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## Smartphones and children's mathematics

*Today – 20 years after the birth of the World Wide Web, 13 years after the launch of Google Search, eight years after the start of the first social networking site, six years after the first YouTube video, four years after the introduction of the first touch-screen smartphone, three years after the opening of the first “app” store, and a little over a year after the first iPad sale – the media world that children are growing up in is changing at lightning speed.*

*(Zero to Eight: Children's Media Use in America, "A Common Sense Media Research Study", Fall 2011)*

“If you are having fun, you are not learning,” proclaimed a sign located in a classroom in the movie *Matilda* (1996). This sentence perfectly describes the contemporary educational situation, especially – and not just in the opinion of children, but also adults – in the context of subjects associated with the development of mathematical competencies. Maybe we still cannot accept the slogan: “learning by playing,” which is considered by many to be the motto of the Enlightenment.

This article aims to show how children act in the world full of media, while presenting some smartphone applications that can help children learn mathematics.

A smartphone, or a device equipped both with a telephone function and internet access, is still called by many in Poland a “mobile phone” and has become not only a communication tool and an excellent entertainment gadget, but it also increasingly often acts as a source of information and a device that supports the education of both adults and children. A smartphone can be

owned by any person, regardless of age or financial status. Such conclusion can be drawn from the *Report on the Telecommunications Market* which was released in 2010. The data presented in this report show that over 47 million people used mobile services in 2010 in Poland. This allows the authors to assert that "Polish market penetration was over 123%, which gave nearly 47 million SIM cards used by consumers."<sup>1</sup> Obviously, the number of new users has been increasing all the time, but since 2007 it has not been growing so rapidly because almost everybody already has a mobile phone (a traditional one or a smartphone). According to a study commissioned by UKE in December 2010, 90.1% of Poles reported having a personal mobile phone. This is confirmed by data according to which over 51 billion text messages (SMS) were sent in Poland in 2010, which shows that, statistically speaking, every owner of a mobile phone/smartphone sent around 1350 text messages during the year.

A smartphone is a composition of various media and it implements, in a practical way, the idea of "media convergence."<sup>2</sup> The most modern smartphones can also act as a radio and television, as well as display good pictures or HD quality movies, and allow users to surf the Internet with all its wealth of information. A smartphone can function as a recorder, alarm clock, watch and a very sophisticated calculator. This device allows users to communicate both verbally (voice communication) and nonverbally (SMS, MMS). These are only some of its possible applications.

Interestingly, not only parents but also children can use a smartphone without any obstacles except for the fear that they can break it down. Obviously, a child may use only some of its functions, services or applications. It can be a source of amusement, contact, and knowledge. P. Levinson found that mobile phones had become portable, interactive and mobile "hearth and home," i.e. a device which is available to all household members (also the youngest!).<sup>3</sup>

In Polish literature the issue of the use of smartphones by children has not been actually taken up yet.<sup>4</sup> The impact of mobile phones on youths or

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<sup>1</sup> *Raport o stanie rynku telekomunikacyjnego w Polsce w 2010 roku* [A Report on the State of the Telecommunications Market in Poland in 2010], Urząd Komunikacji Elektronicznej, Warsaw 2011.

<sup>2</sup> N. Negroponte, *Życie cyfrowe. Jak się odnaleźć w świecie komputerów* [Being Digital], Księążka i Wiedza, Warsaw 1997.

<sup>3</sup> P. Levinson, *Telefon komórkowy: jak zmienił świat najbardziej mobilny ze środków komunikacji* [Cellphone: The Story of the World's Most Mobile Medium and How It Has Transformed Everything!], Muza, Warsaw 2006.

<sup>4</sup> Cf. M. Klichowski, *Nowoczesne media w edukacji dziecka* [Modern media and a child's education], in *Aktywna edukacja w przedszkolu i szkole. Teoria i praktyka* [Active Learning in Kinder-

adults is studied in the context of the media and the relationship between children and the media mainly has pejorative connotations. Increasingly, however, researchers discuss the escalation of digital inequality in Poland and the consequences of lack of access to the latest technology for children from disadvantaged social groups. At the same time, they fail to take into account that smartphones, which are considered to be relatively cheap and within easy reach and which can be easily connected to the Internet, have been radically changing the image of this inequality as they provide an opportunity to overcome this problem by introducing technology to these groups.

It is easy noticeable that the methods and tools for exploring the world as well as education and communication forms are changing with the development of technology, which not only facilitates but also changes our everyday life. Attitudes to education, work, friends and family have also changed. This affects social relations, behavior, and even the rhythm of the day.<sup>5</sup> The student and the teacher are less and less "attached" to one place of education. One can certainly learn while studying at different universities around the world, but one can also do it without going out of one's room, without changing the place of residence, while on vacation with parents, waiting at the doctor's office, or sitting in the backseat of one's parents' car on the way to school or home.

Smartphones, with their user-friendly interface, intuitive control and a huge variety of available applications, offer entertainment, useful information and lots of fun, which makes them very popular among children and adolescents. Recent research by Nielsen Company (USA) shows that almost 1/3 of applications in parents' phones have been installed by their children. "A closer look at the responses of those whose children had downloaded apps onto their (the parent's) phone, reveals that the average age at which their youngest child started downloading apps was nine. When asked what percentage of the apps on their phone were downloaded by their children, these parents reported that 30 percent of the apps on their phones were installed by their kids."<sup>6</sup>

In response to the growing demand and in order to meet the expectations of young users, market penetration of smartphones and tablets has increased more than ever before. Software companies are exploring new

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garten and School. Theory and Practice], eds. H. Krauze-Sikorska, K. Kuszak, Wyd. Naukowe WSPiA, Poznań 2010.

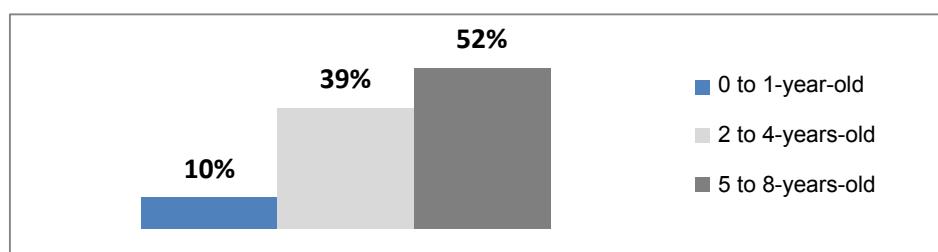
<sup>5</sup> W. Hołubowicz, P. Płociennik, A. Różański, *GSM. Cyfrowy system telefonii komórkowej [GSM. A Digital Cellular System]*, Holkom, Poznań 1996.

<sup>6</sup> *Advice on children and smartphones*, 2011, <http://www.kidsandmedia.co.uk/advice-on-children-and-smartphones/>, [accessed: 18.04.2012].

areas of science while dealing with digital devices and producing educational applications for mobile devices. The need for a thorough discussion on this subject is confirmed by a British study: "almost nine out of 10 school pupils aged seven to 11 have a mobile phone, although less than three-quarters have books at home, reports the National Literacy Trust. With mobile use so widespread, the UK education sector is waking up to the opportunities that technology can offer in reaching everyone from pre-schoolers to undergraduates."<sup>7</sup> As far as e-learning is concerned, the youngest media users were not taken into account for many years because of the barriers associated with equipment operation. With the appearance of smartphones, and especially tablets, these obstacles and fears were found trivial, whereas the vision of e-learning became more realistic.

Many companies started developing "simple" smartphone apps, but the introduction of tablets made it possible to create more interactive devices, with more complex shapes, as well as logos in richer and more vivid colors. As Andrew Carley says "it is learning through fun and creativity, rather than learning for learning's sake."<sup>8</sup>

The report entitled *Zero to Eight*, which was published in autumn 2011 by Common Sense Media and which deals with the use of the media by children aged from 0 to 8, begins with the words that are quoted on the first page of this article. The report aims to provide reliable data concerning young children in order to improve their lives. It says that even very young children are frequent users of digital media. "Half (52%) of all children now have access to one of the newer mobile devices at home: Either a smartphone (41%), and the video iPod (21%), or an iPad tablet or other device (8%)."<sup>9</sup>



**Figure 1.** The use of new media (smartphone, iPod, iPad or similar devices and applications) by children at different ages

Source: [www.commonsensemedia.org](http://www.commonsensemedia.org).

<sup>7</sup> N. Smith, *The rise of the mobile pioneers*, "Marketing Week" 2011, Vol. 34.

<sup>8</sup> Ibidem.

<sup>9</sup> V. Rideout, *Zero to Eight. Children's Media Use in America*, "A Common Sense Media Research Study", Fall 2011.

According to the report, 29% of parents download applications on smartphones for their children, and 38% of children have used at least one of the mobile devices mentioned above. The use of new media (smartphone, iPod, iPad or similar devices and applications) by children at different ages is shown on a graph.

The fact that children have been using new media does not necessarily mean that they develop their mathematical skills. It should not come as a surprise to anyone that, from an educational point of view, the media are a means of teaching, not only a teaching aid. As early as in 1990 Wojciech Skrzyplewski wrote about the growing role of the media in the intellectual development of the individual. The fact that media such as smartphones can also be intellectual tools is still, however, not so obvious to everybody.

A smartphone is an intellectual tool which can affect the development of the individual in society in a way that is widely considered educational. Nowadays, this device, which is understood as an intellectual tool, is not only used for transmitting and processing information or for communication. This device allows one to expand knowledge through gathering, presenting and spreading information. People do not take passively what they are offered by this device, but they actively create and modify data stored in it. Nowadays there is a continuous trend towards making personal devices that are equipped with functions which exceed their own and sometimes even human receptive and use-related capabilities.

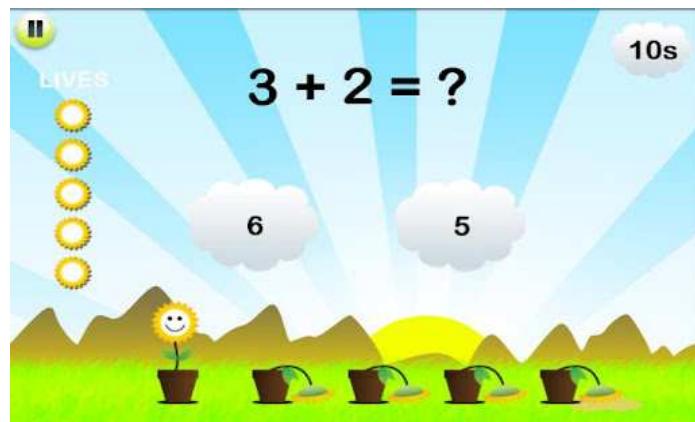
A smartphone, which has been used to facilitate voice communication over the years, has also been evolving into an increasingly perfect mobile tool. It has become a multi-medium tool which offers increasing possibilities in a single, small and handy object, whose size and capabilities can be adjusted to its users' needs. But it is not the device itself that is most important. In order to talk about children's mathematics in the world of smartphones, one needs to look at programs and applications that might help develop the mathematical competences of the youngest users. According to data which were presented earlier in this article, "among all children ages 0 to 8, about one in four (28%) has ever used educational gaming apps (dry as puzzles, memory games, math, or reading programs) on a cell phone, iPod, iPad, or similar device."<sup>10</sup>

In this article we present games, applications and programs which may help develop children's mathematical competence and which are dedicated to devices with Android system, as it is one of the most popular operating systems used in mobile devices in Poland. All the applications presented here are available for download via the Android Market for free.

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<sup>10</sup> Ibidem.

The first application is “Math Training For.” It is colorful and its menu invites children to play a math game. Unfortunately, it is in English, but it is still very intuitive, so a child can easily understand all commands. It includes some exercises that support the learning of addition, subtraction, multiplication and division. One can choose from among three levels of difficulty while working with the program.



Screenshot 1. Math Training For

Source: play.google.com.

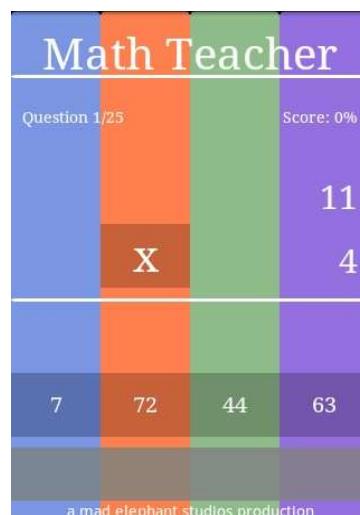


Screenshot 2. KidMaths

Source: play.google.com.

"KidMaths" is a program which is advertised with the slogan: "Math can be really funny and easy to learn." The idea of this game is based on another well-known and popular software used in mathematics education, i.e. Tux-Math. This game has been designed for children and its purpose is to teach numbers and basic math skills such as typing numbers as well as performing the operations of addition, subtraction, multiplication and division on different ranges of numbers. It can be played in pairs – two people can be using the same device.

"Take your time and carry out joint exercises in mathematics every day. This will help your mind to become more efficient and you will be able to solve problems faster," says the advertisement of the third application called "Math Teacher."



**Screenshot 3.** Math Teacher

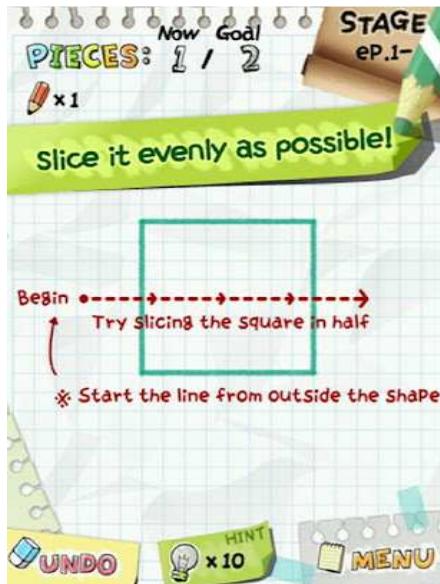
Source: play.google.com.

The program encourages one to do mental arithmetic exercises at any time. It improves addition, subtraction, multiplication and division skills, and the available levels of difficulty may surprise many adults.

Another application became the "Winner of the 2011 Best App Ever Awards." The authors ensure that it is an excellent tool for intellectual exercises:

"Slice It!" is all about slicing shapes into fragments that are equal in size. Sound easy? It may start out that way, but soon you'll be cutting into fragments that will puzzle you like never before. Brainteasing puzzles: over 200 Basic Stages

and a five-star rating system so you can play until you get it right! [...] Each level is a new shape, and each stage has increasingly difficult fragmentation levels.<sup>11</sup>



**Screenshot 4.** Slice It!

Source: play.google.com.

The last application is “Math Maniac.” The aim of this game is to connect numbers in 10 seconds so that their sum is equal to the one presented in the bottom left-hand corner. Colorful, simple graphics and background music make such an approach to solving a mathematical problem attractive to children. However, the element of competition involved in collecting points for correctly solved task within a certain time period makes it attractive for adults as well.

In Poland it is still believed that some of us are “humanists,” while others are “science-minded.” Gruszczyk-Kolczyńska states that, in the opinion of many people, “to learn school mathematics special skills are required.”<sup>12</sup>

<sup>11</sup> <https://play.google.com/store/apps/details?id=com.com2us.sliceit&hl=en>, [accessed: 18.04.2012].

<sup>12</sup> *Wspomaganie rozwoju umysłowego oraz edukacja matematyczna dzieci w ostatnim roku wykowania przedszkolnego i w pierwszym roku szkolnej edukacji. Cele i treści kształcenia, podstawy psychologiczne i pedagogiczne oraz wskazówki do prowadzenia zajęć z dziećmi w domu, w przedszkolu i w szkole* [Supporting the Mental Development and Mathematical Education of Children in the

Despite the fact that more and more people are aware of how unfair and unjust this assertion is, very few people remember that "well-designed opportunity to learn mathematics can help improve mathematics achievement,"<sup>13</sup> and the best opportunities to develop children's mathematical skills occur during spontaneous play which is full of fun, and a smartphone is an excellent tool for that. In fact, it seems that smartphones physically implement the famous words of Hugo Steinhaus' student - Józef Łukaszewicz, who wrote the following in the introduction to a Polish edition of the classic book *Mathematic Kaleidoscope*: "In the 'world of mathematics' which is full of charm, reality is like a fairy tale and wonders become real."<sup>14</sup> Let us use smartphones and give our children a chance (which we did not have when we were kids) to see math as a friendly fairy tale.



Screenshot 5. Math Maniac

Source: play.google.com.

Last Year of Kindergarten and the First Year of School. The Objectives and Content of Education as well as the Psychological and Pedagogical Basis and Guidelines for Teaching Children at Home, in Kindergarten and in School], ed. E. Gruszczyk-Kolczyńska, Edukacja Polska, Warsaw 2009, p. 11.

<sup>13</sup> A.H. Wang, *Optimizing Early Mathematics Experiences for Children from Low-Income Families: A Study on Opportunity to Learn Mathematics*, "Early Childhood Education Journal" 2010, Vol. 37, p. 295.

<sup>14</sup> J. Łukaszewicz, *Od redakcji obecnego wydania* [From the editorial team of the current issue], in *Kalejdoskop matematyczny* [Mathematical Snapshots], ed. H. Steinhaus, WSiP, Warsaw 1989, p. 9.

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