THE USE OF DIGITAL AND MOBILE TECHNOLOGIES IN PRE-PRIMARY EDUCATION

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Abstract

In this contribution, possibilities of an efficient implementation of digital technologies are analyzed in the frame of preprimary education. Nowadays, digital and mobile technologies are part of the daily life of pre-school children. The utilization of various types of digital technologies in pre-schools, together with a current educational approach aiming at an efficient implementation of these technologies can be seen, however, the didactic practice is lagging behind. Digital technologies are essential tools for the learners, including teachers because they have the potential to stimulate a change of perspective on teaching and learning. Preschoolers should be enabled and encouraged to use digital and mobile technologies in their own learning, in order to foster their competencies in information retrieval, creation of solutions, or problem solving. The research presented in this paper focuses on the possibilities of using digital support components and augmented reality in teaching/learning, as well as promoting the development of digital literacy in delivering educational goals. Therefore, it is extremely important for educators to explore the potential of using digital technologies in learning and teaching, together with the benefits of their usage in different areas of life. The research design is quantitative; in the form of a questionnaire, we investigated the views and attitudes of pre-school teachers on the use of interactive whiteboards and mobile technologies in pre-primary education in Slovakia.

Keywords: digital technology, mobile learning, augmented reality, pre-primary education, quantitative research.

1 THEORETICAL BACKGROUND

In current post-modern times, nations and their cultures interweave under the influence of digital technologies, developing the cosmopolitan way of life of educated societies. Digital technologies became a part of lives of individuals and of the society. Individuals use these systems and need to understand how information society technologies may influence creativity and innovation. Digital technologies – computers, communication devices, the Internet, and others – form a natural part of the world of children. Children use them from their early age and technologies serve as a source of knowledge, exploration, expression, and development of their logical thinking. Pre-school children are passionate users of various technological equipment and electronic toys.

Sociologists classify the children born after year 2000 as the “Generation Z”. In their book titled Keeping the Millennials, Joanne G. Sujsjansky and Jan Ferri-Reed claim that modern young people are used to doing several things at once, such as watching TV besides working on a notebook, listening to an iPod while studying, chatting, or texting. Virtual experience is not strictly separated from the real one. They want to be entertained even when working or studying. Numerous psychologists and sociologists divide human generations to “veterans” (born between 1939 and 1947), the post-war generation – “baby boomers” (1948-1963), the “Generation X” (1964-1978), “Generation Y” (1979-1991), and “Generation Z” (born after year 2000). No general consent exists regarding the breaking years; some experts shift Generation Y all the way to years (1983-1996). While some claim that Generation Z includes people born between year 2000 and now, others only include people born in years 1994 to 2004 and classify the children born afterwards as the youngest Generation Alpha. Irrespective of the variances in dating, however, it is already clear that Generation Z is completely different from its parents. It is the technically smartest generation of all times – as soon as in toddler age they are able to find anything on the Internet using YouTube and primary school pupils are able to prepare PowerPoint presentations for school needs, and even animated movies if assisted by teachers. Similarly, to the generations before it, Generation Z has its positives and negatives as well.

The positive aspects of Generation Z: they are technologically skilled, good in building relationships, team-oriented, able to multitask, their moral code. Negatives of Generation Z: they do not understand confidentiality, are dangerously independent, lack certain knowledge.
We believe that we currently have at hand the technology that O. Moore dreamt of 40 years ago. Since the mid-1980s, research of use of new technologies in the development of written language and in learning French as a foreign language in pre-schools was also initiated by French researcher R. Cohen. At that time, she noted extraordinarily interesting findings that interactions of children at a computer were numerous, more numerous than in other parts of classrooms, and the pictures the children selected were increasingly complex and carefully put together [1].

Digital technologies form an important and irreplaceable part of the educational process of teachers and children/pupils in our world. Children/pupils learn globally and acquire new experiences, knowledge, values and opinions also using digital technologies. This is why *digital competences* belong to *competences that need to be developed in pre-schools*. Digital competences include self-confident and critical use of technologies (instruments, etc.) of the information and digital society for various purposes. It is based on the basic skills of use of digital technologies. Using computers to acquire, evaluate, and assess, store, create, present, and transfer information, as well as for mutual communicative exchange and participation in collaborating networks (including social networks) over the Internet. Basic knowledge, skills, values, and opinions related to this competence are: Digital competence requires a corresponding understanding of the knowledge of nature, tasks, and opportunities of use of technologies in information and digital society, in everyday circumstances, in private and social life, as well as in various professional activities.

At present, digital technologies became a part of the lives of individuals and of the society. In the educational context, digital technologies are a system of means, instruments, environment, and procedures used for teaching and learning, communication, collaboration, presenting, creating, etc., for full development of children/pupils/students during education. Partially, digital technologies is a synonym for information and communication technologies (ICT) that is frequently used instead of ICT in educational and other documents in many countries [2].

There are studies aimed at better understanding the use of digital technologies in pre-schools and the potential of digital technologies in supporting children in all decisive developmental areas, when playing and learning. Sceptical opinions in this area are nowadays relatively scarce. In many cases, pre-school teachers enthusiastically defend the educational value of digital technologies. Recently, strategies for digital technologies in pre-primary education were formed in several countries. Never before has such attention been dedicated to the quality of pre-primary education. The New Generation Forum, a group of American researchers, notes that new technologies may serve as efficient supporting components in the development of creative potential of pre-school children. They underline that these children learn with extraordinary efficiency when playing with toys and instruments; this is why we should intermediate digital technologies to them as technological toys and creative instrument. If this statement is applied in the educational process, technological toys and instruments may modify important aspects of the cognitive process of our children as they:

- Change educational relations between children and teachers,
- Support the children by providing them a new, previously unavailable, voice for expressing themselves,
- Offer new ways of creating dynamic outputs, intermediate ideas and notions that have been unreachable for the children before,
- Support development of learning strategies,
- Open new opportunities for social interactions.

An important aspect of perception of didactic use of digital technologies in the educational process is the didactic aspect. This aspect monitors the possibilities of didactic use of digital technologies for teaching, learning, and development of learners in pre-school environments.

Teachers as innovators, researchers – explorers, designers, etc., is another requirement of the present times asking for a role shift of teachers at present, basing on newer perception of didactic organizing of the educational process by the teacher. Reflecting teachers keep considering, the following questions, for example: How would I do/solve that, how did I do/solve that? What do I need to avoid? What is good to remember? What needs to be done otherwise? By that, teachers prove that they are professionals with reflection. Another growth driver of the knowledge network is curiosity, still very strong in children in pre-primary facilities. Excellent teachers in pre-primary education are well aware of that and can create situations in which they sensitively “direct” the children to discovering and learning. They know very well how to assist children in efficient linking of experience and small
discoveries from all educational areas. The purpose of use of information and communication technologies is to support the development of elementary computer skills, but also to support critical and creative thinking.

The introduction of new information and communication technologies into educational activities will contribute to the building of:

- **Cognitive functions**, i.e. development of intelligence, thinking, problem-solving abilities, learning, orientation in an explosion of information, understanding and use thereof,
- **Emotions**, i.e. maturity of the child in emotional intelligence,
- **Motivation**, i.e. increased interest in learning, getting to know, seeking correct values, orientation, both in relation to the child itself and to others,
- **Social skills**, i.e. pro-social behaviour, ability and skill of efficient communication, collaboration with others, and at the time, helping others and forming social relations; children discuss about the programme/game, give advice to each other, evaluate each other’s responses, children become teachers, increase their self-confidence and self-assurance,
- **Self-regulation**, i.e. development of the ability to assume responsibility for oneself and own development, becoming sure that one can influence things and make changes in suitable directions,
- **Creativity**, i.e. flexibility, fantasy, originality, imagination, creative problem-solving, development of divergent thinking, and accepting heuristic methods. [3]

At present, our kindergarten already offers numerous digital technologies: a computer, QOMO interactive board with FLOW interactive software and accessories, ActivBoard interactive board with Activprimary and Activinspire software and accessories, multi-function device, digital toys – Bee Bot, Constructa Bot, digital microscope, digital camera, digital movie camera, EASY SPEAK MP3 microphone, EASY VIEW visualizer, storyphones, tablet, digital toys for role games such as digital cash desk, musical instruments for children, and others, plus educational software such as I'm Starting to Lears (Začínam sa učiť), Happy Ladybird (Veselá lienka), Clown Tom’s PC Circus (PC Cirkus šaša Tomáša), PC Kid’s Corner (PC Detský kútik), PC Natural Societies (PC Prírodné spoločenstvá), Saving Planet Earth (Zachraňujeme planétu Zem), and many others designed for pre-school children.

Augmented reality is a technology that can change a simple sandbox into innovative interactive equipment for education and entertainment. In 2017, Lego started its new Augmented Reality magazines and Lego Augmented Reality-Studio. The application provides a new AR experience. LEGO AR Studio contains six virtual files that intertwine with the popularity of games such as Pokémon. Using our mobile equipment and the Lego AR application, we can show the children 3D models of Lego structures and the children can decide which interests them more.

At present, augmented reality exists in children books for pre-schools. The use of mobile applications with AR technology is a method potentially improving the work of teachers, if it is used right, and may enable the children to participate in the education process more actively. The visual impact of AR is important since motivation is a key factor for children of pre-school age. The use of augmented reality in education extends the work of teachers and motivates children to learning – children, assisted by an application on a mobile device, discover virtual objects in the space and these objects help the children understand new materials [4].

Teachers that use digital technologies in pre-schools must have general knowledge in the relevant field. Teachers are able to:

- Use and integrate digital technologies in educational activities,
- Offer activities on an interactive board to children,
- Offer activities in educational software to children in a targeted manner, complete simple computer programmes,
- Provide various digital toys to children to play with,
- Create situations with the use of programmable toys.

In the kindergarten, we have been successfully including the following digital technologies in the educational activities. We specify the use of some of them in this contribution.
2 USE OF INTERACTIVE BOARDS IN EDUCATION

According to E. Mujkošová [5], interactive board is an electronic device used for interactive learning a learning using digital technologies (such as a computer or a notebook, directly from the interactive board, by clicking interactive pen or by touching (by a finger) the projected picture, etc.). At present, interactive boards can be used in the educational process as didactic (digital aids and/or tools). Using interactive boards, learners and teacher’s subjects use various sources of information (e.g. the Internet, CDs, DVDs, etc.), solve various learning and life problems integrated in the projects, create presentations of own individual projects (children/pupils/students in collaboration with the teacher), present the acquired knowledge directly to the interactive board or from the board, etc. When teaching using interactive boards and creating interactive teaching materials, interactive boards enable the learners to participate actively in the activities presented on the board. One of the conditions of purposeful teaching using interactive boards is quality teaching materials. Various teaching software and interactive teaching materials that teachers may use are available on the market or on the Internet. However, teachers do not need to be limited to the use of finished products as these frequently just update the paradigm of behaviourism and academic approach in the environment of current digital technologies. Teachers can create own interactive teaching materials according to their own ideas and needs and according to the proposals/ideas of children/pupils/students. The ideal situation is when teachers create an environment in which learners are active engaged builders/designers of teaching products in the digital interface of the interactive board. The simplest way to do so is to use the possibilities offered by software such as Microsoft PowerPoint, or other presentation software. When using an ActivBoard interactive board, we use Activprimary and Activinspire software. On the QOMO interactive touch board, we use the Flow software. Interactive boards are not just digital aids for children; it can be concluded that they are becoming toys that children play with every day, mastering what is taught in an entertaining way. Interactive boards offer incredible benefits:

- Use of all sources of information – Internet, CDs, DVDs, etc.,
- Attention of children,
- Presenting everything live directly from the board,
- Children can understand better and faster if they see, hear, experience, and solve tasks actively,
- Solving tasks with parents during common events, and viewing electronic portfolios of children by the parents.

![Figure 1. Presentation called I’ll Be a First-Grader in September – Demonstration.](image)

Modern pre-schools pay a lot of attention to use of digital technologies and integration thereof into the educational activities of kids aged three and up in an appropriate manner as the technologies contribute to the overall development of pre-school children. However, it is necessary to analyse and evaluate the use thereof, to inspire each other in teaching teams to perform creative activities with digital technologies, and to inform the legal representatives of the children about the results.
It is up to the teacher alone:
- To develop their digital literacy,
- To be able to pick suitable digital technologies,
- To watch children during educational activities when using digital technologies,
- To plan further activities and to solve problems.

In practice we see that teachers need to use professional scrutiny using the selection – evaluation – diagnosis process when using digital technologies as didactic tools. In our kindergarten we believe that our way of implementation and analysis of the child – digital technologies – educational activities relationship will be a benefit for everyone involved. About digital technologies in education have been proposed a various spectrum of solutions and analyses [6] – [26].

3 MOBILE DIGITAL APPLICATIONS – AUGMENTED REALITY

The availability and use of digital technologies in pre-schools in the Slovak Republic seems to be insufficient from the didactic viewpoint. Our basis is the practical knowledge of presence of mobile technologies in pre-schools in the entire Slovak Republic using the National Project of Implementation of Digital Technologies in Pre-School Education that was implemented in years 2009 to 2014 by the Centre of Methodology and Education – Education of Pre-School Teachers as a part of the reform of education.

We will present several applications that can be used both in pre-schools and outside them, managed by parents.

1 Quiver-3D Color App - Quiver is a painting application supporting both learning and entertainment. Children can download and print painting sheets for free from http://www.QuiverVision.com.
2 AR Dragon. The educational benefit of this AR application is in care and responsibility. AR Dragon is an application that helps children learn to care for someone with the intention to help the children develop social skills.
3 Sketch AR – The application uses virtual images on white paper as the sample. Success inspires children to continue in their drawings. Children see a virtual image on paper and can use it to make their drawings.
4 AR FlashCards Shapes And Addition. AR Cards Shapes and Addition is an application that can also be used at home. The application assists with development of mathematical operations also at the elementary level suitable for pre-school teaching.
5 Aurasma, Walla Me, QR code. These applications (Aurasma, Walla Me, QR code) can be used to create a treasure hunt in a pre-school. A teacher can hide something (such as a solution of a task). Using the applications, children can decode solutions and/or messages, etc.
6 Animal 4D+. The application is able to show animals in a 3D environment. While children can see animals that they normally see in their natural environment, they don’t have this option with exotic animals. This application helps developing experimental skills supporting learning in children.
7 LEGO 3D – catalogue - Lego 3D catalogue shows new Lego products in 3D animations; this is highly motivating for children. Children are able to watch all parts of the toy from all sides in the application.

4 STATISTICAL ANALYSIS

In frame of declared aims of this paper, particular implementation of digital and mobile technologies in pre-primary education were realized using the quantitative research. Number of respondents was achieved as 443. Methods of questionnaires were applied on field of pre-primary education. This analysis was built on assumptions based on current educational approaches, where a pedagogical practice has not been so widely utilized. According to a priority of current state, results of this analysis can be advantageous for further theoretical and practical extension of this topic.

6 following statistical hypotheses were defined in favour of this empiric analysis:
Hypothesis 1:
1H₀: "There are not statistical significant important dependences between the frequency of using the interactive board and size of a village."
1H₁: "There are statistical significant important dependences between the frequency of using the interactive board and size of a village."

Hypothesis 2:
2H₀: "There are not statistical significant important dependences between the frequency of using the tablets or smartphones and size of a village."
2H₁: "There are statistical significant important dependences between the frequency of using the tablets or smartphones and size of a village."

Hypothesis 3:
3H₀: "There are not statistical significant important dependences between the frequency of using the mobile technologies in education and size of a village."
3H₁: "There are statistical significant important dependences between the frequency of using the mobile technologies in education and size of a village."

Hypothesis 4:
4H₀: "There are not statistical significant important dependences between the frequency of using the mobile technologies in education and age category of respondents."
4H₁: "There are statistical significant important dependences between the frequency of using the mobile technologies in education and age category of respondents."

Hypothesis 5:
5H₀: "There are not statistical significant important dependences between the required level knowledge of mobile technologies in education and age category of respondents."
5H₁: "There are statistical significant important dependences between the required level knowledge of mobile technologies in education and age category of respondents."

Hypothesis 6:
6H₀: "There are not statistical significant important dependences between the required level knowledge of mobile technologies in education and size of a village."
6H₁: "There are statistical significant important dependences between the required level knowledge of mobile technologies in education and size of a village."

Results of the quantitative analysis were achieved using the statistical methods, which can be divided into two categories - the non-parametric and parametric tests. The consideration, which test can be appropriate, is depended on the normality test [27].

As can be seen in Table 1, all hypotheses (1H-6H) were tested using the non-parametric test Kruskal-Wallis, because all data of measured variable (answers of respondents) had not a normal probability Gaussian distribution. Testing this normality using rules in [28] and testing all hypotheses was achieved with results in form of p-value, which is compared with the defined significance level α = 0.05. Form of the analysis was consisted of declared hypotheses testing on existence of the statistical significant dependences between particular phenomenon.
### Table 1 – Achieved Results of Testing Particular Hypothesis 1H-6H.

<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>Analyzed Items in Questionnaire</th>
<th>p-value</th>
<th>Conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>1H</td>
<td>Categorial No. 5, Numbered No. 6</td>
<td>7.1E-5</td>
<td>Zero hypothesis $H_0$ is rejected in favour of $H_1$ on $\alpha = 0.05$</td>
</tr>
<tr>
<td>2H</td>
<td>Categorial No. 5, Numbered No. 8</td>
<td>2.2E-5</td>
<td>Zero hypothesis $H_0$ is rejected in favour of $H_1$ on $\alpha = 0.05$</td>
</tr>
<tr>
<td>3H</td>
<td>Categorial No. 5, Numbered No. 14</td>
<td>0.003</td>
<td>Zero hypothesis $H_0$ is rejected in favour of $H_1$ on $\alpha = 0.05$</td>
</tr>
<tr>
<td>4H</td>
<td>Categorial No. 2, Numbered No. 14</td>
<td>0.006</td>
<td>Zero hypothesis $H_0$ is rejected in favour of $H_1$ on $\alpha = 0.05$</td>
</tr>
<tr>
<td>5H</td>
<td>Categorial No. 2, Numbered No. 20</td>
<td>1.5E-6</td>
<td>Zero hypothesis $H_0$ is rejected in favour of $H_1$ on $\alpha = 0.05$</td>
</tr>
<tr>
<td>6H</td>
<td>Categorial No. 5, Numbered No. 20</td>
<td>0.003</td>
<td>Zero hypothesis $H_0$ is rejected in favour of $H_1$ on $\alpha = 0.05$</td>
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</table>

### 5 CONCLUSION

Various properties of analysed questionnaire data were proved using the quantitative research. All assumed hypotheses were tested on the significance level 0.05.

At present, schools have various mobile technologies that should be used mainly to support the education of children, should serve as a source of motivation or a learning tool, with an intended educational goal, so that interaction between teachers and children lead to a certain change of the learner. According to students’ opinions mobile technologies with AR applications develop communication and collaboration, creativity, social-dramatic games, and teach children to learn.

Augmented reality is a term that is becoming increasingly popular in various work and private environments. It is used both for commercial and educational purposes. It is available in the form of applications also for school children, even in books. It is used mostly for playing, development of fantasy and creativity. We think that this topic offers space for creative exploring activities to teach and learn mathematics, to develop the ability to estimate with resulting data testifying about the real condition in this area at present.

### REFERENCES


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