her PC station to look for a schoolmate who could explain him/her verbally how to continue. The principle of helping each other assists in verbal communication between pupils. All pupils respect these principles.

Another principle, which is also very important for a child's motivation and an active approach to ICT lessons, is "concentrate, and don't be afraid to answer questions even though you don't know if your answer is correct!"

Some children need more time to finish their work. I respect that each child works at his/her own pace. At the end of lesson, each child saves his/her work to be able to continue in the next lesson. My pupils are assessed not only for their knowledge, but especially for their effort and diligence.

A few minutes before the ICT lesson is over, pupils must save their work as a file (named by the rule "surname-name-activity") on a hard disk on a central server in order to be able to continue in the next lesson. Then pupils may play computer games until the lesson is over. It is very important that children are not stressed, they have saved their work; nobody works on a computer after the lesson is over (during the break). By viewing the pupils' monitors, the ICT teacher finds out very easily who has saved his/her work: if there is a computer game on a pupil's screen, it means the child has saved his/her work.

Children respect the clear rules and principles. The classroom looks like a beehive: children are all speaking and working. Children respect and love their ICT teacher.

All teaching methods for ICT lessons are based on the playing game format and interaction with the ICT teacher and schoolmates, if it is permitted.

S7, Prague, Czech Republic.

Example of a promising practice 7, S17, Moscow, Russian Federation

## Greenfingers: 21st century key skills of the primary students

Greenfingers is a complex project that enables students to develop core 21st century skills, using ICT tools, and create an active social citizenship in school children. 21st century skills (we refer to critical thinking, creativity, teamwork, cross-cultural understanding, communication, self-direction, and technology) are necessary for further development of any professional activity and successful adaptation of the individual in society. I am convinced that the problem of today's school is learning how to learn. My principle is to work with students. The amount of knowledge is less important than the knowledge how to use it. This principle is especially important for the Primary school.

Greenfingers is an interactive environmental online action for the primary and secondary school students with the following learning objectives:

- Develop core 21st century skills, using ICT tools, and create an active social citizenship in school children.
- Training in the use of new information technologies and tools, innovative use of previously studied tools.
- Formation of the competencies a student age: cross-cultural understanding, teamwork, self-esteem, and control of critical thinking.

The aim of Greenfingers action is to draw society's attention and the students' attention to environmental issues. We do this mostly in Biology, Citizenship, Computer Science, Digital/Media Literacy, Environment, and Technology/ICT.


Figure 1: The project has several phases of implementation.

The students start by painting their forefingers green and writing names of the objects that need environmental protection. Students take pictures and create images using different technologies, such as AutoCollage etc. Students then publish finished images on the "Community" site, a social network for students and children with disabilities in different areas. One such area is "Greenfingers" (http: //s.gym1517.ru). It is important to note that this is often done together with students from other schools, including the SEN students. In the case of such cross-schools collaboration, we use Skype in the classroom to communicate. We see each other and the result appears immediately online.

In the next phase of the project the students discuss why they wrote about the air, water, forest or Siberian Tigers. The students are divided into groups (by what they wrote on their palms, or by the children's request), and receive an assignment to create an educational project or a research paper.

The students conduct their research using a variety of tools: AutoCollage, Made, Windows Movie Maker, Publisher, etc. Students then present their findings in front of other pupils, teachers and parents. They also have the opportunity to rate each other's projects – in the classroom, and also on the Web. The best projects are published on the school website, the school blog on Facebook or in the school magazine Higgs Boson. Students themselves are praised in the school media.

In the project, we often invite students from other educational institutions, scientists, ecologists, university students... In the process of project work, the students organize a videoconference. Skype makes it possible to study with students from other cities and with children with disabilities. The authors of environmental projects and research can get reviews, annotations and recommendations from scientists and educators directly on the site. They can follow the status of their work.

In June 2013, students and teachers from our school took part in an international conference in Greece on the conservation of clean water. Our students were working with samples of water, after which they presented their results. This large and important activity grew up from the inscription "water" on a primary student's palm. The Greenfingers project gave us opportunity to participate in real research activities on various environmental and social issues. As a result, our students understand their importance in the world. The project shows them the way in which they might affect society.


Figure 2: Milestones of the project "Greenfingers" from primary school to high school.

## 3.2 Meeting curriculum objectives and skills development

### Objective

To understand how different learning activities can contribute to the depth of learning.

### The questions asked

What curriculum objectives do you meet with the use of ICT? (6.2) How do you use ICT for the following skills development? (6.3) We will also consider the level of various activities according to Blooms' taxonomy.

Only in some cases do children receive direct instruction on how to use the equipment or software in lessons aimed explicitly at the development of transferable technical skills. Teachers are certainly encouraged to integrate ICTs in the preparation and delivery of teaching/learning activities and for instructional management., Most governmental and schools' policies (e.g. Quebec MELS, 2001) highlight the increased pressure of integrating new technologies into the working environment and the importance of providing pupils with ICT qualifications. However, the capabilities of ICT are also used to support education in the curriculum, taking for granted either that students are already skilled 'digital natives', or that modern interfaces and applications provide enough information and only need minimal preparation. It seems to be generally assumed that the needed skills will develop automatically while practicing curriculum content-related activities (e.g. children research a history topic on the Internet, children use the computer to analyse data in the context of an activity in science, children edit a text to improve it).

- Curriculum related ICT activities: the study shows much evidence for ICTs fulfilling different curriculum objectives in different subjects such as language (using audio and media facilities provided by ICT tools); writing and grammar (using word processor or handwriting software); maths (including geometry and statistics); science (simulations, and a variety of learning environments); programming and robotics (Lego Logo, etc); geography (using maps that include flags, puzzles, physical features, borders, locations, climates, etc); music (create tunes, melody, play the band and the soloist, select instruments, change tempo and rhythm, record and edit); entrepreneurship (group work, collaboration, project management, etc.).

- Computational thinking skills development: the only place where we found evidence of specific ICT skills being actually taught, are ICT-as-a-subject classes in which the major skills targeted include data handling and processing, online advanced research skills, e-safety, presentation techniques, creating podcasts, video editing and audio recording, and graphic design. The skills related to computational thinking are taught with or without computers, by exploring how processes work, looking for problems in everyday systems, examining patterns in data and discussing algorithms, and questioning evidence. With a computer, learners are invited to put their computational thinking into action. Logo and Scratch still remain very popular as a good way to develop computational thinking. For children with special needs algorithmic thinking and algorithmic problem solving is especially important. Applications that allow step-by-step progress that provides feedback in every step are preferable.

- Cross-curricular skills development: the impact of ICT integration on other types of high-level, cross-curricular competencies. In most countries, we notice an explicit emphasis on ICT-based projects as a way to boost creativity, critical thinking, problem-solving, learning-to-learn and co-operative ability. For example, robotic constructions (e.g. Lego-Logo), or programming may also create the context for collaborative projects fostering creativity, critical thinking, and problem-solving. In some cases, a single activity supports the development of complex skills, as this is the case of using mind maps to help children understand and remember concepts and relations. As for the learning-to-learn dimension, some schools are attracted by the potential of ICT to provide the learners with accessible, real time feedback on their performances, or to deploy large-scale delivery of tests and scoring procedures, or online multiple choice tests in a variety of subject domains.

- Technology as a communication tool is widespread, be it with blogs, email, Skype sessions with other schools, quad-blogging, or through shared documents. We find some examples of schools where communication procedures are explicitly defined, as well as participation in learning communities, so as to provide communication and collaboration tools; they provide opportunities for students to be part of broader communities; to support participation in online collaborative projects; make learning activities and feedback available online anywhere/anytime; to support peer-to-peer as well as students-experts sharing; and increase parent access to student work.

- Citizenship, personal and social responsibility is achieved through multiple, interconnected, transversal learning approaches, such as civic education, human rights education, intercultural education, education for peace, global education and media education, using visual, audio, and independent study approaches.

- Generic digital literacy skills are most frequently encountered in project work, where children create reports, animations, video, charts, creates the context and opportunity to use and learn about different communication channels, and the specific skills involved (e.g. students developing a payroll on a spread-sheet and then merging this information into a word processor document for the receipt). Often students are even on a higher level in digital literacy than their teachers; they navigate and correct their mistakes sometimes in the course of the class. Processing a topic in class often involves activities where students are supposed to develop digital representations by themselves as homework, by which both their skills with individual knowledge acquisition and digital literacy is developed. They also learn about the importance of the form of communication (letter, email, social networks).

### Activity level evaluation according to Blooms' Taxonomy

| Skills | How you use ICT to help in meeting it | Activity level evaluation according to Blooms' Taxonomy |
|---|---|---|
| Remember | Preparing work sheets, students have to insert missing words on the IWB, match corresponding pairs of the words, classify objects based on their properties, and select objects ... etc. | Knowledge: asking the learner to recognise and recall facts and specifics, using either verbs for description of activity: define, delineate, find, label, list, locate, match, memorize, name, outline, recall, record, relate, repeat, retrieve, specify, state. |
| Sense | Developing sensory skills, directions, co-ordination of movement, independence, self-assurance and interest. | |
| Understand | Preparing work sheets with several intentional mistakes and students have to find them. Students also use the Internet when searching for information that needs to be processed, distinguishing significant things from insignificant ones. | Comprehension: asking the learner to summarise or paraphrase given information, using either verbs for description of activity: classify, compare, describe, discuss, exemplify, explain, express, identity, infer, interpret, locate, paraphrase, recognize, report, restate, review, search, summarise, tell. |
| Search for information | Students are often given tasks directly or indirectly that involve searching the Internet individually or in groups. | |

| Skills | How you use ICT to help in meeting it | Activity level evaluation according to Blooms' Taxonomy |
|---|---|---|
| Apply | Students use online software from the Internet for practising maths assignments. | Application: asking the learner to use information in a situation different from the original learning context, using either verbs for description of activity: apply, carry out, demonstrate (a skill), dramatize, employ, execute, illustrate, interpret, implement, operate, practice, translate, show, schedule, sketch, solve, use. |
| Technical | Students develop their technical skills also in the Informatics lessons by connecting all equipment, the mic, the headsets and CDs. They also help teacher to set all hardware. It is important for the teachers and students to understand the operating systems and the basic technical skill of their devices and hardware so that they can work effectively with their equipment and software. | |
| Analyse | Students use the Internet for planning itinerary, comparing prices and the length, finding out the pros and cons of the solutions.<br>Finding out how a presented picture (a collage) has been created. Children analyze components of a picture and describe the way these components were put together. | Analysis: asking the learner to separate the whole into its parts, to better understand the organization of the whole and the relationships between the parts, using either verbs for description of activity: analyse, appraise, attribute, calculate, categorize, classify, compare, contrast, criticize, critique, deconstruct, debate, diagram, differentiate, distinguish, examine, experiment, intercept, integrate, inventory, organize, outline, question, relate, solve, structure, test. |
| Think critically | Students often use mind-mapping software to organise their thoughts. Students investigate a topic using different resources, they contact real people through the social media, watch foreign TV programs, or consult with experts. Tasks require them to obtain information well matched to purpose by selecting appropriate sources, and question the plausibility and value of the information retrieved. Review, modify and evaluate their work as it progresses, reflecting critically on their own and others' practices, assessing the results of their efforts and think about improving. | |
| Solve problems | Search for the cheapest way to get somewhere. In robotics, students build the mechanics to accomplish a routine and use problem solving and creative thinking to debug scripts commanding a robot by trial and error until it operates as the task prescribed. | |
| Decide | Students use handheld voting devices to make decisions quickly and easily, immediately seeing the results. | Evaluation: asking the learner to make decisions, judge, or select based on criteria and rationale, using either verbs for description of activity: appraise, assess, check, choose, compare, detect, estimate, evaluate, experiment, judge, hypothesize, measure, monitor, rate, revise, score, select, test, value. |
| Self-evaluate | Some apps give the feedback in the form of nice pictures, praise or smilies. When playing games and doing tasks, children can verify their own knowledge without the need of an adult. Students understand the metacognition process. They are motivated because they can see that how much they have learned and understand what they need to achieve to improve their grade. In some cases evaluation is done by the individuals' own estimation or as an exercise done together with the teacher. | |
| Access | In many cases this is attained by automated assessments. | |

| Skills | How you use ICT to help in meeting it | Activity level evaluation according to Blooms' Taxonomy |
|---|---|---|
| Create | Students use drawing programs, presentation programs, they create their own documents, invitations etc. They use ICT when working on their projects. Create polygons using Logo language, testing and discovering the correct angle for each polygon to identify regular polygons and their properties. | Synthesis: asking the learner to combine elements learned into a new entity: arrange, assemble, collect, compose, construct, create, design, device, formulate, invent, make, manage, organize, plan, predict, prepare, produce, propose, set up. |
| Boost creativity | Children write a pictorial letter in which some words are replaced by pictures. The same letter is later completed by animated gifs downloaded by children from the Internet. Children playing a role of graffiti artists design letters and put them in a motion using PowerPoint. Students create a poem and tape a podcast where students will recite the poem add pictures and music to it. Students create a poem and tape a podcast where students will recite the poem add pictures and music to it. | |
| Communicate | The pros and cons of electronic and face to face communication smartphones, and the danger of social networks is often discussed. Email is naturally used to communicate with students. In many cases students use blogs to construct meaning and knowledge on specific projects assigned by teachers. Exchange and share information, through a variety of tools such as web publishing and video conferencing. | |
| Co-operate | Students are often paired or grouped to co-operate in an activity. | |
| Present | Students are often given an individual or collaborative task and have to learn how to present their own outcomes in front of the other classmates. | |
| Time management | Working on their own speed develops children's time management skills. The use of a time line in big projects is fundamental so that students do not lose track of time and assignments. | |

## 3.3 Planning and preparing activities with ICT

### Objective

To understand the importance of proper planning of learning activities – Designing to fulfil learning objectives.

### The questions asked

How do you organise the children when using technologies? (6.4) How are the activities with ICT planned for and prepared? (6.5) Which other skills develop when using ICT? (6.7)

### Organising ICT-based activities

In general, ICT is equally used for whole class work, group-based learning as well as individual self-directed learning activities, depending on the objectives and the type of activity, and the problem to be solved. Beyond the class itself, ICT clubs are also popular, as an afterschool activity involving teaching staff as well as parents, as a way to strengthen community engagement. In all cases, there is generally more emphasis on student's activity even in the context of whole class work.

In a whole class organization of the work, ICT is used to present new material from the Internet (e.g. Open Educational Resources), publishers, or created by teachers or the students themselves. It can be an opportunity to increase motivation, generalize a lesson or develop computer literacy skills. This type of ICT activity may take place in the class itself, a computer lab, or even anywhere in the school or at home when using mobile technology.

In group work, small groups are given access to computers, and handle a part of a task, after which groups get together and share their productions and ideas on how to solve the problem, or build a model. During group work, responsibilities and tasks are distributed according to the talents, skills, and inclinations of each pupil, giving each an opportunity to learn from the others.

For individual work (or pairs), a special task is assigned to a given student either for reinforcement or as an individual assignment. It is clear from our study that ICT is perceived worldwide as a perfect mean to individualize and differentiate the educational activities when more able students prepare tasks, presentations of new material and do additional more complicated tasks. And vice versa – weaker students are provided with easier tasks according to their abilities, which they do by themselves or under the supervision of a teacher's assistant.

When groups of mixed age are involved, teachers create co-operative learning environments by helping students of different levels to determine group goals, and teaching students cooperative learning skills. Principles of cooperative learning include distributed leadership (group members have different roles within the group), heterogeneous interdependence (all students sink or swim together), positive acquisition (everybody needs to contribute), and group autonomy (the group develops its own unique process). When grouping two classes or two different age groups, senior students teach junior ones. In some cases, parents also are involved in the learning process.

### Planning and integrating ICT-based activities

The modes of planning, preparation, and integration appear to be very diverse, situated, and pragmatic. In most countries ICT sessions are planned in accordance with the objectives of the National Curriculum, where teachers would plan their session by themselves or together with their partner teacher in school or within a Community of Practice. Teachers usually select the learning objective and choose the best activity for the children that will also suit their age and needs. Differentiated activities are planned, ensuring that expected learning is accessible to all. Teachers will ensure that they have a strong grasp of what needs to be taught and how to use it and also the expected results and criteria of evaluation have to be foreseen. Among the most salient remarks, many schools insist on how teachers struggle to accommodate smart education activities, sometimes supported by professional development

workshops often online using self-directed learning, or centralized at the level of the school, embedded into schemes of work and included in class teachers weekly planning.

## Highlights

To achieve success it is important to formulate the theme of the lesson, to show what the students are going to learn. Also, it is important to have clear and real goals and objectives. During the introductory part of the lesson it is very important to motivate students, and during the main part of the lesson active work of the learners is of great importance. While generalising the lesson it is necessary to ponder the educational process, provide and get back the return reference, evaluate and organize self-evaluation. Creating good physical and psychological learning, and teaching environment, is of great importance as well. When ICT is used in the lessons it is important to foresee what technical means is going to be used, in which part of the lesson it will be used and what goals are expected. It is necessary to co-ordinate more with the ICT maintenance specialist to make sure that the equipment will be in proper technical condition and ready for the students to use. Also, it is important to choose the most appropriate digital content. The teacher has to look carefully through the available digital educational means and select the ones that are the most current and relevant. One more important aspect is that the pupils have to use digital means purposefully and rationally and the standards of hygiene as well as health of students are of great importance.

S12, Taurage, Lithuania.

School already has the main goals and the curricular topics for the specific series. Every 2 months, teachers and pedagogical staff have planning meetings to check out the curriculum, examine the students' results, and make any adjustment, and choose main topics for the next 2 months. By that time, literature books are chosen, and main projects are planned, according to important events. Those projects and didactic units are planned step by step: what do we want kids to learn? What do we want them to create? How are they going to share their knowledge? In this planning process, ICT and all other resources available are evaluated. We prepare presentations; we look for resources on Internet; we download files from a digital library. We plan our lessons and activities for pupils spontaneously; some ideas are born and being developed during the work with the class. Some impulses for ICT activities design originate immediately in teaching. Interactions with our pupils inspire us to develop new teaching computer applications, teaching aids, study materials and topics. Some topics for teaching are proposed by children themselves.

Questions of "who", "why" and "how" are the primary questions to be answered in the integration process, "how" questions should be answered within the context of "what", "where" and "when". All the structures formed under the guidance of the questions in the model are taken into account, both individually and as a whole.

Sometimes, staff plan their own embedded ICT activities in class, usually as part of a Year group activity, with the support of ICT co-ordinators or assistants, whose role is also highlighted as they help ensure that ICT related activities run concurrently with other activities in the classroom, and contribute to reinforce skills already targeted in the other activities as well as cross curricular competencies. This is the case for instance in the UK, where ICT activities are often conducted through team teaching, always as part of the whole learning process, and mixed in with non-ICT methods, never as 'ICT skills' alone.

S28, Dubai, UAE

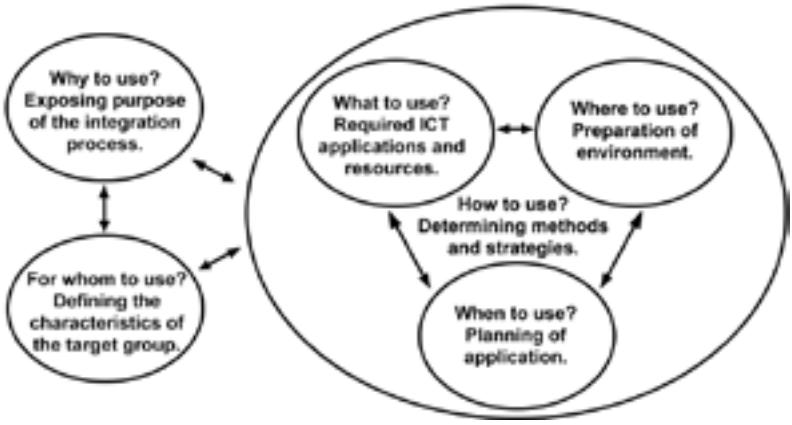



Image 7: Image 7: A model of the questions for integrating ICT

## The use of ICT in real world problem solving

We found many examples of pupils being engaged in real world problem solving in the context of activities that are only possible with the networking capacity, data collection and analysis, simulation capacity, and social dimension provided by ICTs. Although it is rather difficult to summarize and synthesize all real world problems tackled, we can present some highlights of the most striking examples from several schools around the world.

## Highlights

> Pupils are experiencing the experimental approach in science, and performing like real scientists; using simulations, creating hypothesis and collecting information to test them; tackling the problems of water provision in poor countries, using simulations and changing some parameters such as temperature to see what will happen; collecting, manipulating, and analysing data in maths in relation to real life problems e.g. ingredients for 10 biscuits are used to make biscuits for 100 people using spreadsheets.
>
> S29, Dubai, UAE.

> Teacher and students develop a challenge in the local or global community and students investigate and create solutions through the Challenge-Based Learning framework (CBL available on http://cbl.apple.com/challenges). Students are engaged in researching the problem, developing solutions and communicating these solutions to the appropriate audience through digital presentations, videos and global communication. Macbooks and iPads are used to research and survey. iMovie public service announcements convinced the community to improve recycling; students designed an app, which taught specific recycling strategies, and Keynote presentations were used to promote recycling at assemblies. S35, Arlington, USA.

> Explore the 'marketing/communication component' of real world projects. Students are expected to present their results in front of peers and teachers, which can be considered as one real life task that involves communication skills, and prepare them for their future professional life. S32, Broadclyst, UK.

> The school raises funds to support a charity in Ethiopia, providing children with laptops, while learning about solidarity and justice, teaching them equality but also focusing on the issues of what are we trying to do and why, and what they have to offer us, to see this as an equal relationship. They exchange photos, and powerpoints about the school, their video showed footage taken on a teacher's visit to Ethiopia of water pumps being used in the community they raised the money for, and teaching the community about water consumption. The children also exchanged songs, and made books. The Ethiopia school has just won school of the region for working this way with a UK school.
>
> S2, Rio de Janeiro, Brazil.

While working on a geography theme 'Travelling from Kosice to Bratislava', the problem was to find a good connection to go by either train or bus or fly. We used the www.cp.sk portal, working in groups. I divided the class into five teams with four children in each. Each team had a notebook at their disposal. They displayed the portal and found out by themselves they could set the time and date of the departure. They also found a possibility to require a direct connection or to add another town as a transit point. They also found out they could select from different means of transport or combine several of them. Each team got identical time of departure, the place where to depart from, and where to arrive, but got different assignments: 1st team to find a direct train connection, 2nd team to find a direct bus connection, 3rd team to find a train connection with certain extra transit places, the 4th team to find a bus connection with certain extra transit points added, and the 5th team to find a combined trip: flying there and taking a train back. Each team calculated the total time, distance and cost of the ticket. They drew a map of the trip, from the starting point to the destination. Finally, we all together chose the best means of transport, the shortest path and cheapest choice. Many children were excited to teach their parents how to use that portal after they would get home. S22, Bošany, Slovak Republic.

Traffic jams are a huge problem at the end of school day at Barra unit. Kids used Google earth and studied the map of school surroundings. The school is located inside a condo, in a very small street, with 2 other buildings. The kids planned a good solution (changing the direction that cars move at the road) and made a flyer. S2, Rio de Janeiro, Brazil.

In 2012, Rio de Janeiro received a huge conference about sustainability. We asked our students to plan and decide what we should do to make the school more ecological. Kids studied possible solutions, created goals and strategies to solve problems like saving water, saving electricity, reducing the amount of garbage. S2, Rio de Janeiro, Brazil.

A group of 6 and 7 year-old kids were not happy about their classroom: it was too small for the group, and had 3 doors (one for the outside access, and 2 other to the neighbouring classrooms. They tried to change the position of the furniture, and tried 3 different arrangements. Each kid had a different opinion, and it was very hard to test all the ideas. We made a computer program for the kids to plan end test their ideas: they had the shape of the classroom, the tables and other furniture. Small groups tested their ideas in computers, and presented one solution to the class. They tested 4 different ideas and chose the better one. S2, Rio de Janeiro, Brazil.

Example of a promising practice 8, S30,Dubai, UAE

## The Story of the English Language Learners

The English Language Learners (ELL) department was set up in 2012. Through coaching and personal research, the ELL leader saw the potential of using mobile digital technology. The decision was made to use iPads to enhance language acquisition. Through the natural growth in numbers of ELL's more staff were added to the team, by the second year there was a team of 4. With that came the expertise and confidence in using other digital tools. Support came in the form of a Digital Learning Coach (DLC) and each member of the team received coaching and would discuss their ideas in their planning meetings, which impacted directly on teaching and learning. Out of this grew our ELL blog, see http://gemsrdsell.blogspot.com.

As there were multiple sessions being taught simultaneously, resources were spread thinly and the team realised that the way forward with greatest impact for learning would be when the children would bring their own devices into school (BYOD). A workshop was arranged for parents, and the team taught the parents the necessary skills of how to access and navigate the blog, so that they could view their children's learning.

Initially it was expected that children from Years 1 to 6 would take part in BYOD. However, this was soon extended to Foundation Stage as well. Many emails were received from parents wishing to participate. Children were excited to share their favourite apps with their friends, providing opportunities for speaking and listening that were not planned for.

Figure 1: Scan the QR code and you will find http://youtu.be/0j2_yVG8JDw.

In this video clip there are three Year 4 children working from a pupil's home on a mini-challenge assigned by their teacher. The children are using Skype and Edmodo to communicate and collaborate with their teacher.

As part of the challenge, children worked together to decipher Morse Code messages written and shared on Edmodo by the teacher. At this point in time, children were learning about the Titanic as a Topic and therefore this task was created to deepen their understanding of the tragedy. By using Skype the teacher could support the children's learning and guide them through the task. Once the teacher's messages had been deciphered, children were then asked to create their own messages for the teacher to solve. Throughout the task, parents were actively involved in their child's learning and as a consequence learned more about the kind of activities children participate in at school.

Each term, parents are given a new list of apps recommended for their year group topic, or to support their child with a particular area of learning. This allows the children to make informed choices about which apps and websites they wish to use to support their own learning; making it personalised and more importantly accessible to them and their parents wherever they happen to be.

Children are encouraged to share what they have learned on any platform that they prefer. Interestingly, all the children choose different tools to complete their challenges, including Powtoon, Prezi, iMovie trailer, Comic Life, PowerPoint and Voki.

One of the main challenges faced by ELL teachers is the restricted 60-minute sessions, which must be adhered to in order for the pupils to flow smoothly back into the classroom. Because of this, children don't always have enough time to finish tasks. Children using their own devices continue their work in their own time, and bring their finished work to their ELL sessions.

Unsurprisingly, those children who bring their own devices and complete extra learning tasks at home often do so with their parents help. Because of this the parents become much more aware and 'in tune' with their children's learning. Children who were previously shy are now a lot more willing to talk about their work and be more active in their home learning.

Successes: The most noticeable transformations have been the observations of the children's responsibility towards learning. English Language Learners are intrinsically motivated to learn. It highlights that the ELL's are transferring their language skills and confidence into their classrooms.

Figure 2: ELL children using Skype to gain an understanding of how ships are built. Children used the photo, which was sent via Skype, to help them design their own tin foil model ships.

Data: The data we have generated from assessments showed that, on average, the children have already matched the rate of progress achieved for the whole of the previous academic year. one child's vocabulary increased by 5 years in 4 months exceeding the expectations of the ELL team.

Figure 3: ELL children using tin foil and other materials to make a model Titanic. Following the building phase, children filmed and took pictures with their own device of their boat to see if it floated.

## 3.4 Personalisation, scope, and assessment

### Objective

To understand the difference between learners, their needs, and modes of assessment – Choosing proper tools and methodologies.

### The questions asked

What roles do the children play at your school in the process of integrating ICT? (6.6) How does ICT support personalised learning in your class and at your school? (6.8) How do you assess children in activities when ICT is involved? Do you plan to modify your assessment methods? (6.9) How do you record and report on the students' use of ICT? (6.10) How often is ICT used in your classroom? (6.11) Is ICT used only inside or also outside the classroom? (6.12) How is technology used to take learning beyond the class boarders? (6.13)

### The role of children in integrating ICT

It is clear from our study that ICTs, when used in a proper way, have a major impact on independent learning and the development of autonomy, contributing to shift from a 'Teaching & Learning' philosophy to a more 'Learning & Teaching' one. The increased motivation for ICT related activities is often considered as an engine of progress not only for the children, but also for the school itself: 'ICT used at home by children are the impetus for the school to keep up to date in regard to resources available [...] children share their passion for ICT and the school attempts to build on those passions to enhance learning.' (S29, Dubai, UAE). It is also clear that in a growing part of the world, ICT are becoming a natural part of children's life, so that asking questions about ICT integration 'is just like asking how they are involved in the process of integrating paper' (S32, Broadclyst, UK).

Children play a very important role in integrating ICT. They learn very quickly – in cases by themselves – so they are able to help in class with installation of digital technologies, solving given tasks, searching information, dealing with obstacles, helping each other; cooperating with peers, and very often children motivate teachers to progress with the usage and knowledge of ICT. In general, pupils are happy to use ICT tools, they know how to use them and are motivated in their learning tasks. In the process of using ICT pupils learn and teach their friends, create digital educational content, communicate and co-operate (do tasks in pairs and in larger groups, present their work), convey their experience to friends and family members (outside the school), evaluate and assess themselves and even contribute to the improvement of digital content. Some pupils help their teachers in using ICTs since they are more fluent in use and sometimes they themselves ask or suggest doing something using ICT. When using ICT, students develop a sense of ownership of the curriculum, presenting some topics themselves, creating warmers as games or riddles using technology for the benefit of the whole class:

### Highlights

> My teaching, topics and the dynamic of teaching in ICT lessons depend on my pupils and reflect their interests. I am dedicated to teaching children valuable knowledge, skills and attitudes.
> S7, Prague, Czech Republic

### ICT to support personalised learning

Despite the fact that many schools did not specifically provide dedicated examples of ICT support for personalised learning, there appeared to be plenty of situations that convey that personalisation is actually happening using pedagogical tools and methods.

### Highlights

> To ensure the 'equal possibilities' and democratic education to all the pupils, we aim to create environment of quality education despite the mental and physical abilities. We are changing the collective education that was popular in Lithuania for years with the individual education that corresponds the person's abilities. can individualise the activities of students with special needs, reducing the social isolation of those students and apply the methods, motivating individual learning and teaching. Our teachers can additionally bring laptop computers to the classroom if a lesson takes place not in an ICT classroom and prepare individual tasks for the students with special needs. Those students will perform the task with the help of other students and a teacher's assistant or the teacher himself. If the students need more time to develop the skills, the teacher can make arrangements with the specialists of the 'Help a student' team and later improve students' skills in the offices of those specialists. These offices are equipped with ICT as well. Any student in need can get help there. The activities of very smart students can be organised in a similar way when individual tasks are prepared for them. The able students do the tasks by themselves using ICT. In Lithuania a medical board can provide a student with tuition at home when there are very important reasons. Earlier a teacher had to visit such a student in their home and teach there. After implementing ICT there is an opportunity to make an arrangement with the parents of such student and complete certain tasks by Skype, e-register or e-mail. Also, these means are used to give the student a task, later receive it once completed, evaluate, consult, etc. S12, Taurage, Lithuania.

> ICT helps the teacher prepare several variants of assignments for children, while respecting their skills and achievements. It helps her to approach them individually (including children with SEN). This also makes it possible to let children proceed at their individual pace. Each child with an individual needs can work individually on his/her interactive assignments pre-selected by the teacher. Children are not stressed, as they proceed as they wish. Gifted children are given appropriately challenging tasks that give them the opportunity to further develop. They can try to solve problems that are new and sufficiently difficult for them; this is the real benefit of using computers and Internet. "I had two pupils in my class preparing for a contest on the universe. During several days they were individually using the notebooks during every lesson to search for stuff on the Internet; they were using an atlases and encyclopaedia - while others took the usual lessons. I was pleased that they could prepare for the contest in the lessons and I did not have to give them any special homework. They won the contest and it proved to me that my strategy was good. S22, Bošany, Slovak Republic.

> We work especially carefully with children with different disabilities. My experiences reveal, for example, that children with dysgraphia write on computers without any trouble therefore we permit them to complete tasks for other subjects in a digital text format using computers.
> S7, Prague, Czech Republic.

> We have some students with special needs who use ICT to solve tasks in their own time. We also have some exercises on specific curricular topics (arithmetic operation, correct spelling…) that kids can use by themselves, to solve specific doubts, according to their needs.
> S2, Rio de Janeiro, Brazil.

> Technology is a tool that can help students advance at their own pace, so when we are integrating technology to our curriculum, we can differentiate more easily through individual and group work. There are stations with students who need more help, and stations for regular and gifted students. Sometimes gifted students are assigned to work with students who need more help. Similarly, students who can achieve more but are slacking off are placed with gifted students to motivate them to enrich their knowledge and learning skills. S13, Nuevo León, Mexico.

> All pupils get a plan every Monday for the work both at home and at school. These plans are made by all teachers, in the classroom. The plan is discussed in a hour-long meeting, and the teachers have to write the plan for their before Monday morning. Some pupils with learning difficulties have a plan for each day. The teacher gives support and coaching to the pupils during the week. On Fridays they have to pass a test. The parents have to sign both the plan and the test. The plan is divided in three levels and the pupils choose right level after support from the teacher. A lot of the work is done using digital learning resources to support the child's learning style and to find right level. If the pupils are working very well at school, they have less homework. The pupils have some freedom, but after we got a new curriculum in 2006 it became more limited. S14, Godøy, Norway.

> Choosing applications that allow differentiated activities, programs are developed specifically for the different types of special needs children. S10, Budapest, Hungary

### Recording and reporting on students' use of ICT and assessing ICT-based activities

Schools would usually store the pupils' work on their given infrastructure; be that discs, dedicated computers, servers, a cloud application or utilised LMS system. These storage areas could be closed and even parents can only have a look at school consultation sessions (mostly in case of standalone devices and sometimes children can take them home on discs, pen drives, or using emails), or an access system is developed with different hierarchy so that pupils, teachers and parents can continuously access the products of the learning process (mainly in case of LMS use), and in some cases the best products are actually shown off publicly on the schools' web site.

The usual trend seen in our examples shows that students are not directly assessed in ICT-based activities unless ICT or rather Informatics is a dedicated subject in the curriculum. Otherwise, teachers would provide extra praise for students using ICT tools in their solutions for assignments and might raise the given grade for the extra work emerging in the resulting submission.

### Scope of utilization of ICT inside the classroom, outside the classroom, beyond borders

ICT equipment is mainly used inside the classroom, yet we could identify some frequent and rare cases where the scope of use extended beyond the classroom walls:

- Using digital cameras, navigation system, and camcorders to record events and collect data.
- Present schoolwork to public, parents or at different conferences.
- Videoconferencing with partner school through Skype and other social media, sharing information.
- The digital versions of textbooks provided by publisher using the unique codes on the website allow children to access the same materials at home as in class.

### Highlights

> Some time ago a family moved into our village and their daughter enrolled in our school. It was obvious that she was sad to lose her previous friends. The headmaster from her old school contacted me and we agreed to connect both classes for their Music lesson via Skype. We succeeded to do so; the girl saw her old friends and had a nice chat with them. They sang a song to us and we sang a song to them. All children enjoyed such unusual lesson and enjoyed such a long-distance, virtual bridge. S22, Bošany, Slovak Republic.

## Mathematics getting easy with Uchi.ru

Together with Uchi.ru – a portal for interesting and understandable maths for primary education – students of the 1st grade, 6 to 7 year-olds can study and learn mathematics online. One lesson (45 min) per week, is the advised time reserved for online lessons in school N 110 in Moscow, Russia. Access outside the class is unlimited. The main goal of the whole course is to improve and to personalise scholar maths education. The individual approach, combined with classical teaching methods, leads to better results. Minor goals deal with official scholar program: for example, during the 1st term, students are to learn numbers up to 20. That means they are:

a. Not only to know the numbers, how to compare, add or subtract them, but to understand their meaning and connection with real objects,

b. To learn to use abstract models, arrange the sequences, work with axes and mathematical symbols, and produce simple calculations.

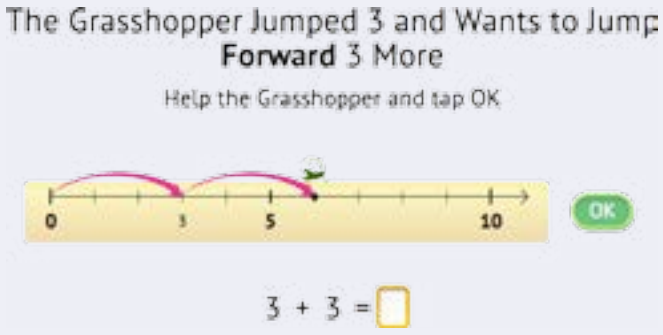

Mathematics seems to be really complicated, but it gets much simpler with the proper approach. First, we organized the online working place for the teacher with the 'online class'. This account works to observe and follow the students' results in real time, correct the 'online class' and generate passwords for children. Than we switched to children's working places, means personal laptops, PCs or tablets with web access and password cards for each student.

Students began with simple activities to get used to maths specialties. Ordinal and vice versa counting, introduction of the axis and the cube's model are performed in a game-like way. The kitten and the grasshopper explained a bit of theory and trained mathematical skills. This held children in the learning mood for a proper time and kept the interest afterwards.

Then the children went on with more complicated matters. How do we build an abstract model to solve math problem? How can we compare different objects by quantity or qualities? Can we change the order of summands in the sum? And what do numbers consist of? All these questions, and plenty more, were covered with the online course. Students got both the learning basics and training skills.

Each topic of the scholar program is divided into several sub-units called 'cards'. The number of cards available, or necessary, per each lesson is not limited, so each student took his or her own comfortable speed. And the learning speed differed a lot for the students of the 1st grade. For example, it took from 3 to 30 hours to cover all the obligatory topics. And each topic deserved certain attention and efforts.

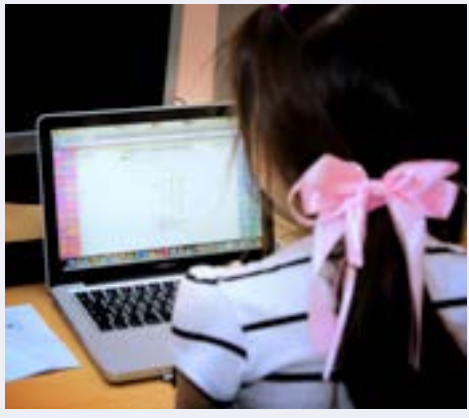
For those, who were quick the teacher prepared extra tasks: these were more complicated to solve, and hence more interesting! We do work on to include such 'smart' extra tasks into the Uchi.ru course.




The mistakes are not against learning process as the system helps students with corrections. Each mistake is just the repetition and 'fixation' occasion. In correcting their own mistakes the children learn more than when they are just listening or watching.

The speed of learning scholar mathematics is increased by almost 10 times. That means individual approach is almost obligatory for effective learning. And Uchi.ru develops personal education for everyone.

After lessons with Uchi.ru covering the whole program of the 1st term, the students demonstrated their knowledge and maths skills in ordinary on-paper tests. The 1st grade students learned how to use mathematical models, solve simple problems, and do arithmetic and logic with numbers up to 20.



All children studied with maximum energy and efficiency and with a certain joy of challenging and playing. The results were outstanding and the students happy.

How easy is it to cover a year learning program within less than 30 hours? It turned our to be easy.

# 4 Limitations and concerns

This section aims to describe the challenges expressed by primary school teachers regarding the integration of ICT in their professional contexts.

In this part of the analysis we will discuss various limitations and concerns expressed by the teachers we interviewed. The following themes came out of the analysis: obstacles and problems faced while trying to integrate ICT; concerns expressed regarding different dimensions of the use of ICT in their schools; recommendations and how to share positive experiences with ICT; prevention and protection of the children and other users when using ICT.

## 4.1 Obstacles and problems

### Objective

To understand the obstacles and problems schools have encountered while integrating ICT

### The questions asked

What are the obstacles of integrating ICT in your school? (7.1) What are the problems faced when integrating ICT? (7.2)

All the 26 schools questioned expressed similar limitations and difficulties related to the integration of ICT. In fact, all schools have discussed problems concerning:

- Financial issues: the majority of schools reported the recurring problem of lack of funding and high costs related to the purchase of computer equipment.
- Support for the use of ICT: some schools mention that lack of support and lack of technical staff present in their school slows down effective implementation.
- Technology and infrastructure: schools mention that sometimes the technologies are outdated, obsolete or failing and difficult to repair. These problems also relate to the quality of Internet connections that are sometimes too slow and inefficient.
- Professional development: when the professional knowledge and skills of teachers are too weak it may lead consequently to a lack of trust and innovation.
- Time: learning the full potential of technologies may take some time that teachers are not always able to find in order to feel comfortable with ICT.
- Management: the role of the school administration is seen by some teachers as the key to the successful implementation of ICT. When the Principal of the school and his or her team are not sufficiently involved in supporting technological and pedagogical innovations, they become major obstacles.
- Family contexts: when the parents or the family are not associated with the school, or if the social and geographical differences are too large between families, ICT implementation can be difficult and teachers see this as a major problem.

One school, S31 in Dubai, seems to have met only minimal obstacles and believes that the integration of ICT was, and continues to be, a fluid process.

### Money

Eleven schools mention a lack of funding, because ICTs are expensive. One school even had to make cuts in other areas, approved of by the entire community, during the first 3 years.

- One school mentions the high cost of the fast technological evolution. They had to opt for a 3 years leasing program to be able to re-evaluate the needs.
- One school says that the software licenses are too expensive, as are the Internet connections for the schools.

### Support

- Three schools mention the lack of a daily support in the school, or that they don't have a qualified administrator (who would be much appreciated).
- One school in Russia mentions that technical problems do happen, but they're usually quickly solved, whereas methodological problems take much longer to solve.

### Technology and infrastructure

For some schools ICTs are, by nature, quite hard to handle. They evolve quickly and they need a good infrastructure to be efficient and to work well. From the technology and the infrastructure's point of view, schools meet different problems and obstacles. For many schools:

- There are not enough computers, laptops or Smartboards.
- Internet connection is slow or unstable.
- It's difficult to choose the best ICT and infrastructure that are appropriate to the needs of both teachers and children.
- Three schools say that they lack space for all the ICT.

For one or two schools:

- ICTs develop at a fast pace that is hard to follow.
- There are not enough software licenses for every computer in the class.
- There is not enough equipment available for the entire school and
- The equipment is too old and there is an incompatibility of specific software and hardware.
- The building is old and hard to adapt to ICT, cables and WiFi
- They encounter regular technical glitches.
- Having the proper infrastructure for servicing many laptops and mobile devices is a big challenge, especially with respect to connecting them to the network because they all use different communication protocols.
- There are not enough quality materials available and that they have to create most of their materials.

### Teachers' knowledge and confidence

Teachers' knowledge and confidence regarding the integration of ICT is one that is often mentioned by the schools. The resistance to change and integrate ICT can be enhanced by the lack of knowledge and confidence, especially when the government doesn't require their use.

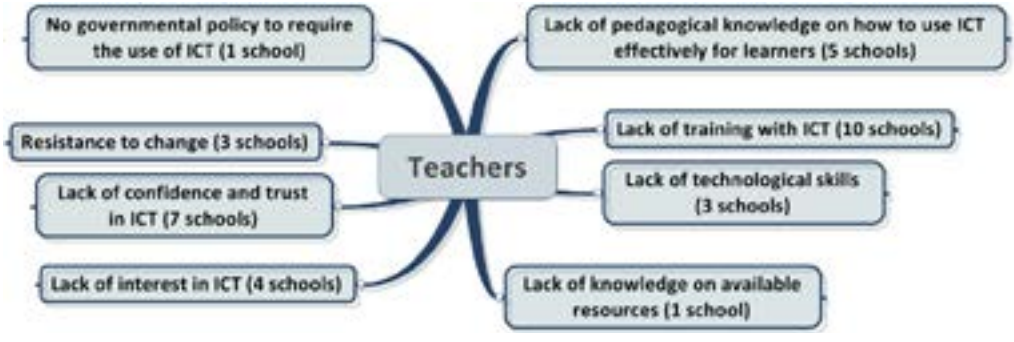



Image 8: Image 8: Factors affecting teachers' knowledge and confidence in ICT

### Time

Integrating ICT in schools requires time, whether it is for professional development, or for development of innovations. This is why, when there is not enough time devoted to these activities, it becomes a problem or an obstacle.

Two schools mentioned their lack of time for teacher professional development. Three schools said their lack of time to develop further integration. And one school mentioned they only devote two periods of ICT into the curriculum, which is not sufficient.

### School management

The role of the school management team seems to be the key to the successful implementation of ICT. However, when this team isn't really concerned or involved, it becomes problematic. In that respect, two schools report their lack of school managers' leadership. Three schools say that policies and education are incompatible and contradictory, most of the time. One school even says that the central recommendations of the school board are obstacles to integration of ICT.

### Family Context

ICT implementation in schools can be difficult when the families are not part of the process. It can also be an obstacle if the social, cultural or geographical differences are too large between families:

- Parents' opinions on the real value of ICT is an obstacle at first.
- Parents who do not respect the rules of Internet use are obstacles to the integration.
- The differences between children who have ICT or Internet at home and those who don't (which means there is a real need to differentiate) can be difficult to handle.
- Some parents do not allow their daughters to use email.
- There are different levels of digital literacy between pupils, which represents a problem to them.

### Highlights

> Pedagogy is more important than technical resources. S2, Rio de Janeiro, Brazil

> So the biggest obstacle in ICT integration in primary education was the understanding that we will be able to raise the younger generation successfully only if we can effectively use all the advances that take place around the world. And we have overcome this obstacle. We have understood that we want to be an up-to-date, modern school, which uses innovative methods of education. S12, Taurage, UAE.

> Some staff do not trust technology to work properly and are slow to take up the challenge. These are usually staff that do not use it at home and so are not confident to have a go at school. S29, Dubai, UAE.

> For individually integrated students we need to prepare specifically designed content, new programs do not work with older technology. We do not have finances to purchase new technology and we are missing qualified administrator.
>
> S23, Lieskovec, Slovak Republic.

## 4.2 Concerns

### Objective

To understand the concerns perceived by the school regarding the integration of ICT in the school or in the classroom.

### The questions asked

What are your concerns when integrating ICT at your school and in your classroom? (7.3)

The concerns of the schools we questioned are all of a sensitive nature. These concerns are certainly linked to the problems and difficulties previously described, but also include issues of education and learning. They are grouped into several dimensions:

- Technological literacy: the importance of a school environment where the ICTs are part of the teaching and learning culture, and that they are fully integrated in the educational reflection, and in the teachers' behaviours.
- Security and privacy: the schools are concerned about issues of security, hacking, harmful sites, cyber bullying etc.
- Continuity of the funding: the schools mention money as a problem because it is often not sufficient, but some schools are specifically concerned by the continuity of the funding in order to keep the technological infrastructure and resources at an adequate level for pedagogical use.
- Maintenance: some schools are concerned that the maintenance of the ICT and the infrastructure is kept at a good level of usability. (This concern is directly linked to the previous one).
- Education and learning: some schools are concerned about the impact of the ICT on education and children's learning, and the quality of the education they receive because of them.
- Relationship with families: the last concern mentioned by the schools interviewed is the quality of the relationship with parents, and the appropriate use of ICT to create a good relationship with families (communication, collaboration, information…).

### ICT Culture

The schools we interviewed have concerns about the importance of a school environment where the ICTs are part of the school culture, and are fully integrated in every dimension of the educational process, for example:

- how to make computers permanent, comfortable, and universal tools.
- getting teachers to embrace ICT in their teaching.
- teacher's willingness to integrate ICT.
- creating a school culture where ICTs are used to reach educational goals.
- the principal should facilitate the implementation of ICT.
- how to develop and ensure a broad education in school, not just concentrating on ICT.
- some teachers want to find complete lesson plans on the Internet, but punish pupils who do the same.
- the children will receive a differing ICT experience depending on the teachers' attitude, which will affect children's perception of ICT.

### Privacy and security

The security of the children, and all the people involved in the school, is a concern for many schools. Concerns include hacking, harmful sites, cyber bullying etc.:

- the privacy, and the availability, of private information.
- the spying programs and the loss of security with Internet.
- inefficient security from harmful Internet content.
- bullying, violence and communication with strangers.

### Funding

Keeping the technological infrastructure and resources at an adequate level for pedagogical use is a concern for some of the schools we interviewed. One school is specifically concerned about the continuity of the funding in order to maintain this infrastructure. Another school is concerned about keeping

the ICT up to date, while two others are concerned by the recurrent technological failures (bugs during classes and backup plans). One school is concerned about the availability of laptops for classroom use, and another one about the cost-effectiveness of educational websites.

### Education

The impact of the use of ICT on education and children's learning can be at different levels. Schools express many concerns of this kind:

- the threat of alienation and loss of direct contact.
- One school is concerned about the reduction of hand and handwriting skills.
- childrens' addiction to the computer and to the Internet.
- the timetable structure doesn't allow project-based learning.
- mobile devices in the classroom cause a distraction.
- pupils learn faster than teachers. They wonder how they could become partners in the educational process.
- tradition, culture, values and native language, where ICT must be used with the purpose to preserve them.
- ICT must be used with good intentions (to support learning) and cannot be overdone.
- the time it takes to plan and try out ICTs before they are used in the classroom.

### Parents

The quality of the relationship with parents is a concern for one school. This school is concerned with the appropriate use of ICT in order to create a good relationship with families (e.g. communication, collaboration, information). For this they use an E-Diary.

### Highlights

> Using computers we installed an e-diary, which was well evaluated by parents. The E-diary became a wonderful, quick, and informative device. The connection between the school and parents became much more effective. S12, Taurage, Lithuania.

> Having mobile devices in the classroom, which are owned by the students, has provided them with another tool of distraction when they are not included within the lesson. S13, Nuevo León, Mexico.

> We are concerned with privacy issues and cost-effectiveness of any website related to education. S16, Jeollanamdo, Republic of Korea.

Our concerns are:

- Is it going to work consistently?
- Is accessible and appropriate for all?
- How is it going to support the pupils learning?
- How long is it going to take for me to learn how to use this? S34, London, UK.

## 4.3 Sharing

### Objective

To identify some suggestions on how to face some of the challenges.

### The questions asked

Can you share with other schools how you have overcome some of the challenges you faced when integrating ICT in a Primary School? (7.4)

With respect to the sharing of experiences and successes, the schools we've interviewed responded in two different ways. Some have expressed how they share advice with colleagues, while others used the opportunity to share with us some recommendations and suggestions. Therefore the answers are diverse, but there are still some very interesting aspects. Firstly regarding the recommendations that teachers have shared, they are connected to:

- Training: the schools underline the importance of the professional development of staff as one the key aspects to overcome the difficulties and problems.
- Infrastructure: some schools mention the importance of the quality of the infrastructure: it has to be well thought out and supported in order to maintain a high level of quality that ensures all the participants are kept involved and motivated.
- Parents: some schools mentioned the role of parents as important collaborators; they should also be involved in the action and well supported.
- Culture: promoting and talking about ICT makes it part of the school culture and people become more aware and ready to face challenges.

Regarding skill-sharing, teachers also mentioned situations that brought them into a relationship with other schools (in their immediate neighbourhood, in their regional or national network). This was through the construction of community practice, or productive and facilitative collaboration, which reduces their isolation.

### Suggestions from one school to another on how to face challenges

Professional development

The schools make some suggestions regarding teachers' professional development required to integrate ICT and face challenges:

- At the beginning, offer technological courses and then keep a constant professional development offer.
- Look for courses to follow to develop teacher's digital literacy.
- Offer teacher training in small groups to ensure mentoring and differentiation.
- Teach teachers to let children learn, explore and express themselves.
- Organise staff workshops led by staff for staff: "when, where, what works".
- Offer a program of continuing professional development for the entire staff, not only teachers.

Infrastructure

Some schools make suggestions regarding the infrastructure:

- Build infrastructure and devices that are specifically designed for ICT integration.
- Give ICT a real focus and value in the school.
- Include ICT in the School Development Plan.

Culture

Some schools make suggestions concerning the digital culture in the school:

- Encourage ICT specialists, pedagogical coordinators and teachers to collaborate with each other
- Create a promotion team.
- Organize a "club of modern teachers" in the school where teachers help each other and present new software.

Parents

Two schools have suggestions for the relationship with parents and families:

- Bridge the generation gap by training parents and children.
- Consider carefully the parental engagement because it is a big part of the success.

### How challenges where shared with other schools

Some schools answered this question by explaining what they have done to share with other schools how they faced challenges:

- They took part in communities of practice, which helped them to share.
- They shared with other schools thanks to workshops they organised during professional conferences.
- They could count on their school board to share with other schools what they have done.
- They can be members of networked schools through which ICT group are created and meet regularly.
- Their teachers are invited to participate in seminars that are part of a national program so that they can share knowledge and experience and collaborate.
- They work with the ICT coordinator of the sister school.
- Even though they would like to share, it is hard in their country (S7, Prague, Czech Republic) because there are not enough ICT schools to share with.

### Highlights

> There is a Club of Modern Teachers at our school – the members meet on a regular basis. At these meetings we learn about news from conferences. We inspire one another by presenting new software; we try to help our colleagues that encountered some problems. We also solve problems while outside the club – during breaks, after school hours or at the teachers' meetings. S22, Bošany, Slovak Republic.

> While creating an ICT basis, we have chosen only those tools that are available to us now, that we have been able to use best. Moreover, we have agreed to get new IT tools only once we have learned to use the current ones well. We monitor other schools' achievements, but at the same time we create our own success based on our real abilities. S12, Taurage, Lithuania.

> Training teachers not to TEACH using ICT, but to let children learn, explore and express themselves. The only way to deal with this kind of challenge is to mix training courses or workshops and working together with the teacher and the classroom. It´s very important that the ICT specialist and pedagogic coordinator take some time to share the class with the teachers and, after this, take some time to talk about the experience with the teacher. S2, Rio de Janeiro, Brazil.

Example of a promising practice 10, S33, Sidcup, UK

## Using Digital Leaders in the learning environment

Burnt Oak Junior School is a two form entry school based in Sidcup in outer London, UK. The age range is 7 to 11 years. Four children from each class are chosen to be Digital Leaders based on their outstanding computing skills and knowledge.

Digital Leaders are pupils chosen for their high level of interest and digital skills, and their ability to support class teachers in their use of learning technologies. This has become common practice in primary schools in the UK.

Usually they are chosen from Years 5 or 6, and may sometimes help the classes with younger children in their use of ICT. At our school the Digital Leaders are also made responsible for the distribution, collection, charging and storage of mobile devices (iPod touches, iPads and tablets) in the school. They ensure that the devices are in the classroom when they are needed. Digital Leaders are also able to support teachers in computing lessons.

Figure 1: A Year 5 student helping a Year 3 student in a teacher-led practice class.

Benefits of using Digital Leaders are:

- Supporting the computing lessons, so they begin to realise that they have to be able to give instructions fluently and be flexible in social negotiation.
- Practising the ability to provide instructions and explanations for a variety of student colleagues.
- Scaffolding the learning process for other less able students.
- Reflecting regularly on their practice and implementation in training sessions with each other and with the teacher.
- Enabling teachers to use mobile devices more often in their lessons since they do not have to ensure that they are charged, or collected, they merely have to book them out.

By having to explain and model instruction to their peers there is the opportunity for Digital Leaders to give support where the teacher cannot. The children will do the detailed support in this respect. The teacher is then able to focus on the general classroom organisation and overview of the students' work, orchestrating and intervening where necessary to facilitate learning, to tutor the basic knowledge, to ask pertinent questions, open or closed where appropriate, and spend more time on assessment for learning.

By explaining to other pupils, Digital Leaders can model and remodel the knowledge they have acquired and refine it by the process of having to explain and teach others.

They can then reflect on this process and come up with their own strategies to teach their digital knowledge and skills.

Figure 2: Digital leaders help by organising the storage and recharging of laptops and iPods

It is also very important for the teacher to give space for:

- A time where Digital Leaders can feed back to each other and to the teacher, and reflect on their experience of how they were able to support or lead sessions.

Self-confidence and independent working is increasing among the Digital Leaders, who are all outstanding in computing skills and knowledge, although some are below average in other core subjects. Some of the pupils selected as DLs are diagnosed as dyslexic.

Figure 3: A Digital Leader explaining how to control the robot arm.

## 4.4 Prevention

### Objective

To discover what schools consider a threat to the school, or the children, and how they handle them and protect the children.

### The questions asked

Keeping children safe in the digital world will always be a concern. What kind of threats are you aware of (in your school – in reality or potentially)? Do you share this issue with your students? Do you share it with parents? (7.5) What does your school do to safeguard children in the digital world? (7.6)

This topic received many propositions from every school we questioned. They all had thoughts on ways to protect their children and community. Some schools think parents have to be involved in that process, and have many suggestions on how to share with them. Some schools or school boards developed strategies to control pupils and what they can access. Most of the schools converged on the importance of educating the pupils, sharing issues and strategies with them. Some schools developed some policies and rules and ways to make them effective. And finally, some schools made sure they're not isolated and collaborate with others to ensure a better prevention.

Share issues with parents

Some schools decided to work on prevention with the parents. For that, they used the following means, where they:

- inform parents during assembly meetings.
- created a school Web page with information and concerns that everybody can read.
- organise workshops for parents on safe Internet and cell phone use.
- advise or teach parents on how to supervise children while using ICT.
- organise information sessions for parents on online safety and digital citizenship issues.
- send newsletters sharing issues on e-safety and sends magazines and leaflets to parents in different languages.
- organise regular talks on "cyberwellness".
- make sure to ask parents permission to use children's work or image.

However:

- One school explains it is very hard to work with parents who don't respect certain rules.
- One school makes parents sign off the acceptable use policy at the beginning of school year.

Control pupils and access

Some schools or school boards developed strategies to control what the pupils can do and what they can access. Twelve schools reported that they use firewalls or filters to censor undesired websites. Others, for example:

- explain that pupils can only access the Internet under supervision.
- ensure that teachers aim to live with the pupils in the digital world.
- monitor pupil's behaviours on the Internet.
- forbid Internet use in the school.
- replaced Safari on the school's iPads with a web browser that has parental control functionalities: Mobicip.
- installed antiviral programs on every computer.
- have a web portal with safe and appropriate content and applications.

Share issues with pupils

Some schools explain they also involve the children in the prevention actions. For that, they used different means, for example they:

- regularly remind pupils of the importance of a safe password and login.
- teach children about digital image and how to protect from harmful programs and viruses.
- tell children they can contact any adult in case of threats.
- make children partners in detecting unacceptable sites.
- educate children about copyrights and ethics in the digital world.
- make pupils sign contracts.
- invite policemen to come to school and talk about cyberprotection and cyberbullying.
- have a cyberwellness education program for all.
- organise discussions with children on cyberwellness.
- organisesa whole school focus week on e-safety.
- use the Internet game called "Adventures of Irma and Jurgis in the Internet".
- organise elementary informatics classes.
- teache children about Digital Citizenship and precautions while on the Internet.
- organise safety lessons at the beginning of year and shows every student an age-adapted video about online dangers.
- teach children moral Catholic values on what is good and what is bad online.
- propose a digital safety curriculum where online safety and netiquette are taught.

Rules and Policy

Some schools developed some policies and rules and ways to make them effective.

- One school writes rules on a big screen (dos and don'ts).
- In one school, the children define rules together and create posters and booklets.
- Two schools publicly share the rules and policy on the school website.
- In one school, there's a safety display wall in its ICT classroom.

Share issues with teachers

Some schools explain they involve all the teachers in the prevention actions. For that, they used different means, where they:

- offer workshops on Internet threats and solutions found.
- offer workshops on social networks and digital image.
- guide the teachers throughout awareness campaigns.
- use a national portal as a reference.

Finally, some schools collaborate with other schools on specific prevention programs. And some others follow the guide given by the Ministry of Education.

## Highlights

> We have a Digital Safety curriculum in place for students and we also have information sessions for parents around online safety and digital citizenship issues.
>
> S35, Arlington, USA.

> Besides the preventive programs and targeted Internet safety education, the teachers aim to live with their pupils in the digital world. S22, Bošany, Slovak Republic.

> We share with students the threats from the computer if misused and advise them to consult any teacher for the site before downloading a programme etc. With parents, we advise them to always supervise what their learners do when it comes to the use of Internet so that will be sure that the purpose of learning is being achieved.
>
> S11, Maseru, Lesotho.

# 5 Equal chances for everybody

## Objective

To analyse and identify state-of-the-art practices and the critical factors that support or hinder the effective use of ICTs in primary settings in education of students who are at any risk of exclusion.

We wanted to understand the potential technological sophistication of the modern primary school in this context.

Our analysis shows there is restricted understanding among educators of the value of accessibility of ICTs, and of the educational digital content of inclusive education for different categories of students with special educational needs (SEN). Only in a few studied cases were ICTs considered essential tools to promote equality in educational opportunities that satisfy the various needs of students.

## The questions asked

How do you use ICT at your school to create an equal opportunity for all children? (8.1) and What kind of inequalities are you aware of (in your school – in reality or potentially)? Do you share this issue with your students? (8.2)

In today's information and knowledge society, learners with special educational needs are among the groups most likely to encounter barriers to accessing and using ICTs. The following groups of students who can experience educational difficulties due to their special needs will be in our focus:

- Students with special educational needs, including those considered who have emotional, behavioural, sensory, physical, or mental disabilities
- Girls and boys in the context of gender issues
- Ethnic and faith minority groups, travellers, asylum seekers, and refugees
- Students who need support in learning the language of instruction (being their second language)
- Gifted and talented students
- Children in need, including those in public care, orphan children etc.

The available data shows that only a few schools mentioned how they mean to promote the social integration of SEN pupils by developing and implementing the use of ICTs to integrate information and knowledge into the educational process.

Despite the fact that the majority of the schools highlighted the importance of an equitable approach concerning access to education, only a few of them described a complex vision of such approach.

The study shows that many schools do not have a full understanding of the concept of inclusive education for different categories of students with SEN. The promotion of inclusive education of persons with disabilities[28] – in relation to their access to information and knowledge through ICTs – means not only a physical access to IT infrastructure, but the full range of educational support (including adaptation of standard hardware and software, using different kinds of assistive technologies, curriculum changes, individual support, teacher training, etc.).

It should be noted that in many cases the teachers indicated that the most serious barrier in regard to the promotion of equal access to education for persons with SEN is the availability of PCs/laptops and Internet in the schools and in the children's homes. Besides that, several schools mentioned affordability of IT devices for families as the only serious barrier in access to education of persons with SEN.

[28] as reflected in the UN Convention on the Rights of Persons with Disabilities, see http://www.un.org/disabilities/convention/conventionfull.shtml

### Highlights

> For students who could not financially afford their own computers, the school worked with the local infocomm authority to provide very affordable new computers and Internet access to the students. S21, Singapore.

> The demands for young people might be unfair between those who have computers and those who do not. S3, Québec, Canada.

> Not all students have a computer at home or Internet access. This is taken into account and special attention is given to avoid any discrimination. This concern is shared with the students. S15, Torun, Poland.

Only in five replies it was mentioned that the schools are trying to adapt standard PCs for the needs of pupils with SEN in accordance with their demands and skills. Also only few schools indicated importance of special tools and software to promote access to information and knowledge.

### Highlights

> With podcasts and audio books, blind children can listen to books and follow teachers' instructions for homework. Using multiple intelligences resources we can reach different kinds of learners. S8, Santo Domingo, Dominican Republic

> We ensure that all pupils have at least an hour's session of ICT per week and, where necessary, purchase equipment to aid and assist pupils who may have SEN or an accessibility issue. S34, London, UK

In seven interviews the teachers mentioned the importance of individual support and curriculum change for personalizing of educational activities for pupils with SEN.

> We have some students with special needs – Downs Syndrome, autism, learning deficits – and those kids have a professional (a psychologist or a teacher) who spends all school time with them, adapting the regular curriculum to the kid's needs. This is the way we gather special attention with being in a regular class group and interacting with the same age group students. S2, Rio de Janeiro, Brazil.

> We differentiate our curriculum according to students' different needs, and technology is a big part of the differentiated teaching and learning. We provide a range of resources and ways for students to express themselves. S35, Arlington, USA.

> …ICT is helpful when a teacher wants to individualize or differentiate tasks (such students get a personal computer and individual tasks) … The e-diary is one more tool that helps to maintain equal chances: It is created not only for evaluation and attendance control, it is also a perfect communication tool because, even if a student is not at school, he/she can find out what is taught in the class, can get and do tasks independently, and consult with teachers. S18, Moscow, Russian Federation.

In some cases, ICTs were considered as essential tools to promote equality in educational opportunities and satisfy the various needs of students.

Technology can have the greatest effect on children with the greatest needs. If well designed, it can transform the lives of learners who find normal tasks and learning activities unusually difficult, whether for physical or conceptual reasons. 'Assistive technologies' are those that counter a physical disability, such as special keyboards or input tools for learners who cannot use their hands, or audio interpretation of text and graphics for learners who are blind or partially sighted. Learners with conceptual disabilities, such as dyslexia or dyscalculia, can use interactive game-like programs that enable them to take all the time they need to practice hearing the composition of words, or to practice estimating the size of a set of objects.

- Special equipment, tools, and devices are purchased for students with SEN or accessibility needs.
- Programs that can be used for independent learning by the students are especially valuable, as this increases their sense of self-efficacy.
- Children with special needs have differential support, and are allowed to use digital tools to help them with their work.
- Teachers plan each child's work with special programs and resources to ensure they have a balanced education, and achieve their learning potential.

## Highlights

> The teachers use ICT for 'differentiation' – personalising the activities to the child's needs and capabilities, so that they still feel part of the class. Being able to do something, which is always possible when they are working with ICT, gives them a sense of accomplishment, and success breeds success. S32, Broadclyst, UK.

> For children with special needs algorithmic thinking and algorithmic problem solving is especially important. Thus we prefer to use applications that allow step-by-step progress that provides feedback in every step, e.g. in Fractions application pupils could check answers at any time in their progress. S9, Szeged, Hungary.

> Children with dysgraphia write on computers without any trouble therefore we permit them to complete tasks for other subjects in a digital text format using computers.
>
> S7, Prague, Czech Republic.

> Almost all kids with special needs love computers and interact a lot with ICT. Sometimes teachers are surprised by the performance they can achieve with ICT. We encourage this usage, because it´s an important tool for kids with special needs. They can interact in their own time, choose the level of the tasks, and go on learning and practicing as much as they need. They really get a lot of learning benefits working with ICT. But we need to be careful because playing alone in a computer is a way of not interacting to other kids, and we need to be aware. S2, Rio de Janeiro, Brazil.

## Findings and concerns

In most of our sample schools there are only pilot projects, which cannot be considered as fully accepted, inclusive strategies in educational policy.

When summarizing the results of the analysis of ICT integration in education of students with special needs, we identified that a number of fundamental requirements of international regulations[29] are not yet reflected in practice of the interviewed schools.

We noticed there was a gap between the aim of including SEN primary students, as declared in some interviews, and any corresponding evidence in the classroom practice. The analysis helped us identify key pre-conditions of the effective ICT use in education of SEN students, namely to (i) systematically increase the awareness of the ICT potential in education for students with various needs, and (ii) promote further teacher capacity building and networking in this context.

Image 9: We can create our own stories. S35, Arlington, USA

[29] including UN Convention on the Rights of Persons with Disabilities, see http://www.un.org/disabilities/convention/conventionfull.shtml

Example of a promising practice 11, S5, Québec, Canada

## A website for the appreciation of the children's digital literature[30]

The introduction of touchpads in primary classrooms raises great interest, but also many questions. Using them in the classroom, students found that many digital books, or e-books available in the digital stores, were often poor quality and lacked sufficient indications about their level of difficulty and the interactive activities they contain. This is why the students created a directory in order to share their appreciation and comments on digital books. The pupils have built a list of rubrics to analyze the digital books and then they have read, appreciated and commented them. To offer this service to the entire population of the school and disseminate the results of their findings, a website was created. Thus, students of all levels, parents and even the general public can view this directory before making their choice and downloading digital books that will please them more.

Figure 1: Pupils appreciating an e-book.

### Main steps

- Defining the rules for the use of iPad tablets in the classroom.
- Organizing pupils' committees based on skills and interests of each: Communications Committee, Website Committee, Literary Committee, Drafting Committee, and Advertising Committee.
- Designing the list of rubrics to appreciate the digital books. They consulted a few websites to get there. At this point, they also had to establish distinctions between a digital book and an e-book.
- Creating a specialized website.
- Reading and appreciating the e-books. The rubrics are completed in dyads.
- Online publishing of the appreciations. Thus, students of the Advertising Committee began to inform the school's students and parents of the new service. They made some posters, went to classes and shared messages on the student radio.

30 At the primary level, pupils of Québec are expected to develop an appreciation for literary, popular and information-based texts. This means they learn to understand, react and interpret these different types of texts, see www1.mels.gouv.qc.ca/sections /programmeFormation/primaire/.

In the second year of the project, students have sought the assistance of all students of the school to achieve the appreciation of digital books. They thus provided training to students in all classes to give them the tools to use the iPad and achieve appreciation. It was nice to see that the use of ICT knowledge of several students 'trainers' exceeded those of some visited classroom's teachers.

Students are highly motivated to appreciate digital books and read in a real and meaningful context. One day, a pupil asked me if he could do appreciations at home on the tablet with the family. At that point, I knew that the goal was reached: Developing reading habits beyond school walls!

## Project Benefits

Students learned a significant amount about ICT environments, especially about the use of tablets (iPad) and the construction of a website.

Many students (and even parents) came to inform us that they enjoyed consulting the appreciation sheet of the books. Moreover, students came with suggestions for books or e-books to appreciate that could be included on the website.

The arrival of tablets is recent and innovations must be done quickly in this context. The pupils identified a need that meets a larger issue: Is everything found on the Web, specifically about reading, good, and does it always allow meaningful learning? No tool currently exists to appreciate digital books and disseminate this information to help parents, teachers and students to make enlightened reading choices for young people. With the large amount of new digital books and e-books published, this project will continue a long time, with the same students or more students to come!

Figure 2: Editorial Committee.

# 6 Major changes

Major changes brought about by the integration of digital technologies have made significant changes in school life, teaching methods and relations between all actors, including parents. In our study, we wanted the teachers to consider all those changes – the expected and the unexpected. The survey showed that ICTs are transforming the way teachers work, interact, prepare, create things, and think. We wanted to learn whether they are explicitly aware of all the major changes, whether they purposefully observe them and how they perceive them.

### Objective

To understand the key issues in making considerable changes to happen

### The questions asked

Reflecting on the past, what has happened since you started integrating ICT in education? What has really changed? (9.1), and Why do you think that change took place? (9.2)

## 6.1 What has really changed since ICT started to be integrated?

Most teachers identify major changes in the following areas:

The teaching profession, and the teachers themselves (teachers cooperate, communicate, share ideas and experiences, help each other in learning – in school, or at the regional, national or international level; continuing professional development and lifelong learning is now inevitable and students are observing teachers whether they develop themselves and esteem such effort; many teachers routinely utilise ICTs to find resources, prepare lessons, organise students' work, evaluate results, and administer learning records; as noted repeatedly, not all staff attempts to integrate ICT, some staff resist change because they do not trust that technology will really work and will support learning[31]).

The pedagogy, the updated learning goals, new teaching and learning forms (new technologies have introduced new opportunities to expand the variety of activities and made them more efficient, attractive, project-based, cross-curricular activities; ICTs strengthened the chances to participate in projects, national or international co-operations and initiatives, and on-line contests[32]; ICTs have been the key element in transforming education from the traditional model to a more interactive, hands-on, student-led, product-oriented, exciting, learning experience; teachers also report that, with the presence of ICTs, the research and communication skills of their students were able to develop significantly. New technologies give students unprecedented chances to create things and control things through programming, creating websites, building and controlling robots, etc., and to express themselves creatively in many different ways).

The learners (students' motivation to use ICT has triggered their skills, they are highly motivated by its use and want to do so to enhance their learning because they feel that they have moved away from routine methods; through ICT, students can revisit their work, get instant feedback and refine it. They have wide range of tools at their disposal, encouraging them to become more independent self-learners; through technologies the whole world came alive in the classroom; they got much better opportunities to become competent in new 21st century skills: collaboratively working in teams, solving more real world problems, communicating with anybody anywhere – these skills support their responsibility, self-confidence, and solidarity; the underachievers have better chances to learn and even to excel in some contexts, which gives them the highly motivating joy of success. Due to different teaching and learning situations, the pressure of public wrong answers has diminished; in some sophisticated settings students become educators themselves, teaching, organizing and helping other students

[31] We noticed that, naturally, mistrust often remains longer with less experienced teachers who have a lower level of digital literacy.

[32] We presented many of them in Vol. 1.

to learn; they observe their teachers learning continuously, which encourages their own lifelong learning skills and independent learning).

Administration and paperwork (some teachers state that their schools became paperless for communication and the administration has reduced considerably. We have to note, however, that some teachers stated exactly the opposite).

Separately, we will also examine the changing relations and roles between teachers, students, and parents. We will conclude this chapter by studying what teachers expected to happen, and what happened unexpectedly.

## Highlights

> Not all staff attempt to embed ICT to the same extent as others – I naively expected all teachers to feel the same – but some staff just resist change because they do not trust that technology will work. Nevertheless, ICT spreads through more classrooms and staff began to support each other and share skills. Children throughout the school trust ICT, they are motivated and excited by its use and WANT to use it to aid their learning.
>
> S29, Dubai, UAE

> The fear of the teachers and parents of not knowing how to handle technology or how to control students with technology has diminished.
>
> S8, Santo Domingo, Dominican Republic.

> Technology has changed a lot, especially access and connectivity. Otherwise there is little change. Technology follows pedagogy. But we have increased our expectations of what the quality of output can be from children. Their ability to revisit their work in a collaborative way, get instant feedback, and refine it is very different now. They have access to wide range of tools; not just access to knowledge, but also people and cultures and resources, etc., and this facilitates children to be more independent self-learners, which encourages the lifelong learning skill of independent learning. They get engaged with what they are learning and take it home. They are in touch with the world.
>
> S32, Broadclyst, UK.

> ICT expanded the grasp of development activities applied and made them more efficient. It also brought information to a wider audience, and enabled this audience to share it. The students got more engaged in the learning experience because they felt that they have moved away from routine methods. It was an exciting experience that acted as motivation towards understanding a lesson in a new modern way. S28, Dubai, UAE.

> ICT strengthened our chances in project participation. Our students take part and achieve great results in various contests that are organized with ICT use. Teachers more often communicate with their colleagues from all over the Republic in the virtual reality space ICT – it is a great opportunity to communicate and cooperate with social partners in foreign countries.
> S12, Taurage, Lithuania.

> The basic concept, though, is that technology has been the key element in transforming education from the traditional model to a more interactive, hands-on, student-led, product-oriented, exciting, learning experience. Through technology, the world not only became smaller but it came alive in the classroom. Technology played a key role in the development of interdisciplinary projects, assuring with other subject teachers that students use technology as an application for all other subjects. When the Internet and email accounts became available within our school, research and communication skills exploded, as well the borders between our country and the world suddenly disappeared! The entire school community —teachers, parents and students — could communicate more efficiently now. In a few years, our school became paperless for communication.

And, of course, students' level of programming has grown exponentially! From creating websites, to robotics using Lego over 15 years ago, to our students' use of STEM standards today in the robotics curricula to provide higher-level challenges for them. Desktop publishing and multimedia tools have transformed the look of student work and projects, as well as of teacher-prepared materials.

With all the transformations we have had, we believe we are at the brink of achieving transformation: where our teachers are cultivating a rich learning environment, promoting student-initiated investigations, discussions and projects across all disciplines.

But not all has been good: our students have lost their innocence at an earlier age and bullying has been magnified through social networking explosions.

S13, Nuevo León, Mexico.

Using the Internet at home is now more common. We are glad that pupils use the Internet for their learning and homework. Parents access a school website and electronic record books (for assessment). We give many Internet-based assignments. Pupils that have no Internet access at home can attend computer clubs.

The process of educating is more effective and attractive – we use more visual, interactive and hands-on methods. DT has motivated our pupils and DT keeps them interested in their own learning. This includes students with learning disorders. Teaching foreign languages also became more effective – digital technology enables students to use foreign language in an authentic setting.

The textbooks cease to be the only source of all knowledge. Our teachers teach pupils to utilize various sources of information, to compare and combine them. The teacher becomes a coordinator of education; he is no more a mere lecturer or supervisor. DT helps to transfer part of the responsibility to the pupil.

The importance of foreign language education is indisputable nowadays. Rapid development of digital technology creates new opportunities for enhancing the quality and effectiveness of acquisition of a foreign language. We can use different media – audio, video, authentic sources, Internet pages. Other school classes also benefit from these new media. The pupils are more active if digital technology is involved.

S22, Bošany, Slovak Republic.

## Heading

The Faculty of Special Education of Eotvos Lorand University (ELTE), Budapest, together with its Faculty of Informatics, have an affiliated special education needs school in the same building named Bárczi Gusztáv Practice Elementary School and Methodological Centre for Special Education (Bárczi school in short). There is an active collaboration between the two institutions: ELTE students, future teachers of Informatics, develop specialised software environments (apps) supporting the special learning needs of the school and its students.

In most cases, our software environments are used for practicing, showing visual examples, modelling problems, helping to find procedures for solving different problems, and conforming constructive learning practices. It is important to note that making a mistake while being involved with a computer is not so embarrassing for a student than doing it in front of a teacher and other classmates. In addition, graphics and animations can be of great help in visual modelling, and creating algorithms and developing computational thinking.

Figure 1: Mathematics lesson in the computer room.

At the moment, Bárczi school uses 36 different applications developed at our university, 34 of which were developed in our T@T lab. 28 of them fit directly into the curriculum and are being used in every day teaching process. From the 36 apps, 15 are developed to support math curriculum and 11 to fit into the ICT curriculum. Among the apps, 18 produce different kinds of log files, 9 save the final image (screen) when the task is finished, and 9 document the whole process.

Main features of the package developed so far for Bárczi school are:

- Motivation: programs are highly motivating and amusing for students.
- Focus: all programs focus on a specific theme and can be easily customized according to the actual needs of a student (by setting various parameters etc.).
- Personalization: programs can be set for the different needs of students concerning the level of difficulty, complexity, visual needs, background knowledge and interest.
- Learning curve and feedback: activities can be flexibly set in terms of the time frame, repetition, feedback, scaffolding, and incentives in order to support the learning curve.

Naturally, not all topics can and should be supported by computer programs. However, they can be good and motivating alternatives for themes that ask for practicing and exploring from different perspectives.

It is also very important for students to get immediate feedback on their final answers before pressing the OK button. Therefore, we put checkpoints into our programs to allow self-checks before submitting answers. We were interested to learn how often students would use these checks and we observed that after working out a solution, they indeed used the self-check every time before submitting a final solution. This feature gave them self-assurance of their own thinking process. If such features were not available, students would ask teachers themselves for feedback, which would consume a lot of teachers' time. This is one good reason for the teachers to use such programs in their classes because, among other benefits, they support self-reflection of the students and thus allow for more efficient learning process.


Figure 2: Screen shots of a puzzle game.

Scaffolding was another feature required by the teachers. For example, when practicing multiplication, after two wrong answers the multiplication table is displayed. After another wrong answer, the corresponding line and column of the table are highlighted. After one more wrong answer, the correct number in the table is highlighted as well. We had to think of appropriate algorithms to help students solve different problems at the level corresponding to their skills and knowledge. (For example: if a student cannot learn multiplication, but can use a multiplication board to find values, the scaffolding method helps him or her to learn as an algorithm to use the multiplication board to solve multiplication tasks.)

As a next step of developing the knowledge and experiences of the students a set of the lesson plans have been produced using educational games like Puzzle or Memory in different subjects.

Our university students, future special educators and ICT teachers, regularly listen to the Bárczi School teachers and often visit their classes at school. They can also take an optional course, Harnessing Digital Technologies for Learning, where they learn how to use our software applications and how to design and develop their own teaching materials. Also, more and more teachers of Bárczi School learn how to create their own materials for IWB, which is also one of the tasks for the future teachers during their teaching practice at school.

## 6.2 Changing relations

### Objective

To understand what relationships have changed during the integration, and how.

### The questions asked

Have any relationships (between students, teachers, students and teachers, between the leaders and the staff) in your school – in the context of ICT – changed during this period? (9.3)

New technologies are – directly or indirectly – influencing all sorts of relationships in the school (between students, teachers, students and teachers, between the leaders and the staff) and beyond it (new opportunities for communication between schools and parents influenced their relationships as well, namely developing their trust in schools). The traditional role of a teacher as a reliable connoisseur is no longer valid, nor is it expected by her students anymore: nowadays, students have unprecedented access to information, thus often ask questions, which teachers cannot answer (frequently sending their questions from home in the evening, to their teachers, school leaders or anybody). This means that teachers now have excellent chances to know their students better: ... We know more about each other and we all try to understand each other. The teacher's authority now comes from their other qualities, and their modified role becomes that of a knowledgeable advisor, a partner, a mediator who organizes the process, who suggests guidelines, evaluates performance, and helps students identify and solve problems and understand different concepts in broader contexts.

Teachers became relieved of some administration, thus relationships between them also changed, mostly towards extensive collaboration and sharing (as already noted earlier). They form small communities to solve particular problems, to learn together, to conduct projects, to promote new opportunities and priorities (such as inclusive education), to research, understand, and improve learning and achievements of their students and themselves.

### Highlights

> Kids can have all kinds of information, and it´s very usual to have kids asking questions teachers are not able to answer; sometimes teachers have no information even to prepare the question, because the kid has seen some TV documentary show, connected to it on such a deep level, full of animations… It changes the role of teachers a lot, and they need to be confident to know that it´s not a big problem not to know the answer to everything the kids ask. It does not happen because ICT is in school – it happens because the kid´s life is just like that nowadays. But I think that working with kids interacting with ICT helps both kids and teachers to understand this "adult and educator" role in the relationship. Teachers can act like teachers (make questions, suggest guidelines, evaluate kids performance, help kids understand concepts, explain how to perform a specific procedure) while kids are using ICT, regardless of the teacher knowing or not knowing the details inside subject or topic that kids are learning. Students are eager to come to school; they are motivated. Teachers co-operate more – they share materials, experience, and knowledge. The content is more realistic. There is a greater resource of information; the search for information is easier and faster as well as the process of analysing it. S 2, Rio de Janeiro, Brazil.

> Pupils have a sense of responsibility, of team spirit and a high portion of solidarity while working in teams, and thus their work has improved. To achieve a better result they help each other and support each other. Sometimes they work more than is required, and they enjoy the work. By using digital technology (DT) we can create diverse assignments while increasing the level of difficulty. The underachieving pupils have better chances to learn, and eventually to excel. The pupils who are not very good at solving traditional assignments are often skilled with computers and other DT. They enjoy success; failure is not that apparent, the pressure of wrong answers disappears. Relationships between teachers and pupils become more relaxed. Pupils often feel they are in charge of their own education. DT improves communication on all levels. Pupils also communicate at home; they ask questions. New friendships arise – at least on the virtual level – we know more about each other and we all try to understand each other.

S22, Bošany, Slovak Republic.

> The teachers' role has changed: now a teacher is an advisor, a partner and a helper. Sometimes students become the educators; they show their higher knowledge and help their friends. Relationships between teachers have also changed. They communicate and cooperate more, they actively exchange innovations and experiences obtained during the seminars. Small teacher groups, ones that prepare and fulfil projects, have been created; they discuss how to encourage students to achieve higher results in education. Teachers have become more courageous because they can feel the support from the school administration. Now they bravely talk about the improvement of qualification level and know how they will spread the knowledge and experiences in school.
>
> S12, Taurage, Lithuania.

## 6.3 What did not happen? What happened unexpectedly?

### Objective

To understand what teachers expected to, but did not, happen within the transformation. And what they think happened unexpectedly.

### The questions asked

Sometimes we have expectations when embarking on a journey. What changes did you hope for when you started integrating ICT, and which of those changes did not happen? What happened that you did not expect? (9.4)

Reflections collected from our schools resulted in a list of expectations not fully met[33], and also several unexpected changes. Many teachers (sometimes parents, politicians, decision makers, and media) expected that:

- The quality of the new learning outcomes (supported by new technologies) would become apparent more quickly. Instead of occurring in traditional achievements, these outcomes usually materialize in other, often new but equally important, issues. ...however, now we know that the transformation takes time.
- Traditional pedagogy would more quickly and easily transform into new pedagogy, which respects and harnesses the potential of ICTs.
- Newly graduated teachers would bring more digital expertise and innovative thinking and practice from their institutes of education, which is not happening.
- The importance of the school and the teachers would decrease, which did not happen at all.

Many teachers and school leaders did not expect that:

- their role would change so abruptly and considerably. However, the changing relationship, and atmosphere in the classrooms, ...helped teachers develop and quickly adapt to their new, more challenging and responsible role.
- the transformation would initiate the discussions about the role, forms and needs of the textbooks, what they are and what they should be – with such urgency
- developing and deploying their own learning materials would be so standard, attractive, but also time consuming.
- big differences in the social status of their students' families would pay such strong influence on the access of the students to ICT and thus to the learning performance and achievements.
- the digital content would play so important a role, and would be so expensive.
- the legal issues of deploying ICTs would become so frequent, wide-ranging, and important.
- the resistance of some of their colleagues to integrate ICT would be so strong and lasting.

[33] and sometimes contradictory

- the success and outstanding outcomes – both their own and of their school – would transform their lives so much: schools are frequently visited by parents, teachers from other schools, and researchers. Teachers are often invited to get involved in more and more initiatives and activities, to present at conferences, etc.

## Highlights

> If we compare a textbook and the Internet: the textbook is clearly intended for learning and lacks any distracting elements, while Internet is full of distraction. On the other hand even if we allow pupils to use the Internet, they prefer to ask the teacher; the teacher is still considered to be the more reliable source of knowledge and the answer is usually faster. We encourage pupils to consult the Internet when they have questions or they are looking for a solution to some problem. However, we are only partly successful.
>
> S22, Bošany, Slovak Republic.

> When the Internet became accessible to families and to schools, we saw many people on TV and in the newspaper saying that "the teacher's role and the importance of school is going to decrease, because now kids can learn everything they want…" I thought that teachers would be afraid of using ICT within their classrooms, and would be insecure because kids could ask questions they do not know how to answer, and they would have to abdicate the "knowing person" role in the classroom. It really happened, in some way. But what I did not expect was that this new classroom, where kids research and share with their peers and the teachers really helped teachers to reach a new role for them in the classroom. Now it´s quite obvious for kids that teachers do not know everything and do not need to know everything. They do not expect this from any adult at all. S2, Rio de Janeiro, Brazil.

> I hoped that integration of ICT would reduce the amount of paperwork teachers have to perform. This did not happen and the amount of paperwork even increased. I expected that preparation of learning materials would be easier, but preparation of the digital content actually requires a significant amount of time – sometimes larger than using traditional methods. Unfortunately this cannot be reused or shared to reduce the overall effort. S15, Torun, Poland.

> Teacher turnover implies that each new year there are teachers to train in all the systems AIM employs and in the technology integration plans within the regular school day; the rapid rate of change in the area of technology results in us not having the chance to master the use of different technological tools before there are new and improved models and versions on the market; the infrastructure support that is needed is a constant challenge too; and then, of course, there is always the need to finance the technological innovations! S13, Nuevo León, Mexico.

> Financial differences in families make bigger differences in the digital devices they own. Sometime there are problems with boasting, or competing, which is then discussed with children and values are then directed in place. The education committee's resistance was huge before the introduction of the electronic grade-book. After going through this compulsory introduction, the initial resistance decreased when they discovered that their work became easier and faster. What caused a struggle previously is only a mouse click now. Educators had similar experiences when a digital curriculum was introduced.
>
> S9, Szeged, Hungary.

> I expected staff to take the lead; in fact I see potential for ICT-savvy students to share their skills and steer the direction we take with ICT. I hoped to see ICT embedded in all classes with children able to access technology at will to complete a task. Because we have to book the use of ICT, it means that the equipment might not be available for a class when it is needed. Natural embedding of ICT is not as easy as I thought it would be. Financial restraints mean not all classes can have the same resources available for free access all the time. S29, Dubai, UAE.

The things I never expected are (a) having to get so involved in the legalities/correct way to deploy apps on IOS devices, (b) becoming very knowledgeable about the iOS devices, to the point that schools come to us to ask the difficult questions and (c) that so many people want to come to our school to see how we use technology in the classroom.

S31, Dubai, UAE.

We did not expect to do so much in such a short time, that we would be able to change so much not only in primary education but also all around the school.

S12, Taurage, Lithuania.

# 7 Students' perspective

The view on ICT in education is usually based on knowledge and experience from experts and school practitioners. In this section we wanted to describe the perception of one of the most important factors in the educational process: children. We asked students from our sample schools "how they perceived the use of ICT in their school" and "how they would describe the difference between the use of ICT inside and outside school".

This section presents the main categories that were present in children's answers, and we include highlighted extracts from their comments that illustrate their perspectives.


Image 10: Word Cloud with students' comments

## 7.1 How they perceive the use of ICT in their school

### Objective

To understand how students perceive the use of ICT in their schools.

### The questions asked

Ask some children how they perceive the use of ICT in your school. List their comments – this could include text, drawings or pictures of learners. (11.1)

### It is cool! - Motivational aspects of Technology

One of the most common reactions of students when asked about the use of ICT in their school is enthusiasm. Technology is perceived as fun, even if related to traditional school subjects, which has the important effect of making schools more attractive to young students.

### Highlights

> I don't know what it would be like without computers. It is a great step for mankind. Using computers is fun for me. S9, Szeged, Hungary.

> When you have it, you like coming to school, so I would say it's truly amazing. S32, Broadclyst, UK.

### Enhancing traditional curricular subjects (Language, Maths & Science)

Some uses of Technology have found a place as tools to support or enhance teaching and learning of traditional school subjects (Language, Maths & Science). Some students have the perception that, with technology, they are able to learn more and understand complex concepts.

Surprisingly, even in some very innovative schools, some students associate the use of technology at school mainly with writing assignments and making presentations to their classmates. Word processors and presentation software are mentioned as the main tools for schoolwork.

Image 11: Produced by students when asked "What do I like in my school when we use computers?"

Some students mention the tools included in word processing programs (such as spell checkers and dictionaries) as an important support in the writing process.

Presentations in front of the classroom are an important activity in many school classrooms. Students recognize how much easier it is to present with today's a presentation technology, but they also recognize the cognitive value of preparing the presentation itself.

For younger students, who are learning to read and write, the use of keyboards is perceived as an important scaffolding tool since ...it uses letters.

Ubiquitous access to Internet has transformed searching for information. Students assume that search engines (Google, Bing) are normal means to search for information. In recent years, searching for information also includes video sources, such as YouTube, as an essential source of information.

Simulations and explanatory videos are perceived as a contribution to learning concepts, especially in Science.

Some teachers use educational games to teach and explore some specific contents (particularly in Maths). The "gamification" of these activities seems to provide high doses of enthusiasm end engagement.

Example of a promising practice 13, S4, Québec, Canada

## Reading Advertisements Effectively

What can we do to protect our children from the multitude of advertisements that they are bombarded with every day? Is it possible for young children to decode and think critically about advertisements? The answer is yes. With the help of information technology, students in our cycle 3 classroom at Pope Memorial Elementary in Bury, Quebec, were able to not only 'read' existing advertisements but create their own.

First, we used ICT to search for advertisements to decode. Since we were studying nutrition at the time, we searched the web for advertisements about food. There are a multitude of advertisements on YouTube to choose from; enabling the students to simply type in the name of a food and a product company name that they were familiar with (i.e. hamburger, McDonald's) to find the video of a commercial for that product. We chose three advertisements and projected them for the entire class to watch. Each student was provided with a set of advertising strategies taken from the www.mediasmarts.ca website. Students were given the instructions to identify at least three strategies that were used in the ads. The strategies from the Media Literacy website were ideal kids or families, family fun, excitement, star power, scale, put-downs, facts and figures, repetition, sounds good, cartoon characters, heartstrings, bandwagon, weasel words, omission, and are you cool enough? (Descriptors of each strategy are given on the website.)

Following each ad, we determined the 'purpose' of the ad (to sell a product to a specific audience) and, through discussion, identified which strategies were being employed to sell the product. The message, we noticed, was often that you would somehow be better if you used the product. How was the message delivered? For example, in the cereal advertisement, the students identified 'ideal family', 'family fun', (images of well dressed, happy families using the product) 'sounds good', (delightful music in the background), 'cartoon characters' (their favourite cartoon character loves this product), and 'bandwagon' (implies that if you buy the product you will join the popular crowd), as the main strategies being used to sell the product. At first, students did not always identify 'omission', that is, purposely leaving out important facts about the nutritional content, such as how much sugar the product contains. With practice, the students began to notice that ads selling food almost always left out important nutritional information.

During the next phase, the students wrote their own ads for food products, employing at least three advertising strategies from the Media Literacy website list. We made videos of the students' advertisements and then projected them for the entire class. At this point, the students had fun identifying the advertising strategies used in their classmates' ads. The production of their ad was a measure of their competency in understanding or 'reading' ads. Was their understanding deep enough to allow them to create an ad that employed advertising strategies that could sell their product?

Our next step solidified their understanding of one of the main strategies used in food advertisements; that is, omission. The students used the Internet to re search the nutritional value of the food product, which was great because information on any type of food imaginable is there but which posed the problem of having to determine which sites had accurate information! Students learned that website addresses ending with .edu or .univ meant that the sites were linked to education. The information could be put out by a student or by the research department. Additionally, they learned that .gov meant government sites, which could be depended upon for accurate information, and that .com meant a commercial site so that the information may be slanted, or favourable to the company who bought the webpage. On our journey to learn how to read advertisements, the students had to learn how to discriminate between accurate and possibly inaccurate information, depending on the source of the website, an important lesson for ICT use. Their final step was to make Advertisements you will never see! In these ads, students added the missing nutritional facts, such as how much sugar or fat their product contained. In order to make the information accessible to all audiences, students showed a serving size of their product and then poured in the amount of sugar, teaspoonful by teaspoonful, into the serving size. It was often shocking to them to see how much sugar there was in the product.

Figure 1: Students identifying different strategies used in the ads.

Figure 2: Producing our own ads, including 'missing' bits of information.

We then projected these ads to the class. I must add that the students found it quite exciting to be producing ads that you would never see on television. In fact, during the whole process, students were excited and engaged in their tasks.

Although we were studying food ads in particular, I believe the process of questioning advertising strategies and website information will stay with the students. When watching ads in the future, students will be asking questions as to what is being omitted and how the product is being sold to them, thereby using critical thinking and arriving at a deeper understanding of advertising texts. I feel it is so important for students to learn to 'read' this type of text (advertisements) because ads are front and centre in their lives every day! Now, every time we gather information from the web, students are reminded to question the source, thereby using critical thinking skills that they need to possess in this world of information technology.

## Highlights

ICT helps me with my learning. S30, Dubai, UAE.

Using the computer makes me smarter. S31, Dubai, UAE.

I like to use the spelling tool and the English dictionary. S9, Szeged, Hungary.

You can have a go at spelling a word and MS word tells you if it's wrong and it helps you learn spelling. S32, Broadclyst, UK.

I like to type my information sometimes instead of writing it. S31, Dubai, UAE.

Spellodrome gives you practice at spelling; it tells you what it should be, and so it helps you learn. You can read books online and listen as well, (Accelerated Reading) and you can learn to read at different levels, and if you can't get to the library, you can read at home. S32, Broadclyst, UK.

Most of all I like to do homework with the Power Point program. Using this program I learned to write, which is most important. I like to find relevant information on the Internet, and in groups, and to communicate using e-mail. I learned to present my work to classmates. 3rd Grade S18, Moscow, Russian Federation.

Kids all prefer to use the computer. One of them explains, "It has the letters". (They are learning to read, and using the keyboard can help some kids).

S2, Rio de Janeiro, Brazil.

I feel really good and I believe it makes thing much, much easier. Before, you could use books or your personal knowledge to look for Information. Now you can use websites such as Google, YouTube, such as educational videos, and websites like that.

S13, Nuevo León, Mexico.

It's good because you could be doing an article on a news story, and you can have what happened right there with you and not have to go off somewhere and look for it.

S32, Broadclyst, UK.

I think that the IWB is very useful for science classes, as we can look at a lot of experiments. Looking at videos and pictures help us to better understand the ideas behind science. S9, Szeged, Hungary.

Using IWB we are able to look at a lot more materials, information, videos and pictures, and that makes the classes to become more fun. We are of course able to do a lot of experiments ourselves, but it is interesting when we see experiments that we would not be able to do in class, like seeing the path of oxygen in the human body during biology class. It is interesting, fun and very useful for everyone. In this way children are able to remember better, since the IWB makes all subjects more interesting.

S9, Szeged, Hungary.

I like it when the teacher shows the movie in the instructive lesson. It is the greatest romp, I listen carefully, and I still learn something. 1st Grade S18, Moscow, Russian Federation.

I learnt how to do fractions and adding up using a game. It's good to learn on the computer by using the multiplication games. We can play Science games like Rocks and Soils. I got to play a football game where I had to do a sum to score a goal.

S31, Dubai, UAE.

I use Mathletics and I have fun playing it online; it has different levels and you can search for other players in other parts of the world and play against them, and it's more fun to learn that way. S32, Broadclyst, UK.

I love to learn maths with the program 'Numbers Town'. For me it isn't boring to play and count, overcoming a variety of tasks. 2nd Grade S18, Moscow, Russian Federation.

## Innovative educational practices through technology

Technology allows students not only to be consumers of multimedia material, but also to be producers and publishers of their own creations. Many students recognise these types of activities with high enthusiasm, even though they may not always recognise them as actual "school activities".

Many students like to tell stories using modern multimedia languages. They use special software for writing comics, creating videos with characters made of clay (stop motion) and producing their own radio or video programs.

Technology also allows whole new experiences through digital music and drawing. Listening to and composing music has become more accessible for young students.

The introduction of new portable devices (such as tablets and cameras) has allowed a natural use of portable technology to "capture" the world. The introduction of touch devices has also allowed direct painting or drawing with their own fingers.

## Highlights

I like Kodu. I love it! Specially Kodu, where I created my world.

S8, Santo Domingo, Dominican Republic.

Good! I like the still videos. (Note from the teacher: A program that made a movie out of a series of pictures) S8, Santo Domingo, Dominican Republic.

I think claymation was the most interesting because you get to model your very own characters and make your own movie. It was a good thing that we could select how to express ourselves by creating our own way of doing it. We worked in small groups, which makes it easier to be creative and we could use a lot of different materials. We used keynote to create lots of different stories and some made claymation for their stories while others made a comic. You get to make it personal, you get to choose how the next scene comes out and how the words are displayed. S35, Arlington, USA.

I like to create stories and images from the series (storybird.com). Sometimes, the teacher e-mails the tasks, so the teacher communicates virtually; it's interesting and quite simple.

I especially like working with the Smart Board and Smart Board table, voting keypads (OptiVote voting system), and creating movies with Movie Maker. I know a lot.

3rd Grade S18, Moscow, Russian Federation.

For me I like the program 'The Little Mozart' the most. With the teacher's help, I created a melody, saved it in MP3 format on the desktop, and then sent it as an e-mail to my Mummy on her birthday. 1st Grade S18, Moscow, Russian Federation.

We use iPads to take pictures of shapes (Shape Hunt) and to create a slideshow to share our shape pictures. S35, Arlington, USA.

With the computer I can do much more than on the piece of paper: we can write with our finger on the interactive blackboard, we can use different colours.

S15, Torun, Poland.

I love it because I can paint.

Student from 3rd Grade of S8, Santo Domingo, Dominican Republic.

### Paperless School administration

Many schools are using Learning Management Systems (LMS) to manage much of the communication flow within the organisation. This has allowed students to create a digitally supported relationship with administrative tasks (such as assignment schedules and teacher feedback).

### Highlights

We can check class schedule on the school web pages. We send results of our work with the computer. Source: student from school S15, Torun, Poland.

It's meant to be more independent for the teacher to see if you are practising at home so the teacher can tell if you're doing your work or not. S32, Broadclyst, UK.

### Digital communication beyond the school walls

Some students have participated in projects that take their learning beyond the boundaries of their school. They use twitter and webinars to communicate with people in different parts of the world (and even with the international space station).

Today's communication skills are hardly understood without digital interaction. Students have the possibility to learn such skills through actual interaction with other students and with adults located in remote places.

Social networks have become a normal part of life for many students (even though formally there are some age restrictions for younger students).

### Highlights

At home, I enjoy the "Pinigėnai", writing emails to my teacher, or using Skype to talk to a friend who lives in England. Every night I check Tamo Blogger.

Source: 3rd Grade S18, Moscow, Russian Federation.

I like taking pictures of the Moon with the astronauts.

Student from 4rd Grade of S8, Santo Domingo, Dominican Republic.

I like to chat with AstroRobonaut in Twitter.

Student from 3rd Grade of S8, Santo Domingo, Dominican Republic.


Image 12: My computer and me' S9, Szeged, Hungary

## 7.2 Differences in the use of ICT inside and outside the school

### Objective

To understand how students perceive the difference between using ICT inside and outside school.

### The questions asked

Ask some children how they would describe the difference between the use of ICT inside and outside school and list their comments here. (11.2)

One of the most common distinctions found in students' comments is that technology in school is for learning, but at home for doing things they like – such as chatting or playing games (they rarely conceptualize what they freely do at home as learning).

Many students value social interaction and friendship as some of their main interests. Social media has became one of the most relevant activities that students associate as a "home only" task, either due to regulatory restrictions at schools or inadequacy of the school context.

For those students who do have access to technology at home, school ICT experiences are sometimes seen as restricted or limited (due to time constraints and/or restrictions in software or Internet access).

Many of today's students are living in a context where technology is a natural dimension of their life. Many of the things they enjoy are related to digital media. Even some students who have strong interests, which are not directly related to technology, seemed to find in technology a way to connect and enhance their personal interests.

## Highlights

At school we learn, at home we play computer games. S15, Torun, Poland.

At home we can use social media such as Facebook or Nasza klasa; at school it is not allowed. S15, Torun, Poland.

Outside the School we mostly use it for social websites like Facebook or Twitter we also like to use YouTube to see other people's projects and we like to share things on the Internet and with our friends and talk with Them. S13, Nuevo León, Mexico.

Image 13: ICT at home' S9, Szeged, Hungary

At school we cannot play games – we have to work with programs. S15, Torun, Poland.

At school we have to finish work within 1 hour, at home we can work as long as we like. S15, Torun, Poland.

My mother does not let me use her computer. She is at the university and she studies a lot with the computer. She is writing a kind of a book. She is afraid I will damage her work… S2, Rio de Janeiro, Brazil.

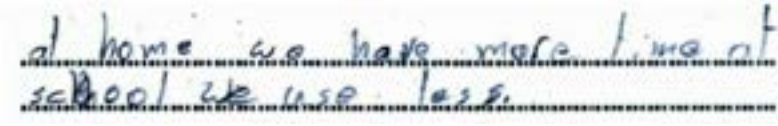



Image 14: 'ICT at home' S28, Dubai, UAE

Outside school, we can explore more games and technologies. Inside the school, space is limited; outside you can explore the world.

At school we only get to play certain games, but outside school we can select our games to play, we can watch movies of our choice at home, we can go to any website that we like (and parents allow us to visit). S35, Arlington, USA.


Image 15: When asked to do an image collage with "what they liked most", students from S9, Szeged, Hungary produced these messages.


Image 16: Student from S9, Szeged, Hungary produced a collage with animals (particularly horses) when asked what she enjoyed most, and horse related software when asked what she liked to do with computers at home.

## World War II – Skype to New Zealand

The day that I introduced the topic World War II to my Year 5 class in Royal Dubai School I quickly realised that all of the planning I had prepared for the next 3 weeks would be useless. Having taught World War II for 3 consecutive years in England I was pretty confident that the activities and lessons I had planned would provide the children with all the skills and knowledge that they needed to understand the war and its impact on children in the UK. I was wrong!

Figure 1: Scan the QR code and you will find http://youtu.be/glOgoPE-v52U, which leads to a video about this activity.

It quickly became apparent in my first lesson that I was dealing with a number of different nationalities, each bringing different perspectives, experiences and stories of WWII. The classroom became a hive of discussion about how each of their countries had been involved in and affected by the war. It was fascinating to watch but I quickly realised that these children would need something much more personal and real to help them understand the perspective of the war from a child in Britain. Books and photographs were useful to an extent but to make their learning memorable and real I had to think outside the box.

That is when I approached our Digital Learning Coach, Mark Stone. I was fortunate enough to have a weekly coaching session with Mark and in that time we had set up Skype links with a school in Sweden, introduced Edmodo, had the children using Dropbox to collaborate in their learning and had incorporated the SAMR model in my classroom, making the children familiar with using the terms of the model to describe their learning.

I would regularly chat to Mark about my classroom practice and the challenges that I faced as a teacher in an international setting. Mark quickly came to know about my ton of useless planning for the WWII project and as I banged my head against a brick wall he told me about his parents' story. Mark's parents had been children in England during WWII. They now lived in New Zealand and had always shared stories of the war with Mark as he was growing up. Mark realised that there was no point in him telling me the story when in fact his mum could tell me the story herself; moreover, through the medium of Skype, his mum could tell the whole class her story.

I raced back to my classroom to tell the children about our idea. The excitement in the classroom was amazing. Children naturally began to collaborate together to create lists of questions to ask and within an hour we had come up with fascinating questions for Mark's mother and father to answer. We emailed the questions to them to have a look at and set up a date for our Skype. In the meantime I used the children's questions to plan my lessons. These lessons were based on their genuine interest in the war and the planning became personalised for my class rather than a general plan to work from. The learning was transformational and the children's motivation was off the scale. They were well and truly gripped and it was brilliant to be driving their learning forward.

On the day of the Skype the children were so excited. They had their questions lined up and, as Mark's Mother and Father appeared on the screen, the whole room fell silent. The children listened attentively to their responses and the level of their questioning indicated that they were captivated by the stories being shared.


Figure 2: Figure 2 Super Skypers" – A poster the children created depicting the different ways Skype is used in their classroom.

Following the Skype session the children wrote letters to Mark's parents. The letters demonstrated that the experience had had a massive impact on the children. They were deeply touched and inspired by the stories they heard and they invited Mark's parents to be VIP guests (via Skype) at our VE day celebrations the following week to signal the end of the topic.

On VE day the children sang WWII songs to our New Zealand guests of honour and shared some of their learning throughout the project with them. The Skype with New Zealand became an integral part of the celebration day.

At the end of the project I was keen to see what the children thought of the process. We used De Bono's thinking hats to evaluate our learning and to think about how we could use Skype in the future to help us engage in our learning. Their responses were honest and inspiring. Skype had given them the medium to engage with WWII survivors who had lived in England at the time. The children still had their own stories of the war but they now had a real understanding of what life was like for children in England during WWII.

Figure 3: Skyping Mrs Stone in New Zealand our 'expert' on what it was like to live as a child in England during World War II.

# 8 Sharing promising practices

In our study, we wanted to obtain a comprehensive picture of the integration of ICT into all aspects of primary education. We asked teachers from our sample schools to provide us with a selection of short, self-contained, narrative descriptions documenting their particular everyday experience, activity or promising practice[34] in the context of ICT, which they would like to share with others. We asked them to send us visual materials, to illustrate aspects of the innovative presence of ICT in their schools. We are presenting some of these across the book as inspiring promising practices and stimulating illustrations.

## Objective

To learn about various everyday activities with students in the context of ICT.

The narratives we collected can be classified into following categories (although most of them would fit well into more than one category):

- Activities directly focused on supporting subjects, including language and literature, mathematics, science, art, design, technology, geography, music, history etc. Technologies are mainly used to improve reading comprehension; for critical thinking and decision making in the reading lessons (e.g. students read a story and collectively, by voting with clickers, modify its course); to support literacy by digital storytelling, expressing oneself with digital images and animations, and recording their own voices; to develop mathematical reasoning by creating Escher tessellations by rotating, reflecting and transforming some elementary pieces etc.
- Activities focused on supporting foreign language lessons, often English, ... "digital technology enables students to use foreign languages in an authentic setting. ... Through technology, the world not only became smaller, but it came alive in the classroom"
- Activities focused on supporting Computing, Informatics, Computer Science or ICT. Programmable digital toys like BeeBots are being used in different contexts; students are creating animated pictures (sometimes using specialized animation software studio); students are developing (programming) their own games with multiple actors and interactions using Scratch or other educational programming environments.
- Activities focused on cross-curricular development (as noted by several teachers, such activities are particularly natural to be implemented at the primary stage). Students are, for example, playing journalists visiting local representatives of various professions and interviewing them. These activities often combine learning goals of Computing or Informatics and another subject.
- Activities focused on the development of 21st century learning, either within the subjects or elsewhere. Older students are preparing a lesson for younger students; a group of students create a product and then present it in front of a bigger community, possibly outside their school; students take part in solving a real world problem, e.g. they virtually connect and collaborate with a group of scientists who are currently on an expedition (analyzing environment, climatic changes etc.); teachers and students work together to learn about compelling issues, propose solutions to real problems, and take action; teachers encourage students to reflect on their learning, realize the impact of their actions, and publish their solutions to a worldwide audience.
- Examples of regional, national or international collaboration, e.g. videoconferencing with other schools or other partners.
- Examples focused on collaboration with local community, parents etc., e.g. inviting grandparents to school to teach them how to use digital technologies for learning.
- Examples of productive cooperation between schools and academic partners, e.g. to better utilise ICT to support SEN students.

[34] Although these narrative descriptions are often referred to as best practices, in our study we prefer to call them promising practices. This, of course, does not mean we do not consider them excellent. The reason is that in the context of harnessing ICT to support learning processes, we still miss a stable collection of criteria of quality. However, the narratives that we managed to collect for our study represent what the teachers themselves consider stimulating illustration of their activities with students, and what they want to share with the public.

## Highlights

Making books on the iPad not only encourages literacy skills, but also allows editing and interactivity. We are planning to introduce this technique to our Year 5s and let them share their skills with Key Stage 1. Already many students in school are using the iPads with a level of expertise which make them fully capable of passing their skills to others whether child or adult.
S29, Dubai, UAE.

Some children, one boy and one girl, after the introduction lesson were so fascinated by the SCRATCH, they downloaded it and installed it on her/his computer at home and started to test its possibilities. During one week they got a lot of experiences including understanding a concept of operator. Their answers and reactions on given task were totally different in a comparison of their schoolmate. S7, Prague, Czech Republic.

The classroom-learning environment has a blended digital toolkit that includes iPads, iPod Touch devices, MacBooks, and interactive whiteboards. This digital toolkit enables students to select their preferred tools for learning, individualizing how students access information, collaborate, express their creativity, and share knowledge. Students express themselves by creating eBooks, producing iMovies, and creating slide presentations, or designing apps. Parents, the community, fellow educators, and international partners access our projects encouraging collaboration, enabling us to learn from one another. S35, Arlington, USA.

Children benefit not just from the use of educational apps, but also from the cross-curricular function of self-assessment. iMovies allows children to demonstrate video skills, but it also allows them to exhibit knowledge, research and understanding of cross-curricular projects. Such movies made by the children can be used as a form of assessment.
S29, Dubai, UAE.

Jamestown is a leader in the deployment of iPad devices, and for appropriate apps for differentiated, personalized learning for students with special needs. Students with Autism are able to make choices, communicate needs and demonstrate what they know and what they are able to understand using the iPad... Jamestown's success with iPads in special education is now replicated across the country. Many other U.S. and international schools have contacted us to learn how to use iPads to reach learners with special needs. S35, Arlington, USA.

Example of a promising practice 15, S21, Singapore

## Digital storytelling

Beacon Primary School is a government school situated in the western part of Singapore. It belongs to the eight future schools under the FutureSchools @Singapore initiative, see edulab.moe.edu.sg/futureschools-at-singapore. The school has taken a progressive approach by providing the necessary computing devices (i.e., notebook computers): the Beacon one-to-one (B121) computing learning environment programme provides each Primary 1 to 3 student with a school-owned computer and, subsequently, allows students of Primary 4 or above to procure their own notebook computers.

Since 2008, when the school started its operations, teachers have developed several interesting and innovative pedagogical practices – for example, the digital storytelling pedagogical approach, where students create their own digital stories with text, images, sound and record their voices. By telling a story, students reflect on what they know, examine their views and record

their own personal experiences. Since storytelling enables students to express themselves and make sense of the external world, it may be used to assess learning goals. In fact, with digital tools, it is even easier to share, revise and even critique stories and learn from one another.

Digital storytelling is integrated at Beacon as a part of the languages curriculum. Students from Primary 1 to 3 create their own digital stories in their language classes (i.e., English and Mother Tongue languages – Chinese, Malay and Tamil).

Figure 1: Students creating their digital stories.

Digital storytelling is realised in two different forms: (a) personal narratives, and (b) complex narratives. Personal narratives are those that have a singular mode of narrating the event that happened to the author whereas complex narratives combine the use of multimodal platforms to present the story. For personal narratives, students create digital stories by recounting their experiences on their learning journeys, such as the Singapore Zoo, or their class experience of making ice cream. For complex narratives, students create digital stories on their learning journey to Chinatown as part of a Social Studies and language curriculum in the form of personal narratives. These digital stories involve the selection of photographs taken by students and uploaded on presentation software applications. Students then recorded their narration on these applications as they recounted their experience and shared their reflection. Music is then inserted into the digital story to reflect the mood of their personal recount. For example, some students selected oriental-influenced tunes for their digital stories on their learning journey to Chinatown. Digital storytelling also evolves into simple animation created with presentation software applications, based on a print version of the fable that students read. Moving images, music and narration were used to represent and re-create the fable for their friends.

In another instance, a Primary 4 teacher has creatively incorporated digital storytelling with drama. Digital storytelling and drama are two pedagogies that have engaging, participatory and immersive qualities. As both forms use story as a means of exploration and of building content knowledge. The teacher successfully incorporated drama and digital storytelling into an English Language module whilst seeking to develop students' authoring skills in information writing and presentations.

The digital storytelling approach is the school's signature approach in the integration of ICT into the learning of languages.

# 9 Conclusion

We are concluding our three-year project ICT in Primary Education, conducted in the name of the UNESCO Institute for Information Technologies in Education from 2011 until 2013. In its first year, we worked with small initial sample of nine innovative primary schools. First outputs of the project were published in volume 1 of this report and comprised:

- Interesting presentations of the historical, cultural and educational background of the ICT in primary education phenomenon
- Deep review of the contemporary research literature in this area of interest
- Short presentations of the sample schools and their activities in this context
- Brief overview of various inspiring national approaches and policies to ICT in education
- Presentation of 16 stimulating national and international initiatives and projects, which connect primary schools and invite them into various exciting national and international collaborations and networking.

Based on our productive cooperation with the nine sample schools from 2011 we extended our sample to 35 schools from 19 different countries and addressed them with our extensive questionnaire. From this we collected a vast amount of data, which we then analyzed by standard qualitative approaches. In our initial reading of the data we identified eight different perspectives, which we then deeply analyzed. The results have been published in the previous eight chapters of Part 2 of this volume. In that way, we managed to meet all initial goals of the project. These goals, formulated at the start of the project, were outlined in Volume 1 thus:

- Demonstrate why governments should invest in integrating ICT into the learning processes of children, and why many of them do so already.
- Investigate the reasons why teachers and leaders use ICT in their everyday pedagogy, what for and, especially, why they should use it in primary education.
- Study the roles of teachers, children, parents and school leaders in this process.
- Study and document the opportunities provided by ICT for teaching and learning (supporting the development of literacy, numeracy, science, 21st century skills etc. in primary schools).
- Collect and share a range of learning outcomes, identifying learning outcomes that may be planned for and expected in this context, examine the limitations of ICT and the associated concerns in primary education.

Part 2 of this volume competently meets all of those goals and offers some answers, comments, observations, and recommendations, corresponding to the current experience and knowledge of the most innovative schools around the world. However, in Volume 1 we specified one more goal:

- Disseminate the experiences of a group of leading primary schools, which IITE will collaborate with during the project.

Now, in 2014, we are going to meet this goal to such extent and in such a form, which we could not have been aware of at the beginning of the project: in cooperation with University of London and its Institute of Education we developed a new MOOC – Massive Open Online Course, the content of which is entirely based on the outcomes of our project. We have good reason to believe that in this and following years thousands of teachers and education stakeholders from around the world will participate from a distance in our open online course titled 'ICT in Primary Education'.

Within the project, however, we succeeded in meeting one extra and special goal, which we did not dare formulate explicitly at the beginning: out of our 35 sample schools, we selected five, in which we managed to conduct deep systemic analyses so that we could publish this as an extensive additional collective case study[35]. In it, each of five schools has been thoroughly inspected from five different

[35] see LIM, C. P. et al. (2014) ICT in Primary Education. Analytical Survey. Volume 3: Collective Case Study of Promising Practices. Moscow, Russian Federation: UNESCO Institute for Information Technologies in Education.

perspectives. Let us present here only one of them and our corresponding findings resulting from one of the schools, to conclude this volume.

The perspective was to identify what the supporting conditions for ICT use in the school are. These are the conditions, which resulted from our observations at S22, Bošany, Slovak Republic:

- The school leaders have a clear vision of the integration of ICT into everyday work, life and play at the school; they initiate it and continuously support it, including giving continuing support to the teachers.
- The integration of ICT into teaching and learning processes has become one of the instruments of a holistic transformation of the school, its values and processes.
- The students and their learning processes constitute the main goal of the integration. The integration supports new pedagogy.
- The school is being converted into a continuous learning environment for all, including the teachers.
- All teachers are innovative, active, undaunted, and creative.
- The school thoroughly develops relationships and partnerships.
- The teachers pay close attention to the safety issues of the students in the digital world.

# Appendix 1: The study methodology

Through the close cooperation with our first year sample of nine exceptionally innovative primary schools, and our previous knowledge, experience and systematic literature review (see Volume 1 of this publication), we managed to identify many different dimensions and aspects of the current process of ICT integration and transformation of primary schools. That was the most important outcome of the first period of the ICT in Primary Education project and we managed to exploit it when developing extensive questionnaire for its second period.

Our intention for the second and the third year of the project was to cooperate with the broader sample of primary schools, better representing different countries, different situations, cultural and social backgrounds, locations etc. Again, we used purposeful sampling to identify several leading innovative primary schools around the world. The extended sample finally incorporated 35 schools from 19 countries, representing different types of schools (often combined either with early years stage or with one of two higher stages in one institution), large and small, urban and rural, state and primate, from less or from more developed regions[36].

The questionnaire[37] consisted of 66 questions organized in eleven groups, from which we wanted to learn as much as possible about each school, how they manage and organize their ICT, which ICT is being used, how and for what, what kind of digital content they use, how the use of ICT fits in the curriculum and how it makes the school change their pedagogy, what types of limitations they face, what type of concerns they (and other actors involved in the process) have, how they provide for equal chances for every student, and much more (the complete text is given below).

The questionnaire was then – in most of the non-English language situations – localized into appropriate languages by members of our team and distributed to all sample schools. In most of the cases, the questionnaire was then collaboratively answered[38] by a group of primary teachers, often together with their ICT coordinator and the school principal. While doing so, they closely cooperated with a member of our team, who in many cases visited them several times in person as well as virtually. Rarely, a single teacher, in the name of her school, answered the whole questionnaire.

In many cases, the collected answers then had to be translated back into English. Altogether, we collected more than 500 pages of texts and large folders of visual materials, products of the students – either photographed or scanned, photographs from various events, scores of video recordings, audio files, documents, presentations, mind maps, etc. Then we divided and rearranged collected data into eight segments and analysed them in detail by standard qualitative process of data analysis. The outcomes comprise eight chapters of Part 2 of this volume. That text of our research report is regularly supplemented by numerous quotations from the teachers' answers and students' statements, and enhanced by a collection of 15 promising practices created by the teachers from our schools.

What follows here is the complete wording of the questionnaire.

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[36] The complete list of the sample schools together with their contact information can be found in Appendix 2.
[37] developed by our team between May and July 2012
[38] from September 2012 till January 2013

## Dear colleagues,

UNESCO Institute for Information Technologies in Education conducts a study on innovative presence of ICT in primary education. Institute aims to put together a book that will be distributed to schools worldwide. The goal of the book is to study aspects and/or challenges of integrating ICT into Primary Schools based on examples from a sample of leading innovative primary schools worldwide. The targeted reader audience for the book is teachers, ICT coordinators, school principals as primary audience and policy makers as secondary audience. We cordially appreciate that you agreed with being our partner for this study as one of the leading innovative schools.

## How to proceed when answering the questions

Through this questionnaire we intend to learn a lot about your school and various aspects of the process of integrating ICT into teaching and learning practice and your whole school environment.

The questions can be answered in a flexible manner: written or via interview with a member of our research team. One or more teachers, ICT coordinator and the principal of your school will probably be involved in producing this complex "story of ICT" of your school. The questionnaire is rather extensive; therefore we divided it into four parts, which may be answered successively, with certain intermissions among them. The parts are:

| | |
|---|---|
| Part 1 | 1 About your school |
| | 2 General questions about ICT integration at school |
| | 3 Managing and organizing ICT |
| Part 2 | 4 Which ICT is used and for what |
| | 5 Digital content |
| | 6 How the use of ICT fits in the curriculum |
| Part 3 | 7 Limitations and concerns |
| | 8 Equal chances for everybody |
| | 9 Big change: inside and outside the school |
| Part 4 | 10 Best practices |
| | 11 Children's perspective |

Our project is entirely focused on primary education (according to UNESCO ISCED classification: primary education usually begins at ages five, six or seven and lasts for four to six years), so kindly concentrate on this age range only. In Part 4 we kindly ask you to provide us with various visual media to illustrate your processes, journey, and achievements. These will supplement and enrich the final book significantly.

## Please note

There are no right or wrong answers to any of these questions. Some questions might call for a short answer, some for a few sentences, and for others you may have no answer at all if it is not applicable to your context. What we hope for is that you answer the questions in such a way that it best illustrates your personal journey and the journey of your school into integrating ICT in the teaching and learning processes.

Thank you for your tremendous help and support for our study,

UNESCO IITE ICT in Primary project research team

# Part 1

Please answer the following questions in as much detail as you find productive to illustrate your school and the process of its journey in the context of ICT

## 1 About your school

Please identify your school:

- its name and address, its website, type of school (run by... )
- who is the contact person for this project (name, e-mail, role)
- approximately how many students do you have, of which age range
- is your school urban or rural
- add whatever you consider specific about your school (its credo, main values, alternative educational system, alternative physical learning space, ... )

## 2 General questions about ICT integration at school

2.1 Do you think ICT should be used in primary education? Why?
2.2 List 5 – 10 key words or expressions to illustrate the use of ICT at your school (these might also include words that children would use to explain ICT at your school).
2.3 What roles does ICT serve at your school?
2.4 When did your school start integrating ICT?
2.5 When did YOU personally start integrating ICT at school? (personal response)
2.6 Why did you start to integrate ICT at school level? Or why did your school start integrating ICT?
2.7 Who started (initiated) the process of ICT integration?
2.8 How did the process start?
2.9 Can you explain the process – what happened when you started integrating ICT?
2.10 If you could restart the process of integrating ICT at your school or in your classroom, what would you do differently?
2.11 How do you keep the staff motivated to integrate ICT and to keep learning new technologies?
2.12 What role does ICT play in parent involvement at your school? Are parents somehow involved in the process of integrating ICT into education?

## 3 Managing and organizing ICT

3.1 How is the space, classroom, environment at your school organized to facilitate the integration of ICT?
3.2 Is the space where most of the ICT is used flexible? If yes, explain how and why.
3.3 What type of technical support is available? Who is looking after the technology?
3.4 What type of daily support is available to staff when they want to try "something new" in their class-rooms? Is there any help available? Explain if possible.
3.5 Do you share technology with other teachers in the school? Explain if possible.
3.6 What access do teachers have to ICT after school hours? Who provided them with this access and why?
3.7 Do you allow children to take technology from school home?
3.8 Do you allow children to bring their own technology to class? If yes, which technology, why, and what for?
3.9 How would you like to change the environment where ICT is used to make it more supportive for teaching and learning?

# Part 2

Please answer the following questions in as much detail as you find productive to illustrate your school and the process of its journey in the context of ICT

## 4 Which ICT is used and for what

4.1 How do you choose what technology will be used at your school or in your classroom (hardware and software)? (E.g. the district selects the type of technology issued to our school)

4.2 To what extend do the learning styles or learning barriers of students play a role when selecting technology to be used?

4.3 List the categories or types of technologies you are using. (Think about hardware and the software that you are using such as computers, mobile devices, cameras, microscopes, robots, digital toys, interactive white boards, different types of software, social media, Internet, communication applications or ...)

4.4 Does your school make use of a Learning management system? Could you provide details of how is it used and why?

4.5 Ergonomics look at what impact the use of technology has on the human body (e.g. the flickering of screens, light in the room, the height of table, the size of the mouse or the shape of the keyboard). In what way does your school take this into consideration when selecting equipment?

4.6 Which new ICT would you like to have? What do you plan to get and why?

## 5 Digital content

Digital content includes software, learning materials, OER, web sites, educational portals, videos...

5.1 From where do you get your digital content? (E.g. the government or a local authority provides preselected software to be used; or our school develops our own content; or we use free source available on the Internet etc. ...)

5.2 How do you choose the digital content for use at your school? Do you have a set of selection criteria? If possible please share.

5.3 Who pays for the digital content used at your school?

5.4 Which kind of digital content do you use?

5.5 Do you use any open source content (like open courseware, open resources, digital content distributed on creative commons licence etc.)?

5.6 Do you share with other schools ideas of how to get the digital content you are using?

5.7 What challenges do you face when selecting and using digital content?

5.8 Do you experience any language issues when selecting and using digital content? (E.g. software in English used in other countries) How do you solve such issues?

5.9 Are you, your colleagues or your students involved in the development of digital content? If yes and possible, please give more details.

5.10 What digital content do you wish you had? What dreams or hope do you have for digital software – which may even not exist at present?

## 6 How the use of ICT fits in the curriculum

The next set of questions deal with pedagogies. When answering these questions, it might help to think of a specific activity where you have used ICT. Think also about what kind of problems do you have to solve... and what you offer your children... to develop their creativity, critical thinking, collaboration, respect to other cultures or opinions etc.

6.1 How is ICT integrated into teaching and learning? Please offer examples of what you do (where you have them), for each of the following:

- Teaching styles?
- Learning activities?
- By topic?
- For skills development?
- Other?

6.2 What curriculum objectives do you meet with the use of ICT? Please offer some examples

| Curriculum objective | How you use ICT to help in meeting it |
|---|---|
| | |
| | |
| | |
| | |

6.3 How do you use ICT for the following skills development? Please give examples where you can, and say Do not use, if you do not use ICT for one of them

- Creativity, Critical thinking, Problem-solving and Learning to learn
- Communication, Collaboration
- Citizenship, Personal and Social Responsibility
- ICT in a curriculum topic
- Digital literacy generic skills
- Computational thinking
- Other?

6.4 How do you organise the children when using technologies? Please choose one or several. If possible, give examples

- whole class work
- in groups
- individually
- in groups of mixed age
- other?

6.5 How are the activities with ICT planned for and prepared?
6.6 What roles do the children play at your school in the process of integrating ICT?
6.6 Are children using ICT to solve real world problems? If yes, please, specify.
6.7 Which other skills develop when using ICT?

- self-monitoring and self-assessment skills
- time management skills
- instruction and negotiation skills
- decision making
- search skills
- technical skills
- other

6.8 How does ICT support personalised learning (i.e. such pedagogy and learning opportunities which prioritize the needs and aspirations of individual learners) in your class and at your school?
6.9 How do you assess children in activities when ICT is involved? Do you plan to modify your assessment methods?
6.10 How do you record and report on the students' use of ICT? Are e-portfolios used at your school for record and assessment?
6.11 How often is ICT used in your classroom?
6.12 Is ICT used only inside or also outside the class-room? Please explain if possible.
6.13 How is technology used to take learning beyond the class boarders? (E.g. you Skype with learners from other schools or you have students that when they are absent from school remotely join the class...)

# Part 3

Please answer the following questions in as much detail as you find productive to illustrate your school and the process of its journey in the context of ICT

## 7 Limitations and concerns

7.1 What are the obstacles of integrating ICT in your school?
7.2 What are the problems faced when integrating ICT?
7.3 What are your concerns when integrating ICT at your school and in your class-room?
7.4 Can you share with other schools how you have overcome some of the challenges you faced when integrating ICT in a Primary School? (E.g. you wanted to introduce Digital Literacy and this was what you did to solve it)
7.5 Safer children in the digital world will always be a concern. What kind of threats are you aware of (in your school – in reality or potentially)? Do you share this issue with your students? With parents?
7.6 What does your school do to safeguard children in the digital world?

## 8 Equal chances for everybody

Schools often use ICT to create equal chances for all students. An example of this could be that a student in hospital could still be part of the classroom through the use of technology or that your school is a virtual school where all students are at remote sites.

8.1 How do you use ICT at your school to create an equal opportunity for all children?
8.2 What kind of inequalities are you aware of (in your school – in reality or potentially)? Do you share this issue with your students?

You could answer these questions by addressing areas such as Inclusive Education, SEN, Gender issues, Socio Economic issues, Migrant students, the fact that your school is in an isolated rural area etc.

## 9 Big change: inside and outside the school

9.1 Reflecting on the past and what has happened since you started integrating ICT in education, what has according to you really changed?
9.2 Why do you think that change took place?
9.3 Have any relations (between students, teachers, students and teachers, between the leaders and the staff,) in your school – in the context of ICT – changed during this period?
9.4 Sometimes we have expectations when embarking on a journey. What changes did you hope for when you started integrating ICT, which did not happen? What happened that you would not have expected?

# Part 4

As you know we would like to include the collection of innovative schools' best practices, and also children's perspective in the book. To represent that we would like you to undertake the following tasks.

## 10 Best practices

10.1 If possible, would you kindly provide us with one or more self-contained short narrative descriptions (up to 200 or 250 words) documenting your particular experience, activity, best practice... in the context of ICT in primary education which you would like to share with other teachers around the world?

We would like you to send us any visual material (of sufficiently good quality to be reproduced in the book), which illustrates the above or any aspect of the innovative presence of ICT in your school. These can be digital photos of events, environment and achievements, scanned or saved products of children etc.

## 11 Children's perspective

11.1 Ask some children how they perceive the use of ICT in your school. List their comments – this could include text, drawings or pictures of learners.

11.2 Ask some children how they would describe the difference in the use of ICT inside and outside school and list their comments here.

We would like you to send us whatever the children produce, either by scanning in paper presentations, or by sending us the digital objects (audio files, word documents, presentation slides, mind maps, digital photos etc.), depending on what you ask them to do.

# Appendix 2: Sample schools

Here we list the complete sample of all innovative primary schools, which we worked with during the second and third years of our ICT in Primary Education project. The sample comprised of 35 schools from 19 countries. Throughout the book, we are referring to them using the following notation: Sn, Town, Country, where S stands for 'school' and its suffix n is a unique number attached to that particular school. If one is interested, the complete reference of each school can be found here.

All schools are listed in alphabetical order by country. First column contains the school reference codes while the second column indicates the country of that school. Third column contains the name of the school and the town or village where the school is situated. The fourth column gives all or some of the following: school address, name of the ICT coordinator or any other ICT contact person, name of the school principal, URL of the school, and the school e-mail.

All listed schools agreed to be listed in this way. It was their own responsibility to include as detailed information in the last column as they wanted to.

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|---|---|---|---|
| S1 | Australia | Bertram Primary School, Bertram | Champion Drive, Bertram<br>Western Australia 6167<br>Contact person: Sarah Hill,<br>Sarah.hill5@education.wa.edu.au<br>www.bertramps.wa.edu.au |
| S2 | Brazil | Escola Parque, Rio de Janeiro | Escola Parque Gávea<br>Marquês de São Vicente Str. 355<br>Gávea, Rio de Janeiro<br>Contact person:<br>Adriana Sobreira Torres<br>adriana@escolaparque.g12.br<br>www.escolaparque.g12.br |
| S3 | Canada | École Cœur Vaillant, Québec | 3430 Boul. Neilson, Québec, QC, G1W 2W1<br>www.csdecou.qc.ca/coeur-vaillant/ |
| S4 | Canada | Pope Memorial Elementary, Bury | 523 Stokes st., Bury, QC, J0B 1J0<br>http://pope.etsb.qc.ca/ |
| S5 | Canada | École Primaire Ste Bernadette, Jonquière | 2908 Ste Émilie, Jonquière, QC, G7S 1S1<br>www.csjonquiere.qc.ca/page_ecole.php?section=23 |
| S6 | Canada | École Ste Margueritte, Magog | 295 Rue Saint-David, Magog, QC, J1X 2Z8<br>http://tinyurl.com/nbsflrv |
| S7 | Czech Republic | Primary and Lower Secondary School, Prague | Základní škola Bítovská<br>Bítovská 1/1246<br>140 00 Praha 4<br>www.zsbitovska.cz |
| S8 | Dominican Republic | Notre Dame School, Santo Domingo | Manuel de Jesús Troncoso 52, Paraíso,<br>Santo Domingo<br>Contact person: María Lorraine de Ruiz-Alma, school principal<br>mruiz@notredame.edu.do<br>www.notredame.edu.do |
| S9 | Hungary | Arany János Elementary School, Szeged | Kukovecz Nana u. 4-6, 6724 Szeged<br>www.arany-szeged.hu |

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| S10 | Hungary | ELTE Gusztav Barczi Methodical Centre and Educational Consultancy School for Primary Education, Budapest | 1071 Budapest, Damjanich u. 41-43<br>barczigyakorlo.elte.hu |
| S11 | Lesotho | Phethahatso English Medium School, Maseru | PO Box 12497<br>Maseru, Lesotho |
| S12 | Lithuania | Taurages "Saltinio" Primary School, Taurage | J. Tumo-Vaizganto Str. 123,<br>72232 Taurage |
| S13 | Mexico | American Institute of Monterrey, Nuevo León | San Pedro Campus,<br>Perseverancia 100, Col. Balcones del Valle, San Pedro Garza García,<br>Nuevo León, Mexico<br>Contact person: Elizabeth Wagner de Huergo, AIM General Director<br>ehuergo@aim-net.m<br>www.aim-net.mx |
| S14 | Norway | Godoy Primary School, Godøy | 6055 Godøy, Norway<br>www.godoy.no |
| S15 | Poland | Primary school, Torun | Zespół Szkół Nr 8, Torun |
| S16 | Republic of Korea | Damyang Goseo Elementary School, Jeollanamdo | Wondeung 1 gil, Goseo-myun Damyang-gun, Jeollanamdo<br>www.goseo.es.kr/goseo.html |
| S17 | Russian Federation | Gymnasium № 1517, Moscow | 11 Zhivopisnaya str., bld.1, 123103, Moscow |
| S18 | Russian Federation | Primary school №1811 of of educational center "Izmaylovo", Moscow | 52 Izmaylovsky Blvd., 105077 Moscow |
| S19 | Russian Federation | School 110 Miguel Hernández, Moscow | 10 Stoloviy pereulok, bld.2, 121069, Moscow |
| S20 | Russian Federation | State-financed Educational Institution (SFEI) Educational Center (EC), i-school, Moscow | 10, Rezervniy proyezd, 121151 Moscow |
| S21 | Singapore | Beacon Primary School, Singapore | Beacon Primary School<br>36 Bukit Panjang Ring Road, Singapore 679944<br>Boon Cheng LIM, school principal<br>www.beaconpri.moe.edu.sg<br>beaconprisch@moe.edu.sg |
| S22 | Slovak Republic | Primary and Lower Secondary School, Bošany | Základná škola, Školská 14, 956 18 Bošany<br>Contact person: Jana Kontúrová, school principal<br>konturova@zs.boosany.edu.sk<br>www.zsbosany.edu.sk |
| S23 | Slovak Republic | Primary School, Lieskovec | Základná škola stredisková 2735/5<br>Lieskovec<br>Contact person: Katarina Valockova, school principal<br>zwkladns@zslieskovec.edu.sk<br>www.zslieskovec.edu.sk |
| S24 | South Africa | St Andrew's School for Boys, Bloemfontein | Contact person: Christopher Thomas, school principal<br>Bloemfontein 9301<br>jennydg@sasb.co.za www.sasb.co.za |

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| S25 | South Africa | St Mary's School, Johannesburg | St Mary's School, Waverley<br>P O Box 981, Highlands North 2037,<br>Johannesburg, South Africa<br>www.stmaryschool.co.za |
| S26 | UAE | Al Ittihad Private School, Al Mamzar, Dubai | Walid Ibrahim Mustafa, school principal<br>Contact person: Dr. Khadeegha Al Zouebi, Asst. Professor, HBMeU<br>K.Alzouebi@hbmeu.ac.ae<br>www.ittihadschools.com/almamzar/ |
| S27 | UAE | Al Khaleej National School, Dubai | Contact person: Dima AlZuhair, head of ICT<br>dima.a_akn@gemsedu.com<br>www.gemsakns.com/home.php |
| S28 | UAE | Dubai International School | Contact person: Dr. Akram Zayour, school principal<br>zeiour@yahoo.com<br>www.dis.sch.ae/dis/index.php |
| S29 | UAE | Jebel Ali Primary School, Dubai | Contact person: Angela Souter<br>ICT Leader<br>asouter@gmail.com<br>www.jebelalischool.org |
| S30 | UAE | Rashid School for Boys, Dubai | Contact person: Peter Williams, ICTCurriculum Coordinator, pwi@rsb.sch.ae<br>www.rsbdubai.sch.ae |
| S31 | UAE | GEMS Royal Dubai School | Contact person: Rebecca McNamara, mcnamara_rds@gemsedu.com<br>www.royaldubaischool.com/BritishPrivateSchool.php |
| S32 | UK | Broadclyst Primary School, Broadclyst | School Lane, Broadclyst, Exeter, Devon, EX5 3JG<br>Contact person: Jonathan Bishop<br>www.bcps.org.uk<br>admin@bcps.org.uk |
| S33 | UK | Burnt Oak Junior School, Sidcup | Burnt Oak Lane, Sidcup<br>Kent, DA15 9DA<br>Contact person: Peter Barrett<br>www.burntoak-junior.com<br>admin@burntoak.bexley.sch.uk |
| S34 | UK | SirJohn Lillie Primary School, London | Lillie Road, Fulham,<br>London, SW6 7LN<br>Contact person: Lee Duffy<br>www.sirjohnlillieprimary.co.uk<br>admin@sirjohnlillie.lbhf.sch.uk |
| S35 | USA | Jamestown Elementary, Arlington | Jamestown Elementary School<br>3700 N. Delaware Street<br>Arlington, VA 22207<br>Kenwyn Schaffner, school principal<br>Contact person: Camilla Gagliolo, Instructional Technology Coordinator<br>gaglioloc@gmail.com<br>www.apsva.us/jamestown |

The ICT in Primary Education project was initiated by the UNESCO Institute for Information Technologies in Education (IITE) in 2011 with the goal to better understand the phenomenon of ICT in the first stage of institutional compulsory education.

The UNESCO IITE Analytical survey Volume 2: *Policy, Practices, and Recommendations* is a continuation of the first report of the Institute's Project "Analytical survey Volume 1: *Exploring the origins, settings and initiatives*" published in 2012.

This report was elaborated by UNESCO IITE in cooperation with a team of leading international experts from Canada, Chile, Hong Kong, Hungary, Slovak Republic, South Africa, Russian Federation, UAE, and UK. The expert team was headed by Professor Ivan Kalaš (Comenius University, Slovak Republic).

The goal of this book is to study aspects and/or challenges of integrating ICT into primary schools based on examples from a sample of leading innovative primary schools worldwide. The authors of the Volume 2 describe a number of emerging technologies and new pedagogical methods. The targeted reader audience for the book is teachers, ICT coordinators, school principals as primary audience and policy makers as secondary audience.

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