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# Mobile Technologies As the Medium of Change based on the Classroom Experiences of Teachers from Four European Countries

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The article presents results of a qualitative research conducted among 83 respondents (28 teachers and 55 students) from four European countries, using tablets for work at school. The aim of the research was to investigate the scope of mobile technology usage in teaching and its usefulness in supporting the educational process based on the experiences of teachers and students. The individual interviews and focus group interviews present a picture of teachers and students who realistically assess the advantages and disadvantages of tablets and who now redefine their role in the educational process as a result of their exposure to the pedagogic use of mobile devices

**KEY WORDS:** mobile technologies, social change, innovation, creativity, teamwork

# 1. Introduction

"The term «change» (...) is the key to understand our times; for many, the future will happen too fast"[1] wrote Alvin Toffler at the beginning of the 1970s, diagnosing the end of the industrial stage of development of human civilisation and the advent of the third post-industrial wave, with the dominant role of information and new communication technologies. His forecasts, which are almost 50 years old, remain surprisingly valid: in reality, in the catalogue of features defining today's world, the category of change still occupies a central position. Cultural, economic, technological and social transformations are happening rapidly in all areas of human existence existence, solidifying the conviction that today, the sole stable feature of the world is, paradoxically, the change. "We are dealing with a total change," writes Mirosław J. Szymański "(...) In this situation, a new reality is created, along with changed needs, new stimuli and barriers that become factors designating the course of human life."[2] He is supported by Krystyna Pankowska, who stresses that such changes "first of all intensify contrasts between generations and, secondly, change the life of individuals, posing new challenges in various areas of existence, including in the realm of education, work, attitude towards the world and values. In this manner, new and hitherto unprecedented pedagogical problems emerge and multiply rapidly."[3]

In this complex situation, the role of the teacher has to be redefined, whereas the catalogue of tasks faced by education has to be modified. Today's students will enter adult life and start working in

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[1] A. Toffler, Szok przyszłości, Państwowy Instytut Wydawniczy, Warsaw 1974, p. 19.

[2] M. J. Szymański, Kryzys i zmiana. Studium nad przemianami edukacyjnymi w Polsce w latach dziewięćdziesiątych, Wydawnictwo Naukowe AP, Kraków 2006, p. 6.

[3] K. Pankowska, Kultura - sztuka - edukacja w świecie zmian. Refleksje antropologiczno-pedagogiczne, Wydawnictwa Uniwersytetu Warszawskiego, Warsaw 2013, p. 9.

professions which do not exist yet, but which will most probably be related to the accumulation and processing of information. The necessity of building an information society, resulting from the logic of current technological progress, as well as the emancipation opportunities which are still perceived in it, has become one of the goals officially included in the EU documents.[4]

## 2. Necessity of Changes and Ostensible Activities

In this situation the school, in order to live up to the reality in which it has to function, must also open up to the new technologies. One of its fundamental tasks is to prepare students to use ICT (information and communication technologies) competently, safely and creatively so that once their formal education has been completed they are capable of functioning in the shimmering, changeable reality, irrespective of the direction which the changes take. As emphasised by Jolanta Szempruch, "in the context of dynamic social changes, the school ceases to be the institution in which a schematic transfer of knowledge takes place, but it becomes a place for its creative search and independent construction."[5] The main task of school is to prepare people for independent lifelong learning, a necessity when living in an era of constant change. What is more, an ideal graduate is a person who offers hope for becoming the driver of changes, thanks to the capacity of innovative thinking, which drives the technological and the economic development of a country forward. Postulates of education for innovation are emerging, resulting from a remark that absence of innovation unavoidably

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[4] Cf. M. Bangemann i in., Zalecenia dla Rady Europejskiej. Europa i społeczeństwo globalnej informacji, http://http://kbn.icm.edu.pl/gsi/raport.html (access 14.08.2018), Europe 2020 Strategy, http://ec.europa.eu/eu2020/pdf/1_PL_ACT_ part1_ v1.pdf – along with its component in the form of the European Digital Agenda et al.

[5] J. Szempruch, Nauczyciel w warunkach zmiany społecznej i edukacyjnej, Impuls, Kraków 2012, p. 8.

reduces every country to the role of a subcontractor and a labour force resource for truly creative and affluent economies[6]. Furthermore, as provocatively emphasised by economist Ewa Okoń-Horodyńska, "in the conditions of growing uncertainty and risk, knowledge and experience acquired previously are of little use, thereby depreciating the traditional systems of education. (...) Limited funds [on education - author's note] cannot thus be wasted in the traditional systems of education, which often fail to ensure patency in the channels of professional career."[7] Postulates of permanent, innovative education that allows students to get their bearings in any conditions have been discussed for a number of years in several international reports, such as the studies of the Club of Rome (Uczyć się, aby być[8] or Edukacja. W niej jest ukryty skarb[9]) or the report of P. Lengrand Obszary permanentnej samoedukacji[10]. Such readiness for self-education and innovation are strictly allied to the use of new technologies, due to the fact that the world today is interested primarily in innovation in the area of STEM (science, technology, engineering, mathematics) and sees the most promising areas for development there.

Meanwhile, todays teachers are left on their own in this situation. Common knowledge pertaining to the models of introducing new technologies to education is lacking, in spite of the fact that such models exist and are applied, even though mainly by teachers or school principals who are true enthusiasts and who thinking

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[6] cf. E. Okoń-Horodyńska, Edukacja dla innowacji (czy tylko wybrani skazani są na sukces innowacyjny?), "Nauka i Szkolnictwo Wyższe" 2009, No. 1/31, pp. 34–54, B. Galwas, Uwagi o edukacyjnym wysiłku społeczeństwa i konieczność kształcenia ustawicznego, [in:] Świat przyszłości a Polska, Komitet Prognoz "Polska w XXI – wieku" przy Prezydium PAN, Dom Wydawniczy Elipsa, Warsaw 1995.

[7] E. Okoń-Horodyńska, Edukacja dla innowacji (czy tylko wybrani skazani są na sukces innowacyjny?), "Nauka i Szkolnictwo Wyższe" 2009, No. 1/31, pp. 36-37.

[8] E. Faure, Uczyć się, aby być, PWN, Warsaw 1975.

[9] J. Delors, Edukacja. W niej jest ukryty skarb, Stowarzyszenie Oświatowców Polskich UNESCO, Warsaw 1998.

[10] P. Legrand, Obszary permanentnej samoedukacji, Towarzystwo Wiedzy Powszechnej, Warsaw 1995.

outside the box. The European exception is Switzerland, which, in the Canton of Aargau, offers comprehensive technical and substantive assistance to schools (Imedias Institute in Brugg), who are in the process of integrating information and communication technologies with the content and methods of teaching, inspired by the the Kerres implementation model and the increasingly popular methodological SAMR model (also in Poland)[11]. Nevertheless, a much more frequent situation, not only in Poland, is where the decision-makers' concern about effective and sensible introduction of ICT to school education bears the hallmarks of ostensible but often surface levels actions. For as long as the focus primarily lies on purchase-related projects such as equipping schools with computers or Internet access without also providing funding for on-going device maintenance and supporting teacher training, educational ICT cannot fulfil its change agent potential. A computer or a tablet are mere tools which, without a pedagogical framework, will not on their own fundamentally change or alter teaching. Schools which apply encyclopaedism as the dominant didactic strategy will not suddenly start using the Internet in a creative way, but will only use it for searching for subsequent sources of information. The problem will not be solved on its own even with the change of generations and appearance of teachers who are digital natives[12]. As shown by international studies conducted by Àgueda Gras-Velázquez future teachers taught in a traditional manner at school are less willing to deploy new technologies in their teaching[13]. A point also made by

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[11] More about these models cf. S. Galanciak, A. Weiss, *Nowe technologie w edukacji – między teorią a praktyką pedagogiczną*, [in:] *Nastolatki wobec internetu*, ed. M. Tanaś, NASK, Warsaw 2016, pp. 77–89.

[12] Marc Prensky, *Digital natives, digital immigrants. Part* 1, [in:] „On The Horizon" 9 (5) 2001; Marc Prensky, *Digital natives, digital immigrants. Part 2,* [in:] „On The Horizon" 9 (6) 2001.

[13] Àgueda Gras-Velázquez, *ICT in STEM Education - Impacts and Challenges ON TEACHERS,* European Schoolnet (EUN Partnership AIBSL), Brussels 2017, http://www.stemalliance.eu/documents/99712/104016/STEM_Alliance_ict-paper-3-on-teachers.pdf/ac115d43-4d17-43f1-8bc6-15fbc0acaccb (access: 13.08.2018).

Judge[14] on the Hermes Thin Client Project in Ireland who noted that younger teachers were less inclined to use their schools computer systems compared to older colleagues and who despite their self proclaimed proficiency with ICT in their day to day lives struggled to transfer this ability into classroom practice. On the other hand, those who were taught by teachers who intensely used ICT show a more positive approach and greater motivation to use such tools in their future work.[15] The report of Àguedy Gras-Velázquez "ICT in STEM Education" indicates just how significant a solid pedagogical framework is to the successful introduction of new technologies in teaching. It seems that without pedagogical theory, teachers move in this area intuitively, making mistakes and failing to use the tools at their disposal in an optimum manner. According to the author, training support - often trivialised in the case of modernisation projects in school education - is also necessary. Devices which are more and more intuitive in use (especially mobile), encourage teachers to use them during classes without fear of the alleged loss of authority when devices fail to service the device.[16] In this instance, it has to be added that in line with the famous statement of Marshall McLuhan that the medium is the message, mobi le technologies do not create a revolution in the philosophy of teaching on their own, but on account of the specific nature of working with them, they may offer a great impetus for introducing changes. This is the issue tackled by the results of international studies, which are discussed in the next part of this paper.

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[14] Miriam Judge, *Mapping out the terrain in school context: Identifying the challenges of ICT integration during an innovative project*, „Irish Educational Studies", 32 (3) 2013, pp. 309–333.

[15] Àgueda Gras-Velázquez, *ICT in STEM Education - Impacts and Challenges ON TEACHERS,* European Schoolnet (EUN Partnership AIBSL), Brussels 2017, http://www.stemalliance.eu/documents/99712/104016/STEM_Alliance_ict-paper-3-on-teachers.pdf/ac115d43-4d17-43f1-8bc6-15fbc0acaccb (access: 13.08.2018).

[16] Àgueda Gras-Velázquez, *ICT in STEM Education - Impacts and Challenges ON TEACHERS*, European Schoolnet (EUN Partnership AIBSL), Brussels 2017, p. 34, http://www.stemalliance.eu/documents/99712/104016/STEM_Alliance_ict-paper-3-on-teachers.pdf/ac115d43-4d17-43f1-8bc6-15fbc0acaccb (access: 13.08.2018).

## 3. Description of Study

As part of the international project "Mobile Intercultural Cooperative Learning", researchers from Ireland (Dublin City University, infocus Training Ltd.), Poland (Maria Grzegorzewska University in Warsaw), Germany (Staatliches Schulamt Lörrach) and Portugal (Agrupamento de Escolas de Figueiró dos Vinhos) conducted studies among teachers and pupils pertaining to the use of mobile technologies in education. The study, designed and performed under the supervision of Miriam Judge, PhD from Dublin City University, was qualitative in nature and was conducted among 83 teachers and students working on tablets from schools in four countries: Ireland, Poland, Germany and Portugal. The purpose of the study was to assess the extent to which teachers were using mobile devices to support classroom pedagogy and the respondents' opinions about the usefulness of these technologies to support the education process.[17] The technique applied in the study was structured interview format comprising individual teacher interviews and focus group interviews with students.

A very important thread that became prominent in the study was the issue of change as an element inseparably linked to the deployment of mobile technologies in the process of education which the remainder of this paper will now deal with. It focuses on the statements of teachers as the contractors and usually the architects of such change. Among the respondents special attention should be drawn to teachers from Germany, who specialise in work with children with special educational needs, even though it has to be emphasised that every school covered by the study had students with SEN.

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[17] The entire report is available on website: https://micool.org/wp-content/uploads/2017/12/A-Micool-Project-Cross-European-Case-Study-On-The-Classroom-Use-of-Tablet-Technologies.pdf (access: 15.08.2018).

## 4. What Should Be Changed and What Is Changing: Mobile Technologies in the Classroom in the Opinion of Teachers and Students

The interviews with teachers reveal that there is a dualistic nature to the changes discussed here comprising both internal and external manifestations. First of all, at an internal level teachers identified a change in both their personal teaching philosophy and methodology inspired by the use of tablets in their classrooms. As they used the devices they could see that they needed to adapt their teaching approach and methods to become more student centered. This involved encouraging more autonomous student learning and providing more opportunities for creativity and expression, without which mobile devices would continue to be merely an extension of the blackboard, a textbook or a notebook.

Secondly, the outward manifestations of these internal changes as noted by the respondents included: self-development of teachers, emotions accompanying teaching, development of the students' potential, learning teamwork. Crucially, according to the respondents there is a symbiotic link between the two with change at the philosophical level informing the observed changes they were now seeing in their teaching and classrooms.

### 4.1. Changes: Tasks

What often instils teachers fears of using new technologies is frequently associated with device and system technical failures. However, as noted by the respondents, this is no longer the case with mobile devices which operate at a more intuitive level. The more pressing issue now for them was the necessity of changing one's teaching philosophy of teaching and accepting one's own new role in this process.

### 4.1.1. Changes in the Teaching Philosophy

One of the more prominent issues in the teachers' statements related to their observations on the changing role of teachers as a result of a shift away from dictactic style teaching to more student autonomous learning. A tablet or a smartphone with creative and knowledge-related applications installed on them encouraged teachers to hand over the tasks of searching, systematising and presenting knowledge to students (acquire knowledge in the form of an animation, a multi-media presentation or a film, they become a more attractive part of work during a class). As noted by a Portuguese teacher: "Yes, using the iPad changed my mode of thinking about the subject of a class because now, instead of simply providing the teaching content, I can challenge my students to search for information which we will later discuss together" (Teacher A, Portugal). Another respondent from the same country says: "The teacher no longer has to explain everything. The only thing that you have to say is: "Now you are going to explore this problem" (Teacher F, Portugal). Students also notice this change: after all, the significant portion of the burden of active searching for and processing knowledge is transferred to them - however, they evaluate it positively: "I think that it offers a completely new dynamics of learning. We are no longer focused on the blackboard and the teacher, but we acquire completely new experiences, expand the horizons and knowledge, search for new things" (Student from the second focus group, Portugal).

In this model of working with students, the role of teachers inevitably changes. "In such case, the teacher's role is always minor" (Teacher C, Poland) claims the respondent teaching German language. This thought is elaborated on by a teacher for whom a change in the method of work with students has become an inspiration for deep self-reflection: "I can say that (under the impact of mobile technologies - author's note) my methods of teaching and learning have changed, but in a deeper sense - in the sense of the philosophy of education, due to the fact that it is now more focused

on the student and less on the teacher... The teacher is almost invisible. Now, I believe that the teacher should simply show the way, that the teacher is only the student's assistant and not some type of god who knows the truth. So, since I have started using tablets, not only my skills related to pedagogical practice developed, but primarily my entire philosophy of teaching and learning has changed" (Teacher B, Poland). Similar self-awareness is also present in the answers of a respondent from Portugal: "Now I understand that when I work with students I am no longer the teacher and they learn from me. This is more about working together, allowing them to help me, and not only about explaining things to them. I can feel that my students like this mode of work more, and I am trying to get to know them better" (Teacher E, Portugal).

## 4.1.2. Changes in Teaching Practice

It follows clearly from the respondents' statements that a constituent of changes in the philosophy of teaching is a change in the method of work with students. However, this does not entail that the teacher is released from some or all of their obligations. The respondents emphasise that they have even more work, because encouraging student self directing learning requires a lot of advance scenario planning in order to create the conditions for the acquisition of specific knowledge, skills and social competence. In addition, teachers also need to invest time in becoming acquainted with electronic devices, which in the case of mobile technologies means an unending process of searching for new apps and learning how to use them. One of the teachers explains this process: "Obviously, you have to get prepared for every class, because a tablet is a new tool and getting to know it requires more effort to feel ready to use it. First, you have to get to know the applications and then come up with ideas of how to use them. But eventually we master it, and this was also my case (...). Now, I can come up with new plans of classes using the iMovie application or Quizzlet Life or apps related to cre-

ative writing, so even though it is now easy for me, it still requires time (...). With every new tool, we need more time to learn how it works (Teacher B, Poland).

It also follows from the respondents' statements that the use of digital technologies significantly differs from the use of desktop computers - it requires different competence, but also offers different effects. "This year, I have not even been to the computer room, and it is March," says a teacher from Portugal. "I prefer iPads, because I can use them in my classroom without the necessity of going to the computer room. My classes are more interactive now, because I can talk to students and see what they are doing, whereas in the computer room I sit at my desk and look at what they are doing, but without going into any interaction with them. In the case of tablets, the situation is different, because you are walking, talking and entering in interactions" (Teacher C, Portugal).

Use of mobile technologies means additional work for the teacher, but it also gives the feeling of satisfaction. The respondents declare that in effect, their self-esteem improved and they have better relations with students. An excellent example is provided in the statement of a respondent from Poland: "I definitely developed, because I want to show my students that I am as advanced in the use of new technologies as they are. I also want to encourage them to improve their skills, so I try to be a partner... Because I continue to develop with my students. Obviously, it does not come on its own, I have to learn to use new apps. I have to understand them and obviously, every time I fail, I can ask the students and I do not have any problems with it" (Teacher A, Poland).

However, the teachers should not devolve the responsibility for the use of applications to students and hope that they will manage on their own. Using mobile devices is a multidimensional activity and requires varied competence, not only technical. The teacher should possess them. As emphasised by a respondent from Germany: "(...) students are not as competent in using media as it seems to us, even as far as the use of smartphones and tablets is concerned. They need a lot of education in this respect, primarily as far as the

protection of data is concerned, user settings and simplest functions. As teachers, we should not initially expect too much from them" (Teacher 5, Germany).

### 4.1.3. Who May Experience Difficulties?

Teachers from schools covered by the study in all countries operate without any additional (or simply without none at all) system support. They look for training opportunities and courses on their own, also abroad. The Polish school (non-public) and the Portuguese school have their own sets of tablets; in Irish and German schools, they are made available. However, one cannot expect that every teacher will be determined enough to learn how to use new technologies in the process of education on his/ her own.

One of the respondent students described the preparation of teachers as follows: "I believe that some teachers are not ready. I mean, they are not used to using computers, they prefer to work with text, so they are more old-fashioned and traditional... This is the way in which they learnt and they want to teach others in the same way" (Student, Group 6, Ireland). Another young respondent concurs: "A tablet (author's note) is seen by them as a toy and they do not know how to handle it. It is hard for them, because they were taught in a traditional mode and they do not have extensive knowledge about technology and prefer the blackboard and books. They do not know how to teach with technology. In a certain sense, they are old-fashioned. They have to "feel" the paper and all these things that one has to learn" (Student, Group 2, Ireland). Some teachers assess the situation even more harshly: "The majority of our schools still rely on the philosophy that was probably performing well in the 19th century...." (Teacher A, Poland).

Some schools offer technical support to teachers in the form of an extra person conducting the classes and responsible for operation of equipment. As noted by the respondents, this does not solve the problem. "It is very hard, because the majority of teachers do not want anybody else in the classroom. They are very much against it" (Teacher A, Ireland).

Problems with the use of mobile technologies also result from the current system solutions, where the declared skills that the students should acquire (creativity, independence, teamwork) do not go hand in hand with the official assessment systems. A telling statement of a respondent from Portugal is presented below, even though it seems that it may well have been uttered by Polish respondents:

"In Portugal, we have a huge problem, because our system of education is based on examinations and tests. I could often explore a subject, do something more, but this requires time and I have to deal with absolutely all the content contained in the core curriculum, because if there is something at the examinations that I have not discussed, I will have to deal with parents saying: "You did not discuss it, you did not teach it to them." I cannot tell them: "Oh, I was trying some new methods with iPads." This does not work. This is a huge problem. You have to have good grades if you want to get to the university, otherwise you can forget about a good school" (Teacher A, Portugal).

## 4.2. Changes: Benefits

Apart from personal benefits, such as increased satisfaction with the performed work, a noted improvement in their own teaching methods and the development of a more partnership approach to learning with students, the respondent teachers also noticed numerous beneficial changes pertaining to the development of many desirable student competences, progress which in this respect, they attribute to working with mobile technologies.

### 4.2.1. Student: Change of Motivation

One of the most obvious and easy-to-observe effects of using tablets and smartphones during classes is the students' greater interest in the subject matter and greater motivation for work, which is related to it.

"The benefit is greater motivation and interest on the part of students. They are really interested in what they are doing. And because they have a lot of fun, school is no longer so boring to them... All the sitting in the classroom and listening to the teacher, again and again... Thus they are more motivated and this makes work with them more effective" (Teacher C, Portugal). This is confirmed by a Portuguese student: "We learn faster when we have fun!" (Student, Group 6, Portugal).

In this context, it is also worth mentioning another statement: "For a number of years, I was looking for a solution to the problems that I experienced in the classroom, related to the students' motivation. I believe that the traditional teaching is not enough if we want to make the students fascinated with a subject matter and keep their attention up, which is in reality necessary if they are to learn efficiently. I have always been trying to diversify my methods and iPads seem a very good solution, because students are very much interested in technologies of this type" (Teacher A, Portugal).

A very important benefit is the possibility of exciting interest in all students. Today, very few teenagers are able to resist the charms of tablets or smartphones. This is an observation made by an Irish teacher: "All students were involved in work with the use of iPads. All of them liked the work on the projects that they were pursuing. This really was a great reinforcement of the learning outcome when all of them actively participated in activities" (Teacher 1, School B, Ireland).

### 4.2.2. Student: Independence and Individualisation

With respect to the necessity of lifelong learning, which is key to twenty-first century learning, one of the main skills that schools need to equip students with is the ability to independently acquire knowledge, verify sources of knowledge and utilise that knowledge in a practical way. The respondents assess the potential of mobile technologies highly in this respect. Students "are more independent

from the teacher and they have more opportunities... They can in-dependently examine information, search for vocabulary, design own dialogues and record a film without the teacher's assistance. They are more involved in the process of learning. And they learn to take responsibility for their own education." (Teacher C, Portugal).

Teachers from Germany who work with children with special educational needs mention another aspect: mobile technologies allow for individualising work with students to a great degree. "I work a lot with students individually, which means that they decide about what they want to work on and I support them in their work. iPad is an excellent didactic aid, because it allows for setting the application in a manner that every child can work at a level ad-justed to his/ her potential" (Teacher 3, Germany). Another re-spondent supports this opinion: "Even weakest students can signifi-cantly benefit from the fact that classes may be designed more individually; you can respond directly to their needs, adjusting spe-cific content to them" (Teacher 7, Germany).

## 4.2.4. Student: Creativity

As noted at the beginning of this paper, a very important and coveted feature of persons entering the labour market is creativity and the ability to think innovatively. These features may be, to a certain extent, worked out and improved, by properly selecting the content and the methods of work with students. As noted by the above-quoted respondent from Portugal, the core curriculum does not always facilitate development of such competence, yet mobile technologies – in a unanimous opinion of respondents - excellently support work on them. "Students are more engaged in learning and they are more creative, they can implement their own ideas," notic-es one of the respondents (Teacher C, Poland). A teacher from Ger-many concurs: "I believe that the creative potential (of tablets – au-thor's note) is really great, because children have the possibility of perceiving themselves as creative and they realise that this is not

only a consumer product. For me, it very important that we discourage the students from ordinary consumption" (Teacher 6, Germany). Their remarks are confirmed by an Irish student; however, he ends his enthusiastic response with a bitter conclusion: "I think that making films was great fun. I liked it a lot, because when using iPads, we had to be creative and this is something that we usually do not do at school..." (Student from a focus group, School A, Ireland).

### 4.2.5. Student: Teamwork

According to respondents, teamwork is another added benefit that the use of mobile technologies in the learning process brings: "I use iPads for teamwork, because then I can help students with various skills," declares one teacher. "When doing work in groups, you can pair students with different talents, who work together and they learn from one another in the sense that a weaker student can learn from better ones. But the good students can also learn. They can help others, which is always good, so they can learn tolerance. This possibility of cooperation and mutual assistance is truly great" (Teacher B, Poland).

Other aspects of cooperation among students while working on projects are noted by a teacher from Ireland: "Due to the fact I never had a sufficient number of tablets at my disposal, my class had to work in pairs or in groups of three. This really helped them understand the meaning of compromise and cooperation, and how to share the ideas and what it means to accept an obligation (...). This was a great lesson of cooperation" (Teacher 4, School B, Ireland). Their conclusions are summed up by a teacher from Germany who made the following observation: "I believe that it is fascinating to see how cooperation is born, how all of these group processes take place, how the students start helping one another" (Teacher 6, Germany).

## 5. Recapitulation

Introduction of new technologies to schools in a situation when these technologies constitute the driver of socio-economic and cultural transformations is an inevitable and necessary activity. In particular mobile technologies, which constitute a natural environment within which the majority of todays students operate, seem to be very promising tools with respect to didactic utility. Responses by participants who took part in this research as part of the Micool project and whose results are presented in this paper, are testimony to this. The research also confirmed the fact that competent introduction of mobile devices to the classroom, making a full use of their potential, requires substantive, technical and intellectual preparation of the teachers.

Implementation models, such as the Kerres square mentioned earlier, take into account components of the implementation process such as infrastructure, development (human and material resources), media and didactics. But it is necessary to supplement them with the aspect of change - the necessity of its occurrence, the degree of readiness to carry it out by/from the school environment (a headteacher, teachers), possible forms of support in its preparation and sustaining the effects. Readiness for change is in fact not only a sign of our times, but an essential skill of present and future graduates which should be developed by today's school preparing children for the future.

## Bibliography

Bangemann et al., *Zalecenia dla Rady Europejskiej. Europa i społeczeństwo globalnej informacji,* http://kbn.icm.edu.pl/gsi/raport.html (access: 14.08.2018).

Delors J., *Edukacja. W niej jest ukryty skarb*, UNESCO, Warsaw 1998.

Dudzikowa M., *Użuteczność pojęcia działań pozornych jako kategorii analitycznej. Egzemplifikacje z obszaru edukacji (i nie tylko),* [in:] *Sprawcy i/lub ofiary działań pozornych w edukacji szkolnej,* ed. M. Dudzikowa, K. Knasiecka-Falbierska, Impuls, Kraków 2013.

Faure E., *Uczyć się, aby być*, PWN, Warsaw 1975.

Galanciak S., Weiss A., *Nowe technologie w edukacji - między teorią a praktyką pedagogiczną,* [in:] *Nastolatki wobec internetu*, ed. M. Tanaś, NASK, Warsaw 2016.

Galwas B., *Uwagi o edukacyjnym wysiłku społeczeństwa i konieczność kształcenia ustawicznego,* [in:] *Świat przyszłości a Polska*, Komitet Prognoz "Polska w XXI wieku" przy Prezydium PAN, Dom Wydawniczy Elipsa, Warsaw 1995.

Gras-Velázquez A., *ICT in STEM Education - Impacts and Challenges ON TEACHERS,* European Schoolnet (EUN Partnership AIBSL), Brussels 2017, http://www.ste malliance.eu/documents/99712/104016/STEM_Alliance_ict-paper-3-on-teachers. pdf/ac115d43-4d17-43f1-8bc6-15fbc0acaccb (access: 13.08.2018).

Judge, M., *Mapping out the terrain in school context: Identifying the challenges of ICT integration during an innovative project*, "Irish Educational Studies" 2013, Vol 32, (3), pp 309–333.

Judge M., *A Micool-Project Cross European Case Study on the Classroom Use of Tablet Technologies,* https://micool.org/wp-content/uploads/2017/12/A-Micool-Project-Cross-European-Case-Study-On-The-Classroom-Use-of-Tablet-Technologies.pdf (access: 15.08.2018).

Legrand P., *Obszary permanentnej samoedukacji*, TWP, Warsaw 1995.

Okoń-Horodyńska E., *Edukacja dla innowacji (czy tylko wybrani skazani są na sukces innowacyjny?),* "Nauka i Szkolnictwo Wyższe" 2009, No. 1/31, pp. 34-54.

Prensky M. (2001), *Digital natives, digital immigrants. Part 1*, [in:] „On The Horizon" 9 (5).

Prensky M. (2001), *Digital natives, digital immigrants. Part 2*, [in:] „On The Horizon" 9 (6).

*Strategia Europa 2020,* http://ec.europa.eu/eu2020/pdf/1_PL_ACT_part1_v1.pdf (access 14.08.2018).

Szempruch J., *Nauczyciel w warunkach zmiany społecznej i edukacyjnej,* Impuls, Kraków 2012.

Szymański M. J., *Kryzys i zmiana. Studium nad przemianami edukacyjnymi w Polsce w latach dziewięćdziesiątych,* Wydawnictwo Naukowe AP, Kraków 2006.

Toffler A., *Szok przyszłości,* Państwowy Instytut Wydawniczy, Warsaw 1974.