Digital Competencies in the Early Years

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The Asian Conference on Education 2014
Official Conference Proceedings

Abstract
The paper presents a model for development of digital skills in early years. The model is structured in four levels and is designed for implementation in Primary school. The content follows the government policy in ICT teaching and learning in Bulgaria.

Year after year, digital skills have become part of a person's literacy. It is of great importance to form a proper attitude in children towards contemporary computer technologies. ICT skills should be used for the implementation of effective learning processes in all educational stages. Students should take the computer as a learning tool, not just as a tool for fun and free time activities.

The main pedagogical accents underlying the model development are: Implementation of project-based learning; Cross-curricular approach; Development of algorithmic, critical and creative thinking. The system follows the spiral and systematic approaches. Methodologically, the model is implemented as the educational system „ITI 1-4", with a full teaching and learning set.

First two levels are designed for use in environment with appropriate user interface for pupils of ages 6 to 8. Students work with graphic painting applications, develop skills to use a keyboard, operate with text working on interesting tasks and during didactic games. The next two levels include more functionality. Students operate with files and folders, create their own projects, and communicate online. A specific feature is the student's E-book consisting of algorithms, video materials, and instructions. Students do text processing, work with images, sound and video files. Skills for working with widespread software products are developed.

Keywords: ICT in Primary school, digital skills

Introduction

Education in Bulgaria is mainly supported by the state through the Ministry of Education and Science. School education is compulsory for children from first to eighth grade. The structure of educational system consists of Basic education (1-8 grades) and Upper Secondary level (4 years). The Basic education comprises primary school (grades 1-4) and (pre-) secondary school (grades 5-8). The Upper Secondary level is provided in three types of schools: comprehensive (general) secondary schools, profile-oriented schools and vocational-technical schools (Figure 1).

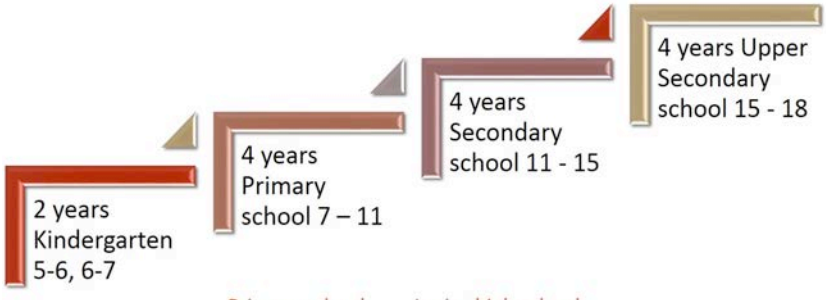

Figure 1: Structure of Bulgarian educational system

Curriculum is unified for all schools. It includes subjects such as Literature, Mathematics, Foreign Languages, subjects from social and natural sciences. The curriculum includes ICT subject which is compulsory from 5th grade. Students from Primary School study ICT in facultative form. There are government educational standards concerning this discipline. According those pupils from first to fourth grade study ICT one hour per week. The content includes knowledge about computer system, software products for processing images, text, multimedia, knowledge about Internet and variety of internet services. Main content kernels are summarized and presented on Figure 2.

1st grade	2nd grade	3rd grade	4th grade
The computer system	The computer system	The computer system	The computer system
Information and data processing	Information and data processing	Information and data processing	Information and data processing
	Informational culture	Informational culture	Informational culture
		Electronic communication	Electronic communication

Figure 2: The ICT curricula's kernels

Theoretical framework

The nowadays education is facing one of the most difficult tasks – to prepare and train children today for their lives tomorrow. In the dynamic and rapidly changing world, contemporary pedagogical science must predict what should be the skills that the tomorrow inhabitants of the land should possess. The importance of 21st century skills as analytical thinking, problem solving, collaboration and communication skills and digital literacy is indisputable. Knowledge building became one of the most important approaches in education.

The construction of knowledge is linked to the use of ICT. Digital competence is essential for the development of any other personal competence. Its formation is a long and complex process, so it should start targeted by school age. There are different methods by which young students begin to learn computer skills. The study of ICT and formation of digital culture should be linked with learning from different areas of knowledge. Learning from and learning with ICT could provide a very useful conceptual framework when integrating ICT into teaching and learning. Learning from the computer inclines towards the behaviouristic theories of learning whereas learning with ICT has its roots in the constructivist and social constructivism paradigms. More passive behaviours such as reading and listening are associated with learning from ICT, while more active behaviours such as creating, writing and updating are associated with learning with ICT (Harris & Rea, 2009). While learning from computers can help students to enhance their performance on basic skills, learning with computers could facilitate the learning of higher-order thinking (Jonassen, 2000; Lim & Tay, 2003).

Many researchers investigating the use of technology in education have found that technology is most powerful when used as a tool for problem solving, conceptual development and critical thinking (Ringstaff & Kelley, 2002, p 5). However, as compared to the learning of basic knowledge and skills, it is much harder to quantify the learning of higher order type of thinking and skills.

Project-Based Learning (PBL) is an innovative approach to learning that teaches a multitude of strategies critical for success in the twenty-first century. Students drive their own learning through inquiry, as well as work collaboratively to research and create projects that reflect their knowledge. From gleaning new, viable technology skills, to becoming proficient communicators and advanced problem solvers, students benefit from this approach to instruction (Bell Stephanie, 2010). A study of the effectiveness of combining a collaborative teaching approach with inquiry project-based learning (PBL) on the development of primary students' information literacy and IT skills, indicates that learning in this type had a positive impact of on the development of different dimensions of the students' information literacy and IT skills (Chu, S.K.W, 2011).

Using different methods and approaches that have proven their effectiveness and following the national educational standards the authors have developed and implemented a methodological system, named ITI for developing digital skills at primary school. The system aims at building knowledge from various scientific fields and development of the skills of the 21st century.

Research Methodology

Methodology is required to establish on what basis and by what methods new knowledge may be obtained. ITI-model consists of three kernels – content, approaches and outcomes. The content follows the government requirements and give to teachers and students variety of exercises and digital resources. The approaches used concern both learning content and methods of teaching and learning at school. Content and methods should guarantee the achievement of the outcomes set. Model implementation aims at development of digital skills to young students, but as well at development of algorithmic and creative thinking and knowledge transfer skills (Figure 3).

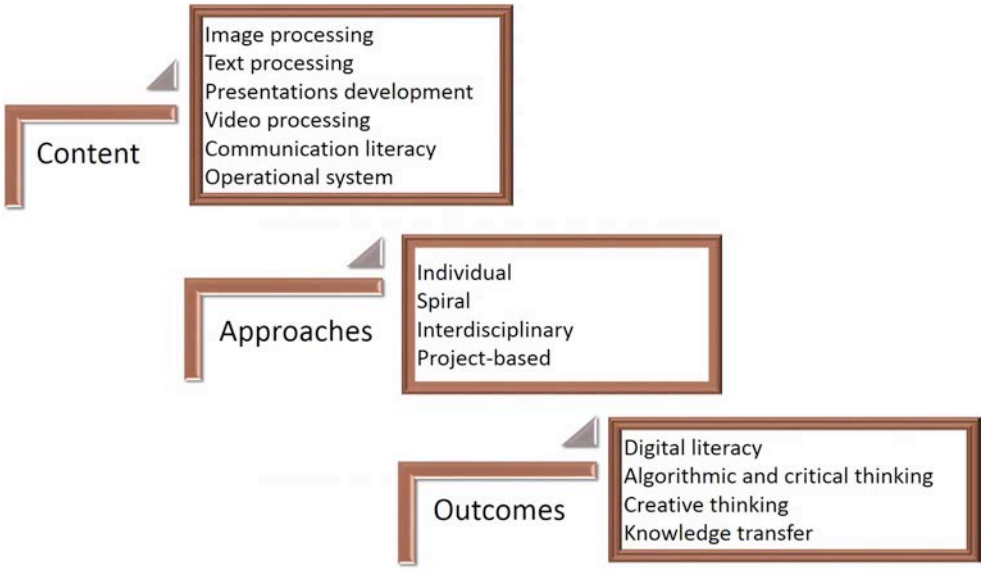

Figure 3: Structure of the methodological system ITI

Content

Digital skills development at primary school level includes skills for working with graphing painting application, text, presentations, video, sound, animation. Children at this age express themselves mainly through drawings, colours, movements, dancing, and singing. Painting and drawing with computer is one of the most effective way to form some digital skills to young students.

On Figures 4 to 8 some examples of computer graphics are illustrated. Different software products for drawing and painting could be used. Within the ITI system all these projects are done with MS Paint application. In first grade students use the painting tool, figures, magnifier, eraser, and airbrush and text tool. On figures bellow the starting points and the final realizations of the tasks are presented.

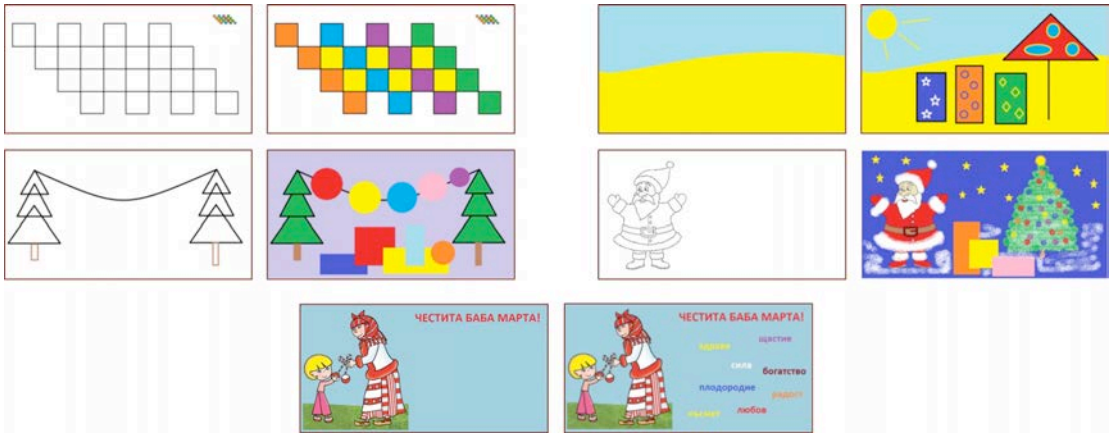

Figure 4: Examples of student's projects at first grade

In second grade students work with variety of brushes. The motoric of children's hands and fingers is on higher level according first grade and working with brushes provoke young students to create more detailed and precise graphic projects. Free hand drawing gives rich opportunities to pupils to express themselves through interesting thematic projects.

The polygon instrument and the tools for rotation of selected objects are very useful for developing spatial orientation in a child. Any mobile organism must be able to navigate in its world to survive and must represent the spatial environment in order to do so. Spatial intelligence is one of the types of intelligence proposed in multiple-intelligence theory of Gardner. Spatial thinking is often difficult and it is important that this thinking to be promoted in Primary school through integrating spatial content (Newcombe, Nora S., Frick Andrea, 2010).

The concept of copy and paste is introduced to students on an intuitive level. They follow given steps – select, copy, paste – without paying attention to the theoretical background of these actions. Later students repeat this algorithm in order to copy and paste text or other objects. In fourth grade some more information about clipboard mechanism is introduced to primary school students.

Another emphasis of the ITI model is the development of an algorithmic thinking to children. Algorithmic thinking is considered to be one of the key information technology concepts that enable people to become fluent with information technologies. Students should learn how to state a problem clearly, how to break the problem down into a number of well-defined smaller problems, and how to devise a step-by-step solution to solve each of the sub-tasks. One example task that provokes algorithmic thinking is presented of figure 5 (the red car with a bear on it). Students are given starting image, created from figures and final picture produced from the starting one. They should produce the same result without teacher's instructions. They should decide how to do it independently.

Figure 5: Examples of student's projects at second grade

On third grade students study about file system. They create graphic projects using external images. The use of MS Paint is on more advanced level – students use colour picker tool and colour editing features, they create figures filled with different art techniques and use the second colour feature of the MS Paint application.

Creating animated images is powerful tool for developing creative thinking to children. Through given examples some animation techniques are presented – change of colour schemes, change of position, and change of size between frames. Students work with Photo Scape – free photo editing software with appropriate interface.

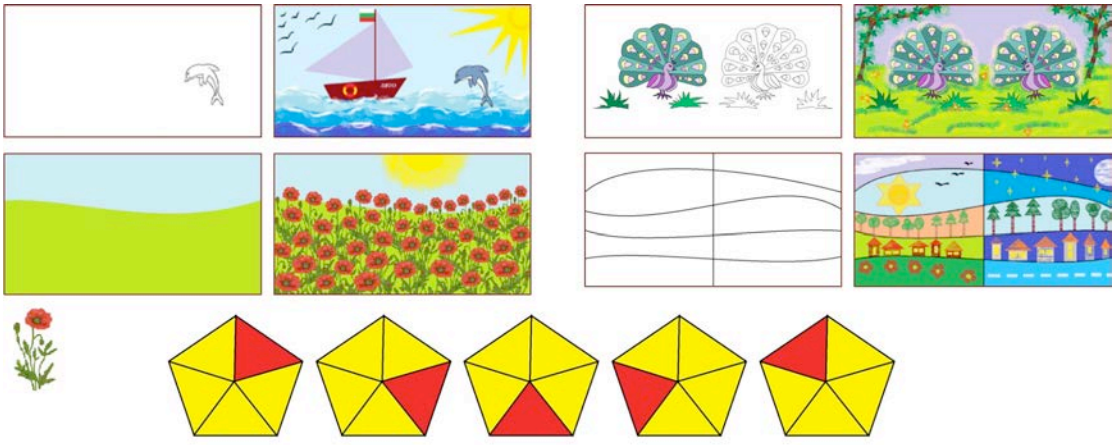

Figure 6: Examples of student's projects at third grade

On fourth grade students create more complicated animations. Children include them into PowerPoint presentations and create animated multimedia products. Graphic projects proposed to students' attention are on quite advanced level and provoke creative and critical thinking.

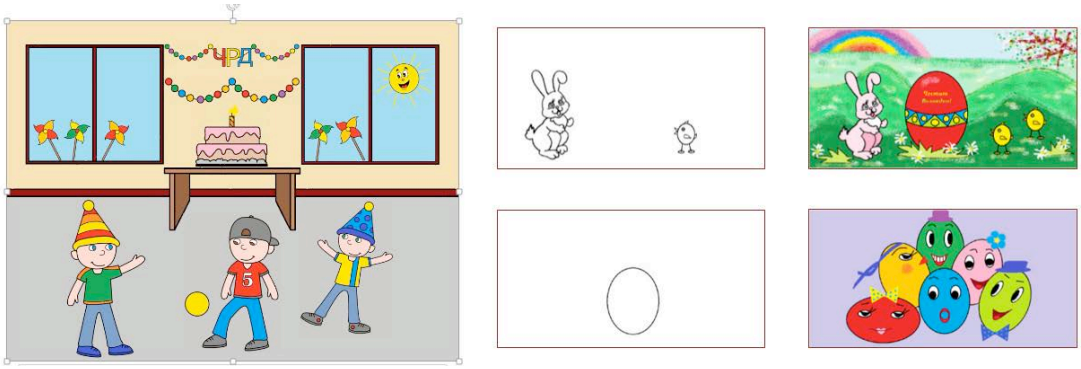

Figure 7: Examples of student's projects at fourth grade

Beside graphical digital skills students acquire knowledge and skills concerning text processing. In the beginning at first grade pupils form skills to work with the keyboard. They enter letters, syllables and single words while playing specially designed computer games, included to ITI educational software package.

All practical work with text from second to fourth grade students do with real text editing software – the MS Office Word. The system of teaching resources includes well-designed and colourful Word documents where students should enter words, sentences or longer text. Gradually to fourth grade students create independently complete reports consisting of text and images (Figure 8). Working with text is of great importance. The skills for entering text and editing and formatting documents are part of the digital literacy which is so important for the future life of the students.

Real research work is closely related with internet literacy and online culture of communication. Within the content kernel named "Electronic communication" students acquire knowledge about Internet and variety of online services like e-mail, messengers, searching engines and so on.

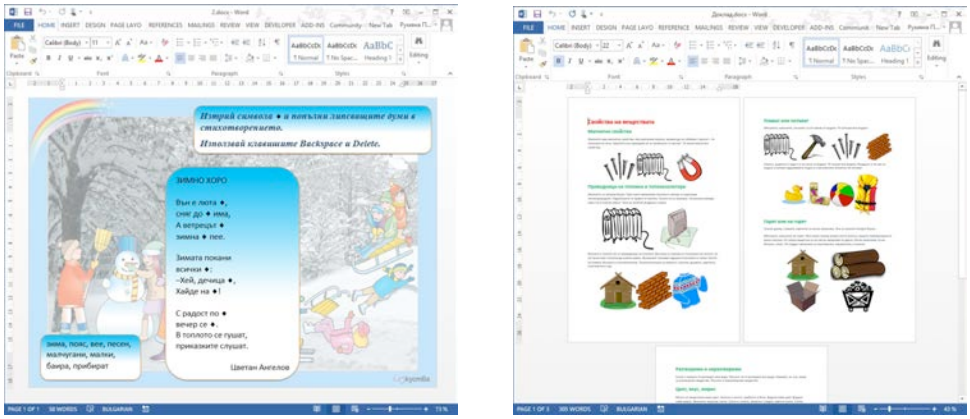

Figure 8: Working with text – comparison between second and fourth grade exercise

The methodological system under consideration includes modules for multimedia skills development – working with presentations, video and sound. Concerning video and sound knowledge students first create photo stories working with Movie Maker. They include pictures, set transitions and effects, add music, title and text. On next

level children work with real video files. They cut or combine clips and produce their own movies.

The acquisition of skills for creating multimedia presentations is very important. By presenting their project works students become more confident and behave in more responsible and self-critical way. Children work with PowerPoint application. They enter text, include pictures, and work with design templates and layouts. Children insert video and music, record sound, set transitions and save their final work.

From technical point of view the model ITI is designed in two conceptual levels. For first and for second grade the educational software packages ITI-1 and ITI-2 offer completely integrated environment. Students have direct access to all exercises and help resources by clicking on certain buttons. They don't need to know something about file system in Windows. On figure 9 the steps of a student's actions are presented. The student first selects a lesson, then selects an exercise from this lesson. As a result the corresponding software application is started automatically for further student's work.

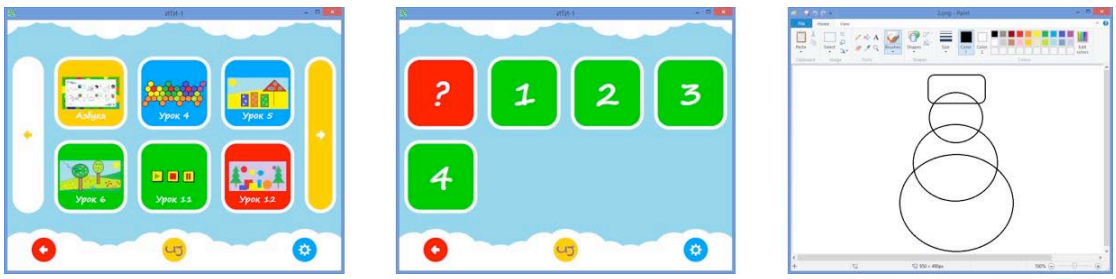

Figure 9: ITI-1 educational software package.

In third grade students acquire knowledge about file system and could work independently with different files containing certain exercises or digital resources as pictures, sound files, video and so on. The software package is no more integrated environment but personalized e-book of the student. All tasks are clearly stated and well-illustrated by pictures. For more complicated algorithms video demonstrations are included. On figure 10 some screenshots from ITI-3 package are illustrated.

Figure 10: ITI-3 educational software package.

Approaches

Today, a real learner-centred approach can be seen in skills-based courses. It can be readily acknowledged that students differ both in ability, prior knowledge and motivation (Mayes J.T. 2004). ITI educational system is multiuser environment and

the individual approach is implemented through registration rules. Each student select his/her avatar (Figure 11) and work independently from the other users, registered on the same computer. This feature is especially useful in classroom working mode. The teacher could check the individual progress of a selected student in any time during the school year, using specially developed administrative module. In third and fourth grade each student could work faster or slower on his/her tasks. The student has access to help resources in any time and could work independently from the others.

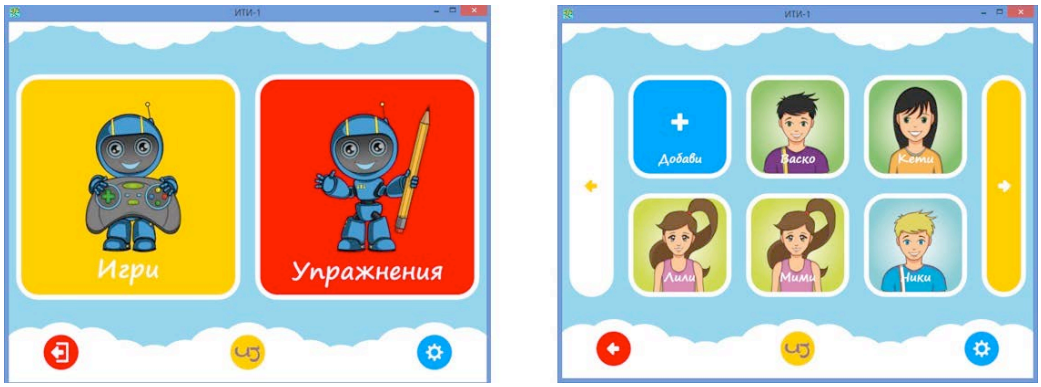

Figure 11: Multiuser environment and avatar's system in ITI packages

Project-based approach is widely used in ITI methodological model. Through creating the content authors' aim was to develop thematic lines and to put students in active position of researchers, creators and presenters. Project work starts in first grade where students create graphic pictures on given theme – to illustrate seasons using geometry figures, to illustrate Christmas songs, to create animal alphabet and so on. From grade to grade the project work becomes more complicated and in third and fourth grade students develop real digital products in form of video, presentations and reports on interesting research and creative tasks (Figure 12). Rich interdisciplinary connections are realized that help students to transfer knowledge between math, science, literature and art.

Figure 12: Example of project-based works

The system follows the spiral and systematic approaches as well. The methodology system is designed to prepare students for further ICT knowledge on next educational levels.

Outcomes

Authors' aim was beside digital literacy some very important skills as algorithmic, critical and creative thinking to be developed. Critical thinking helps students to extract the most important, short and clear content from the huge information flow around us. One way to practice this skills is the realization of researches on variety and interesting for the children topics.

An example of creative task is illustrated on figure 13. Children are given starting template, shown in the down left corner of the frames. Fantastic realizations as colourful, rich and full of objects pictures reveal the unlimited children fantasy and ideas. ICT teaching and learning could be exploit as an excellent tool for developing of creative and original thinking.

Figure 13: Example of creative students' works

Implementation

The methodology system ITI was fully completed. The system is implemented in practice 2014/2015 school year in Bulgarian Primary school. Complete set of student's book with installation disk and all teaching materials for the teachers are presented in figure 14 (Papancheva, R, Dimitrova, K., 2014).

Figure 14: Final realization of ITI model

Conclusion

Year after year, digital skills have become part of a person's literacy. It is of great importance to form a proper attitude in children towards contemporary computer technologies. ICT skills should be used for the implementation of effective learning processes in all educational stages.

Teaching and learning through and with technologies set new challenges to society in general. Developing digital skills at early ages is a way of more effective future education and personal realization of the nowadays primary school pupils.

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