Digitalization in Early School Education in North Macedonia

Marina Vasileva Connell and Darko Taleski

Abstract This chapter reports on the various initiatives, projects and challenges faced by the introduction of digitalization in the classroom in the Republic of North Macedonia. The Ministry of Education and Science with the help of National experts in setting up the Program for development of ICT in education gave recommendations for implementing changes in the educational process and suggested the development of strategies for the sustainability of such essential transformation. The good reactions to, and active participation of, young students and teachers to innovative projects supported by many institutions and external financial help allowed the easy implementation of ICT also in schools in rural areas. These led to several prizes being awarded by Microsoft in the international context to digital programs developed and used by students in primary schools. The further challenges represented by the distance learning imposed by the recent pandemic were linked to the lack of available digital platform and have been overcome thanks to the clear guidelines received from the Ministry of Education, the creation of video and the support from private initiatives and the dedication of Macedonian experts from abroad the country. The importance of Friends of Education meetings to informing, and doing workshops for, teachers facilitating the implementation of STEM digital innovative programs in the classroom is also outlined.

Keywords Application of ICT · Digital tools and digital projects · STEM · Robotic · Distance learning

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1 Introduction

The Republic of North Macedonia, after independence (1991), faced new social and economic relations that imposed the need to take note of modern European and world global trends and technologies and to incorporate them as much as possible into educational activity. Hence, schools should supply knowledge commensurate with the environment in which the students are expected to live and work, which implies implementing modern technologies and giving more weight to STEM contents in teaching.

The intensive and rapid development of information and communication technologies (ICT) leads to an inevitable massification of their use in daily life, to the diversity in their use, need of readiness for constant and rapid innovation for prompt and adequate reaction to changes in societies.

It is worth to remember that North Macedonia is a multiethnic and multicultural country. The population by end 2022 was 2.08 million persons. Primary and lower secondary school students in 2021/2022 were 186,649 and in the upper secondary school 71,018 (State Statistical Office, Republic of North Macedonia). The teaching is in 4 languages: Macedonian (official language of the country), Albanian, Turkish and Serbian. The country has 21 higher education institutions and 7 Universities.

This chapter attempt to explain how the Republic of North Macedonia, since its independence, has sought to adapt its education system not only to economic and social changes but also how reacted to digital challenges.

2 Events Related to the Computerization and Application of Digital Technologies for Education in the Republic of North Macedonia

Computerization and digitization in the Republic of North Macedonia developed intensively after 2002, when a Chinese donation was received which enabled a certain degree of mainstreaming of ICT in primary and secondary schools. This donation encouraged state institutions to start thinking about the need for sustained and adequate systemic reforms and transformation of education, to respond to the demands of competitiveness, competence, participation and connectivity, imposed by global and European societies, and the modernization of their educational systems. In that sense, the changes in education that referred to the intensive introduction of ICT in the educational process required the re-definition and strategic restructuring of the educational system in the Republic of North Macedonia. They were intended to lead to social and educational development, and at the same time encourage the creation and incorporation of new programs, as well as initiatives for equipping schools, and above all for the effective and innovative use of ICT in the educational system. As

a result, in 2005, the National Program for the Development of Education 2005–2015, the Draft Program for the Development of ICT in Education (2005–2015) was prepared by the relevant institutions and working groups of experts and began to be implemented.

According to the report of the Foundation for Sustainable Information Solutions, Metamorphosis, issued in June 2010, on the topic "*The use of computers in the educational system in the Republic of North Macedonia*", the chronology of the events has been the following:

- 1986
  - Informatics as a subject was introduced in secondary schools.
- 2002
  - The government of the Republic of Macedonia received a donation from the Chinese government of 6000 computers for primary and secondary schools.
  - Microsoft supplied 6000 licenses for using Windows on school computers.
- 2003
  - The USAID e-School project, at the initiative of the Government of the Republic of Macedonia, deployed 2000 computers in 91 secondary schools from the Chinese donation.
  - Immediately after that, initial training for using them began.
- 2004
  - The Ministry of Education and a group of experts prepared the National Education Development Program 2005–2015.
  - The National Project Modernization of Education began to be implemented.
  - By the end of the 2004, all secondary schools received a computer laboratory with 20 computers through the e-School project.
- 2005
  - The Commission for Information Society prepared a National Policy for Information Society.
  - In April, the Information Society Commission and a working group of experts prepared the National Strategy for the Development of the Information Society.
  - In July, the Draft Program for the Development of ICT in Education (2005–2015) prepared by the Ministry of Education and a working group of experts was published.
  - FIOOM provided computer laboratories with an additional 225 computers in 45 primary and 180 computers in 18 secondary schools
  - Through the "Macedonia Connects" project, 460 primary and secondary schools were provided with internet until 2008 (WLAN in 360 primary schools and LAN in 100 secondary schools) (Metamorphosis Foundation 2010).

3 Application of ICT in Education in the Republic of North Macedonia

In 2004, the National Program for Development of Education was prepared by the Ministry of Education and Science and the National experts group. A part of this program was the Program for development of ICT in education which put more stress on implementing digital technology in education, giving recommendations for changes in the educational process as well as the development of strategies for sustainability of transformation in the educational system. The vision of this program was digital literacy for all teachers and implementation of ICT in education, digital literacy of students starting from 4th grade, networked schools with fast internet connections and multimedia computers, support services for the development of educational multimedia content in mother tongue. It also prepared an action plan for digital literacy in the primary, secondary and high schools following the National program for the development of education. Before 2002, the use of ICT in teaching was carried out in the context of the school subject Informatics on the basis of several computers per school. Informatics was implemented for the first time in high schools in 1986. By 2002, the intensive computerization of education began at the initiative of the then president, Boris Trajkovski, with the provided donation of 6000 computers. In addition to that donation, Microsoft also donated 6000 licenses for the use of the Windows operating system.

However, the provision of ICT equipment was not sufficient for the final use in primary and secondary schools; therefore, the United States Agency for International Development (USAID) got involved as a strategic partner in the realization of the effective integration of ICT in education. From that year, USAID began to implement programs such as "*e-School"* (2003–2008), "*Macedonia Connects"* (2004–2007), and later the "*Primary Education Project"* (2006–2011) in order to provide continuous support for computerization in education. Over these 8 years, these programs enabled the provision and installation of ICT equipment, software and internet infrastructure, as well as the provision of training for teachers on the integration of ICT in teaching.

In September 2003, the "*e-School"* project deployed 2000 donated computers in 91 secondary schools and began implementing teacher training. At the start, a computer laboratory was piloted in each of three high schools, and by the end of 2004, all high schools received a computer laboratory with 20 computers.

In 2005, an additional 3000 donated computers were installed in 360 central and remote district primary schools. Computer laboratories in primary schools were provided with 5–20 computers depending on the number of students (Draft Program for the Development of ICT in Education, 2005) (Hathaway 2005). In 2007, an additional 1500 computers arrived in primary schools. During that period, the Open Society Foundation Macedonia (FIOOM) and USAID additionally donated another 400 computers (180 in 18 secondary schools and 225 in 45 primary schools) (Draft program for the development of ICT in education, 2005). Also at the beginning of the school year 2005–2006, computers in both primary and secondary schools were

connected to the internet through the "*Macedonia Connects*" project, implemented by USAID, the Government of the Republic of North Macedonia, the Education Development Agency (AED) and the internet provider ONNET. In total, 460 primary and secondary schools were provided with internet for three years by this means.

Within the *"e-School"* and "*Macedonia Connects"* projects, a series of trainings was provided for primary and secondary school teachers on basic ICT skills, as well as trainings for the integration of specific software solutions in interactive teaching Windows tools, Toolkid (ToolKid, etc.), web site development training (Mambo) and the use of the internet for search, collaboration and communication.

The government project "*Computer for every child"* began to be implemented at the end of 2006 in 366 primary and 93 secondary public schools in the Republic of North Macedonia, and was based on the National Program for the Development of Education (2005–2015). Computers were planned for every student in primary and secondary schools.

This project took place in several, interdependent segments:

- Procurement, installation and maintenance of equipment;
- Creation of local networks and internet connection;
- Training of teachers on the use of equipment, software tools and e-content;
- Development of learning management environment (e-obrazovanie.mk);
- Development of electronic contents and electronic textbooks (skoool.mk, e-ucebnici.mk).

The implementation of all segments was started, and depending on the project plans, each of them had a different level of progress.

Edubuntu, the Linux distribution, was chosen as the operating system for the purchased equipment. Along with the operating system, the Ministry of Information Society identified over 120 educational tools from the subjects: informatics, mathematics, physics, chemistry, geography, musical art and Latin language. From them, the experts from the Education Development Bureau selected 43 that best correspond to the educational goals in question. The applications were localized in Macedonian and Albanian language (Ministry of education and science of the Republic of North Macedonia 2021).

In 2021, the Ministry of Education and Science of the Republic of North Macedonia adopted a new Concept for Primary Education. The new Concept describes the need for further digital integration in primary education in the Republic of North Macedonia, emphasizing the need for a combined approach to learning through digital platforms and distance learning, as well as the use of digital technology to support the inclusion of students with disabilities in regular teaching.

Within this concept, national standards are defined, including the competencies that students should acquire by the end of primary education, across eight areas. The fourth area is digital literacy, which refers to using ICT as a source of information, using it skillfully and effectively for problem solving, sharing ideas, communication and collaboration within the school and outside it, creating digital content, as well as the ethical and safe use of digital technology in everyday life. Digital competencies are intended to be acquired through their inclusion in several compulsory and optional

teaching subjects. In the content of the curriculum for each subject, the national standards are implemented through the competencies that students should acquire, which are related to the specific program, as well as the transversal competencies that should be included in most curricula, one of them being digital competencies, i.e., digital literacy (Ministry of education and science of the Republic of North Macedonia 2021).

4 International Successes of the Teachers from the Republic of North Macedonia in the Innovative Use of Digital Technologies in Education

In the process of digitalization of education in North Macedonia, as well as popularizing the use of digital technologies in education, the Microsoft team in North Macedonia made its contribution in the period from 2009 to 2017 through the Partners in Learning program. Within the framework of this program, several events were organized with the aim of encouraging teachers to use and integrate digital tools in the teaching of various teaching subjects.

Some of the activities that were carried out during this period are the following:

- Partners in Learning monthly newsletter for teachers to learn about the latest Microsoft tools that have applications in education
- Microsoft Innovative Educators Forum—a competition for teachers for an innovative way of using digital tools in education. The first forum organized in December 2009 supported by USAID
- The forum for children's safety on the internet
- Competition in entrepreneurship for secondary schools in cooperation with the British Council
- Microsoft Hour of Code week—the week of coding is an international event promoting programming for students as a way to solve problems, develop logical and critical thinking and creativity (Blog post 2017).

Teachers from Macedonia have achieved distinguished results from participating in the Microsoft Forum of Innovative Teachers, for several years in a row. The **Grandma's Games** project was winner out of 80 other projects from Europe at the European Forum of Innovative Educators in Moscow in 2011, thus taking it forward to the world Microsoft Innovative Educators forum 2011 in Washington DC where they were 1st Runner Up in the category Educators' Choice.

The Grandma's Games project was implemented as an interdisciplinary approach to learning in which students, through physical activities involving playing, interacting, competing, creating digital learning resources, and using the latest technology for programming, were able to develop key twenty-first century skills through all the project cycles. The project emerged as a multicultural bridge between students and teachers of different ethnic backgrounds as well as from different geographic regions

across the country and beyond (Vasileva 2011a). As the founder and author of this project, Dr. Marina Vasileva Connell was given a series of awards, first at the national level, then onto the Microsoft Education Olympiad for Innovative Teachers where she achieved first place at the European level in Moscow, and finally when she won at the global level in Washington DC.

The project activities were realized within a curriculum that applied interactive playing and gaming methods, acquiring knowledge from outside the classroom walls, from the school playground, with open access that allowed the implementation of various workshops using different devices and technologies, including a pioneering application of robotics. Regular lectures were conducted according to a predetermined program, for which, the author of the project developed a special manual for teachers (Vasileva 2011b).

Different methods were implemented to achieve the students' learning objectives including, the "web-quest" method, "learning by doing," critical thinking, role playing, use of community resources (e.g., organizing a visit to school by grandparents and creating events with traditional grandma food recipes in different communities), learning from each other (video conference classes between schools from different regions and countries), Grandma's Games Idol (competition for the best lyric, best music for the anthem and best singer), PRES method (Point, Reason, Example, Summarize), enquiry based learning, etc. At the same time, the project endeavored to show maturity in critical cultural heritage and traditional values connected to life and technology, children's rights and democratic values.

The key benefit emerging from the project was a recognized need to find ways to deal with the negative impact of the increased time spent playing video games on the physical and mental development of children, while at the same time discovering its potential as a tool for digitalization of the cultural heritage.

4.1 Grandma's Games Activities

The project activities, in line with the curriculum, enabled students to develop an interest in the use of both their native language and English as essential means of communication in the world, to learn the power of public oral skills and modern presentational skills using ICT, to come to know old traditions as a characteristic feature of their national identity. While collecting the Grandma's Games, playing the role of "the journalist," they created survey questionnaires and developed listening, writing, communication and comprehension skills (Malinovski et al. 2014). They enhanced their abilities in oral expression while explaining the games to their peers via video conference classes involving more than 150 schools (Malinovski et al. 2015). In addition, students learned to apply the standard linguistics norms (phonetic, morphological, syntactic, lexical and spelling in their mother language and in the English language).

In art classes, students developed their sense of color, line, forms in open space; they broadened their art literacy through the illustration of the games; they developed

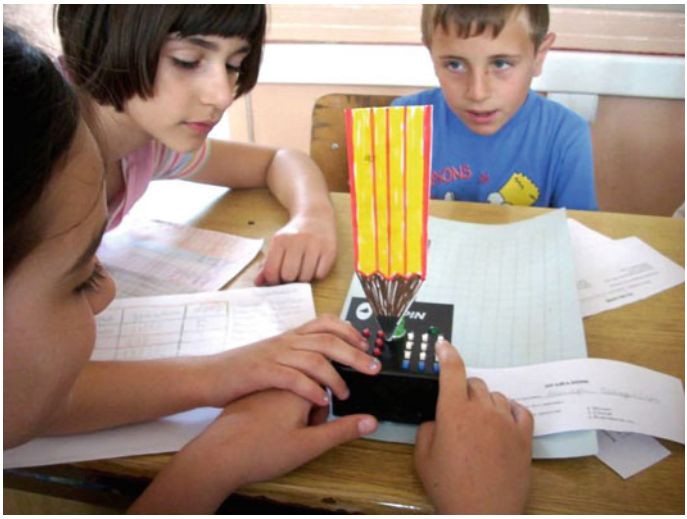

Fig. 1 Students' activities

their creative abilities and acquired experience for coherence in composition; they gained new technology skills such as drawing in MS Paint (Fig. 1).

Mathematical concepts were adjusted according to develop cognitive skills and abilities of the students. For example, the game "Lady (Dama)" is correlated with other subjects and develops perception ability (particularly visual and tactile), orientation in space and time, process thinking, ability to analyze and synthesize abstractions and generalization in deciding next steps in the game or solving specific problems.

Grandma's Idol was directly linked to Music Education. In terms of the curriculum, the games offered an opportunity to encourage intuitive positive behavior, empathy and physical development, enhance self-esteem, and develop perseverance/responsibility, accuracy and good work habits. Students were collected, classified, compared, presented and interpreted data.

The logical thinking involved in games strengthened behavior as well as competitive skills among students (Vasileva et al. 2014).

The collaboration took place in the following key directions:

- Student–student of different age (mentors), regions and countries through MSN, e-mail, video conference links;
- Teacher–teacher from different regions and countries to exchange project ideas and develop activities;
- Students–other people from different professions to achieve joint products.

Through the games, students were gradually introduced to problematic situations, encouraging them to develop their critical thinking over a number of steps:

1. First, to allow them to consider how they can influence their peers with an idea to reduce the time spent in front of an IT device, to develop creative research and to conduct a survey to collect the most popular Grandma's Games. This also allowed them to develop further thinking on not only how to play and have a fun but also on how to learn and develop new skills (Stojanovska and Vasilev 2014).
2. Secondly, students grasped their own learning while playing Grandma's Games, establishing logical links between the games and making generalized conclusions about the set tasks as a challenge.
3. Thirdly, they were able to interpret the findings, self-evaluate with justification both of their evaluation and of their ability to ask critical questions and lead productive discussions.

The project introduced new ways of learning which focused on "learning by doing" and all participants of the project were driven by the motto *"Let's play games, let's be friends, let's learn together!"*.

4.2 The Technology Context

A mixture of MS applications and other tools were used: designing and reporting research/interview survey (MS Word and Excel); illustration of Grandma's Games drawing in MS Paint; writing the games rules in MS Word; presenting the games using MS Power Point; exchange of collected information in between schools via Windows Live MSN (@live account and videoconference); programming a robot Pippin to draw shapes, such as rectangles and squares and to recreate the design of the old game known as Hopscotch; video recording and processing the games played in the school yard with Movie Maker; publishing the calendar and poster with 12 Grandma's Games using MS Publisher; presenting the games pictures using Auto Collage and Photo Synth; and a final Grandma's Games portfolio published in MS OneNote. Some of the technologies such as Movie Maker, Skype, MS OneNote and Publisher were introduced for the first time to this primary and lower secondary age group of students. This led to organizing student mentorship groups who were in charge of performing various sets of activities based on these applications and then transferring the knowledge to other students. For the first time, MS Kinect was introduced to play the game "Zavor," where children not only had fun playing one of the Grandma's Games in Kinect (X-Box) but also learned how to convert measurements in innovative ways. Students achieved curricular learning objectives using ICT in different ways, for example, online MSN and Skype video conference links (Vasileva 2010). Students wrote the game rules and survey reports about the games on a computer, and they then created Bing maps about the geographical origin of each game. They drew their own designs for games, inserted the data in MS Excel tables, developed surveys in MS Word, recorded videos with a Flip camera and then published each game. They created presentations in Power Point, took pictures of activities and made an auto collage of images. Using MS Songsmith, students wrote

a huge number of poems and lyrics for the Grandma's Song competition, composed an anthem for Grandma's Games, and then selected the best singer to perform the anthem. The impact of the games in comparison to the usual mode of accessing technology enabled more ecological and healthier patterns to the child's learning and their physical development and well-being.

4.3 Stop-Motion Animation

In 2012, the project "*Fun education stop-motion animation*" as a state representative at the European Forum of Innovative Teachers in Lisbon, Portugal, was winner in the Teachers' Choice category. By winning this competition, the project was taken forward to participate in the Global Forum of Innovative Teachers 2012, which was held in Prague, Czech Republic, where it was 1st runner up in the Teachers' Choice category.

The leader of this project was the co-author of this chapter, Darko Taleski, an art teacher. He, together with Sofia Grabuloska, also an art teacher, Zorica Trajanoska and Dragica Zdraveska both English language teachers, and Mirjana Trompeska, a mathematics teacher, conceived and developed the project. In the second phase of the project, representatives from the Faculty of Information Sciences and Computer Engineering Bojan Kostadinov and Nikola Mijanovic were also involved. As result, more than 45 animations for 12 teaching subjects from students aged 8 to 14, in total more than 500 students and 30 teachers from North Macedonia were involved in the realization of this project.

The challenge was making stop-motion animations from all types of school subjects in primary and secondary education spanning from STEM to humanities. This project proved that stop-motion animation is adaptive to all school subjects, age and levels.

The aims and learning outcomes of the projects can be summarized as follows:

- Use of stop-motion animation in education.
- Wide-ranging new working classroom method capable of reaching students with different motivations and interesting them in science subject and technology, economically affordable anywhere independently of resources.
- An opportunity for cross-disciplinary teaching and learning, adaptive to more than one style of learning and teaching outcome (like one video = multipurpose storytelling, quizzes, interactive lesson, feedback on learning outcomes, competition).
- Develop critical thinking and skills in practical learning, allow the students to play a very active role in the two levels of the learning process: the content and the technology (Fig. 2).

In addition, the students found making stop-motion animation very stimulating as they learned the subject and developed their animation story. They first learned to do photography prior to computer processing which added to their interest and

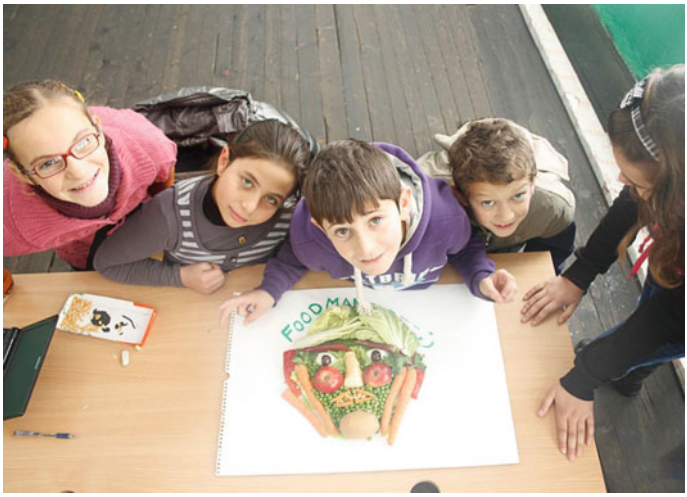

Fig. 2 Students' activities about healthy food, "Fun education, stop-motion animation" project

motivation and encouraged them to modify, change and adapt the subject to obtain the wanted result. The process of creating stop-motion animations helped the students to visualize and make models for certain phenomena in the field of sciences, making them more understandable. Stop-motion animation was introduced in education for the first time in North Macedonian.

4.4 This is My Voice

Two years later in 2014 at the next Microsoft Teachers Experts Forum held in Barcelona, Spain the project "**This is my voice**", conceived and lead by Darko Taleski and Sofija Grabuloska, was the winner in the category Collaboration.

Teachers and students between the ages of 13 and 15, from 2 rural primary schools in 5 different villages, participated and gave voice to the project. They used digital technology producing powerful videos, animations, posters, and photo stories that provided the young people the possibility to explore and express their opinion on issues that their peers are facing in the rural community. Two distinct topics *Premature marriage*, often used to get away from family, and *Cultural heritage* and one joint media project on *Bullying* were worked on by the two schools. They created 16 targeted media products, including 3 animations, 3 videos, 4 photo stories and 6 posters providing their vital viewpoint on the issues that their peers are facing. Student art exhibits were organized in each school, and in a final exhibition the students spoke out for changes in their own and other people's lives (Taleski 2013).

5 Digitalization in the Time of Pandemic

The changes that occurred with the introduction of quarantine drastically changed everyday life and had a great impact on the education system, one of the most affected areas. As a consequence of this, the need to use digital tools for teaching by teachers in North Macedonia was rendered inevitable. Teaching staff were forced into activities for which most of them were not prepared. The closure of schools and the transition to online teaching in the Republic of North Macedonia was introduced at the beginning of March 2020 by a decision of the Government. A basic problem that appeared in the transition to online teaching was the lack of an online learning platform for primary and lower secondary school in Macedonian that teachers could use. At the beginning, according to the guidelines of the Ministry of Education, each school was allowed to choose a free platform that they could use to connect with students, share digital content, and create electronic tests. Google Classroom, Edmodo and social networks were the first platforms that were most accessible to teachers. They also faced a lack of digital educational content for most of school subjects in the mother tongue. This deficiency was more noticeable among teachers who teach in a language other than the Macedonian language (Metamorphosis Foundation 2020).

The project "Setting up an environment that enables the improvement of the quality of teaching and learning through co-creation and innovation," was started in March 2020 during the pandemic with the Eduino platform. The Eduino portal is implemented by SmartApp—the Laboratory for Social Innovation, funded by the Government of the United Kingdom through the British Embassy in Skopje with the support of the Education Development Bureau as an institution responsible for pre-school, primary and secondary education, the Ministry of Education and science, the Ministry of Labor and Social Policy of the Republic of North Macedonia, and UNICEF (InnovationLab 2020a). The project aimed to encourage innovation in education and create an EDUINO community, a group for professional cooperation and sharing, with the aim of collaboratively creating resources and strengthening the skills of the teaching staff. Through this project, teachers had the opportunity to be actively involved in the creation of digital teaching content for various teaching subjects by recording video lessons that were shared on this platform. The portal was enriched with a large number of resources, i.e., video lessons for teachers and students who had the opportunity to apply them during online teaching. Within the framework of the project, webinars were organized for teachers on various topics aimed at helping with the implementation of online teaching. By the end of 2020, 2,925 videos for primary education were created, 13 webinars were held, attended live by a total of 1,700 teachers, and a total of 155 published educational activities (InnovationLab 2020b).

The support of teachers and students with online content included private initiatives such as the portal Science for Children, organized by the *Kantarot foundation*—a foundation for science, culture and mental fitness founded by Nikola and Dragana

Stikovi. Nikola has a bachelor's degree, a master's degree and a doctorate from Stanford University, and currently works as a professor at the Polytechnic Faculty of the University of Montreal. Dragana has a bachelor's degree in management from UKIM and a master's degree in educational administration from Santa Clara University (Qantarot 2019). The *Science for Kids* portal aims to bring together scientists, teachers and media experts in one place, and that in times of a pandemic when the need for digital educational content had become great! Interactive digital contents from the fields of: mathematics, physics, chemistry and biology have been placed on the portal. On this portal, interactive digital content in mathematics has been uploaded, a total of 39 content for students 11–14 years old, physics a total of 24 content for students 13–14 years old, chemistry a total of 49 content for students aged 13–14, biology a total of 32 content for students aged 12–14 years old. In addition to the interactive content for these teaching subjects, other activities have been published that include science from different areas, given as an opportunity for website visitors to create and share them (Nauka za deca 2020). In order to popularize science among children, the first "*Science for Children"* conference was organized in March 2021, which includes workshops for children where they had the opportunity to get acquainted with holograms, brought them closer to the world of magnets, activities to encourage children's curiosity and get to know the scientific method, discussions were held on the topic of play and learning, technology and the future of education.

At the beginning of the 2021/2022 academic year, the Ministry of Education and Science of the Republic of North Macedonia, in cooperation with the Faculty of Information Technologies and Computer Engineering, launched the national online learning platform for primary and secondary schools www.schools.mk. In order to interact and implement live online teaching, the platform was connected to the Microsoft Teams communication platform, which is part of the Microsoft 365 cloud service that was provided to all teachers and students in primary and secondary schools in North Macedonia (Ministry of Education and Science of the Republic of North Macedonia 2020).

The well-known Macedonian physics teacher, Aida Petrovska, puts a lot of effort into creating digital online resources for both teachers and students. Her statement for this matter…. "*I am glad that lately there is a space opening for the introduction of STEM classes in our educational system, which implies interdisciplinary learning of science through technology and engineering. For me, STEM is a perfect model no matter how rejected it is in our school system, the excuse such as pocketing funds for equipment that STEM requires, is not a big issue, in reality, it is not large funds, to be honest, we spend much more irrationally funds and aimlessly. Education and motivation of the physics teaching staff is needed, and the students will be more motivated by the very novelty—taking a break from chalk and blackboard. Students through practical examples get to know the ways of making life easier and dealing with many life challenges and problems*" (Petrovska 2020).

Fig. 3 First Educonference for teachers and IT experts 2015

6 Other Initiatives for Using Digital Tools in Education in the Republic of North Macedonia

The non-governmental sector has also made its own contribution to the development of digitization in education in North Macedonia. One organization that has had a big impact on promoting digital tools for education is Friends of Education[1] a nonprofit organization for promoting the modernization of education through the use of digital resources while simultaneously embracing a holistic approach to teaching and learning. It was established by a group of teachers in 2014 as a result of the international successes they had in the innovative use of digital tools in education.

The Association Friends of Education become known in North Macedonia for organizing the First Educonference for teachers and IT experts in 2015 which was the biggest conference for education organized in North Macedonia (Friends of education 2015) (Fig. 3).

The following years were organized 5 more conferences. On conferences took place many international and domestic experts in science, IT, robotics and pedagogy. Various topics were covered like STEM education, robotics in education, prosocial values, open education resources, professional and career development of teachers, digital tools for teaching, science and art in education, virtual and augmented reality in education, inclusion in education and gamification in education. The last Sixth Educonference for teachers and IT experts was held in September 2022. It was dedicated to the Robotics versus Bullying, Erasmus + Project KA3—Support for Policy Reform 612872-EPP-1-2019-1-IT-EPPKA3-PI-FORWARD, in partnership

[1] https://www.friends-of-education.org/en/.

with organizations and institutions from Europe, Polo Europeo Della Conoscenza (Italy), Friends of Education (North Macedonia), CLEMENTONI S.p.A, Ministry of Education (Spain), University of Burgos (Spain), Ushak Provincial Directorate of National Education (Turkey), Panevezys District Education Center (Lithuania), Kino Information Technology Education (Bulgaria), MAKE IT BETTER Association for Innovation and Social Economy (Portugal), Association ARID (Poland), ASOCIATIA SINAPTICA (Romania).

The project, Robotics versus Bullying, an Erasmus + Project KA3—Support for Policy Reform, started in 2021 and will last until the middle of 2023. Its goal is to prevent bullying from the early age of school through the use of cutting-edge educational pedagogical strategies built on the cooperative use of robots in a co-constructivist setting. Combining peer education as a technique for inclusion, learning by doing in the field of educational robotics, socializing, learning and teamwork with innovation, learning and education. Learning by doing helps students become aware of bullying and cyber bullying. By providing teachers with courses that advanced their knowledge, the project worked in both the classroom and higher education sectors.

The values of this project are innovation and cross-disciplinarity, requiring a more innovative approach from teachers in their teaching while recognizing the challenges of social inclusion. At the conference were presented educational contents and practices for the implementation of STEM education—robotics, which allows students aged 6–12 to take their first steps in science, technology and engineering in a fun way and through social inclusion. The outcome is not only to increase students' digital skills, but above all the skills in problem-solving, critical thinking, experimentation and teamwork which are crucial in a child's present and future life (Friends of education 2022a). Teachers from North Macedonia and partner countries took active role on the conference by organizing 20 workshops covering the topics of innovative use of robots in the classroom including: Coding and robotics tools for inclusive and interdisciplinary approaching in the classroom; RobotArt-Drawing while programming; how to implement Roby's educational games in class; Robotics in Scotland's Primary schools—Bringing STEM to Life, the 4th Education Revolution (Friends of education 2022b).

Another initiative is the project "Digitalization of services in the education sector" (CUP 2021) funded by the Government of the United Kingdom, through the British Embassy in Skopje, and is implemented by the nonprofit, non-governmental organization Development Association, Center for Change Management (CMP).

This project's main objective is to further digitalize educational services, which are frequently used and can have a significant influence on both users and the Manufacturing Execution System (MES) as service providers. The project includes the complete digitalization of these services (reaching transactional level in accordance with EU benchmarks), support for restructuring internal MES administration processes for these services, development of MES administration capacities for services administration, and creation and delivery of promotional campaigns to encourage the target user groups to use the e-services. The implementation of the project was in the period from October 1, 2021 to March 31, 2022.

7 Conclusions

After describing the chronological development of events related to the computerization and digitalization of education in the Republic of North Macedonia, limited to primary and lower secondary school, we showed how in practice teachers created many innovative examples of the use of technology through interdisciplinary project activities.

Today, more than ever, ICTs define society not only in terms of access to information but dictate its transformation into a society of knowledge, ability and skills. The real transformation of society is achieved only if education responds with effective changes through the introduction and application of new concepts known as *Teaching for the twenty-first century, Learning for the twenty-first century and Skills for the twenty-first century*. Following these concepts, ICT is clearly not only a means for the realization of educational goals but also a significant factor in the complete restructuring of the educational system, the introduction of new interactive and participatory models of teaching, new educational pedagogy, continuous and lifelong learning.

Annex 1: Links to Digital Applications for Teachers

Grandma's Games Manual for teachers. https://www.academia.edu/9753118/GRANDMAS_GAMES_Teachers_Manual_Marina_Vasileva

Fun education stopmotion animation teacher manual https://www.academia.edu/s/2901997916

Eduino, North Macedonia web platform for digital educational content, collaboration and professional development of educators https://www.eduino.gov.mk/

Nauka za deca (Science for children) is under the patronage of the civic initiative Kantarot, with the desire to promote scientific culture and mental fitness among the youngest https://naukazadeca.mk/

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