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POMIĘDZY BYTAMI

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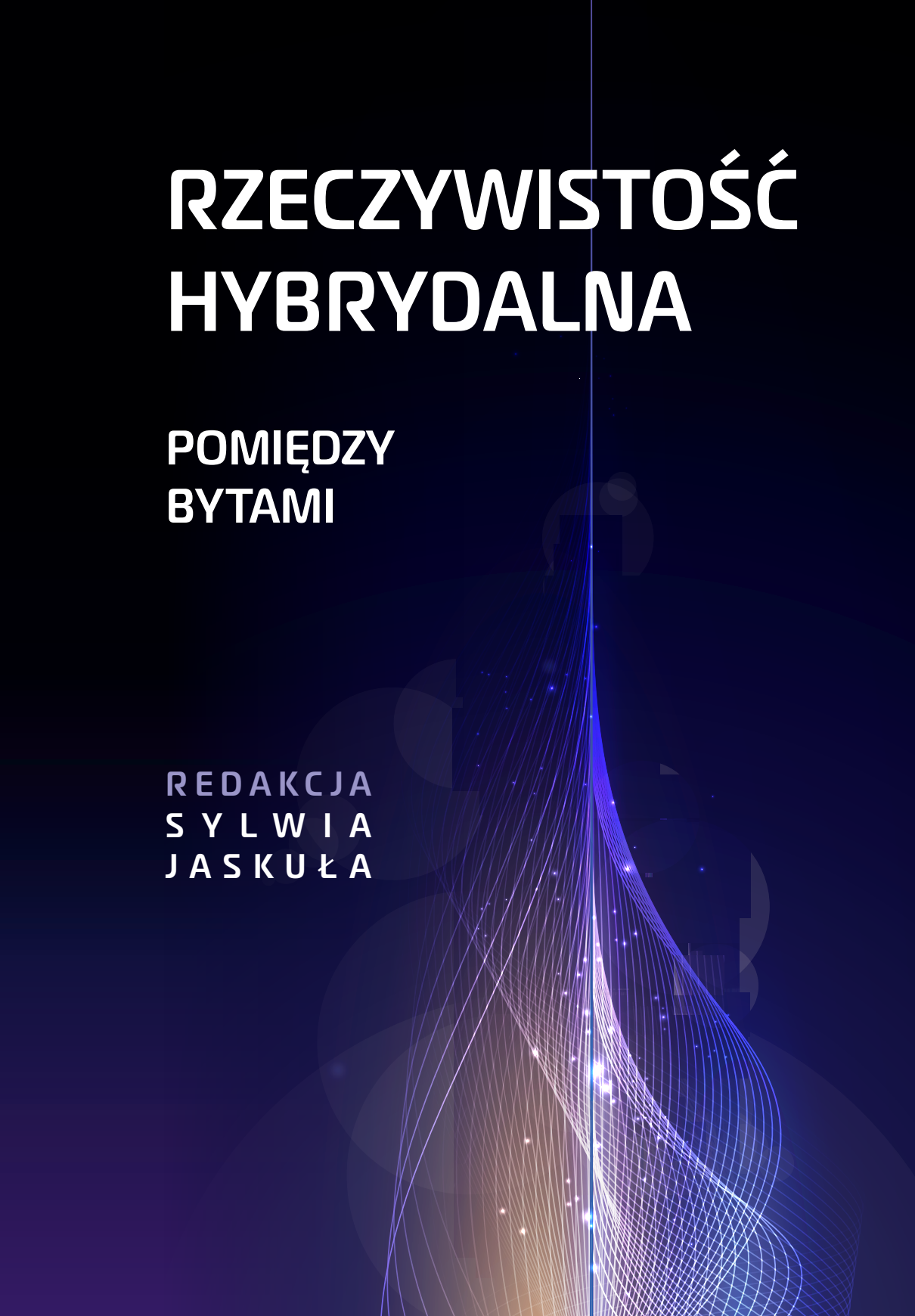
JASKUŁA



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POD REDAKCJĄ
SYLWII JASKUŁY

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EDUCATION IN THE DIGITAL AGE

SOME IMPLICATIONS FOR TEACHING AND TEACHER TRAINING

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INTRODUCTION

There is no denying that technology has revolutionised the modern world. Not only is it omnipresent, and thus inescapable, but also inexorable, and the process of technological development seems to stretch into infinity. Moreover, technology is evolving at such a rapid pace that it is impossible to be up-to-date with tech innovations, let alone evade being affected by the digitalisation process. Computers and digital devices have become an non-detachable part of our lives. As Cathy Burnett argues, "[d]igital technologies are engrained in our institutions and infrastructures, in commerce, politics, manufacturing and administration," adding that "[t]hey are central to many of the ways in which we form and sustain relationships, communicate ideas, and generate, share and distribute knowledge."[1] Technology pervades nearly all aspects of human activity, and school

[1] C. Burnett, *The Digital Age and its Implications for Learning and Teaching in the Primary School*, Cambridge Primary Review Trust, York, UK 2016, p. 3, http://cprtrust.org.uk/wp-content/uploads/2016/07/Burnett-report-20160720.pdf (5.08.2018).

education is no exception. E-registers, digital teaching tools, e-learning platforms, interactive boards are just among the main terms which show how technology has invaded the modern classroom. As a result, teachers face a great many challenges and have to adapt to the rapidly changing school environment. Digital technologies have already influenced teaching methodologies to a great extent, especially after the period of the COVID-19 pandemic, and what is more, they have significantly affected learners and their family settings, thus making the work of the 21st century teachers even more difficult and challenging.

THE EFFECT OF THE DIGITALISATION PROCESS

With the rise of modern technology and a significant change in people's lifestyles, fearful apprehension of the impact of the Internet and social media have been widely disseminated. Gary Small and Gigi Vorgan, for instance, claim that "[d]aily exposure to high technology, including computers and video games, creates changes in the brain."[2] This "popular science notion that digital technology might hijack or re-wire children's brains" is, however, not supported by neuroscience evidence.[3] Still, digital devices do appear to have an influence upon children's behaviour and their style of learning, as well as their social and cognitive development. The man of the 21st century, and likewise, the 21st century learner is a person whose brain functions differently than the brains of people twenty years ago. It is due

[2] G. Small, G. Vorgan, *Meet Your Ibrain: How the Technologies That Become Part of Our Daily Lives Are Changing the Way We Think*, "Scientific American Mind", no. 19(5), 2008, pp. 43-49.

[3] D. Kardefelt-Winther, *How Does the Time Children Spend Using Digital Technology Impact their Mental Well-Being, Social Relationships and Physical Activity? An Evidence-focused Literature Review*, UNICEF Office of Research – Innocenti Discussion Paper 2017-02, Florence 2017, p. 13, https://www.unicef-irc.org/publications/925-how-does-the-time-children-spend-using-digital-technology-impact-their-mental-well.html; K.L. Mills, *Effects of Internet Use on the Adolescent Brain: Despite Popular Claims, Experimental Evidence Remains Scarce*, "Trends in Cognitive Sciences", no. 18(8), 2014, pp. 385-387.

to the differences in lifestyles, differences in the ways of spending free time, in norms of behaviour and in the ways in which information is processed.[4] The present man is brought up in the world of television, computers and computer games, smartphones, and last but not least, the Internet. He is a digital native, to use the name coined by Marc Prensky.[5]

A typical digital native, unlike their parents, is capable of texting messages while listening to music, and at the same time, studying successfully. Some scholars claim that the neurological structure of a typical digital native's brain enables them to do it since their brains' neurological structure differs from the neurological structure of their parents' brains, even though the effectiveness of young people's learning in cases involving multitasking remains questionable.[6] Doing two different things at the same time forces the brain to go back and forth from one activity to the other, and therefore, it is more time consuming than doing those activities one at a time.[7] Very often, performing two things simultaneously and successfully is impossible, like in the case of listening to somebody and reading lists of words since these two activities require an activation of overlapping areas of the brain. By means of comparison, listening to somebody and enjoying the landscape at the same time will be much easier to do. Nevertheless, multitasking and dependence upon technological devices is very common today, especially among young people.

The digitalisation process cannot be retarded and children need to acquire technical skills which appear to be indispensable not only for their future but also for their current lives.[8] The 21st century learners are already balancing on the border between the two worlds: a real

[4] See J. Morbitzer, *O nowej przestrzeni edukacyjnej w hybrydowym świecie*, "Labor et Educatio", no. 3, 2015, p. 414.

[5] Cit. after: M. Żylińska, *Neurodydaktyka. Nauczanie i uczenie się przyjazne mózgowi*, Wydawnictwo Naukowe Uniwersytetu Mikołaja Kopernika, Toruń 2013.

[6] G. Small, G. Vorgan, *op. cit.*; M. Żylińska, *op. cit.*; K. Nordengen, *Mózg rządzi. Twój niezastąpiony narząd*, transl. M. Skoczko-Nakielska, Wydawnictwo Marginesy, Warszawa 2018.

[7] K. Nordengen, *op. cit.*, p. 150.

[8] C. Burnett, *op. cit.*

and a virtual one,[9] or to be more specific, a digital one. Marek Krajewski emphasizes that there are, in fact, two types of virtual reality: universal virtuality and particular virtuality, which Janusz Morbitzer describes as soft virtuality and hard virtuality, respectively.[10] Universal, or soft virtuality, is cultural in nature and refers to products of human intellectual activity, e.g., thoughts, projections, dreams, or beliefs.[11] Culture itself is said to be the most fundamental type of virtuality; it is not material, but it materializes in the way that a given society lives and it can be experienced through the objects and customs that a given society produces. On the other hand, particular virtuality, or hard virtuality, is technological in nature, because it requires technological tools, equipment, and proper software for its generation. Young people are getting more and more immersed in this hard virtuality, which has an immense impact upon their real lives.

In fact, the hybrid world the 21st century learners live in is not exactly a world in which reality and virtual reality exist next to each other. Rather, it is a world in which the two coexist in such a way that it is no longer possible to draw a clear-cut division line between them.[12] Reality and virtual reality are both created by people and both have substantial consequences in life. It is common knowledge how important the activity in the Web was during presidential or parliamentary elections, both in the USA and in Poland. Internet posts, likes on Facebook, comments on YouTube or Instagram and other types of online activity have a huge impact on people's lives, their choices, beliefs, and behaviour. In this connection the youth are the group most affected by virtual reality and for them there is no point in separating virtual reality from reality, because the former is part of the latter.[13] The two are convergent, which the term 'hybrid world'

[9] J. Morbitzer, *Współczesna przestrzeń obecności człowieka – między realnością a wirtualnością*, „Zeszyty Naukowe Wyższej Szkoły Humanitas. Pedagogika", no. 13, 2016, pp. 59-68.

[10] See *ibidem*, p. 60.

[11] *Ibidem*.

[12] *Ibidem*, pp. 61-63.

[13] *My, dzieci sieci* (2016) by Piotr Czerski is a manifesto published in 2012, in which this idea was then formulated. https://dziennikbaltycki.pl/pisarz-piotr-czerski-my-dzieci-sieci/ar/506821/2 (3.08.2018).

captures successfully,[14] and it is not necessary to try to establish precise boundaries between them.[15] Growing increasingly fond of the Web, the young have at least two identities: their real-life identity and their virtual one. In fact, in the online world, they may exhibit multiple identities, none of which may be authentic, and which may lead to split personality disorders.

THE IMPORT OF NEUROSCIENCES AND THEIR IMPLICATIONS FOR TEACHING

It goes without saying that the development of technology has contributed to the intensification of research into the workings of the human brain. Never before has the concept of lifelong learning been so applicable to the teacher profession as it is now. Teachers need to be knowledgeable not only about their own subject of study, but they should also draw on neuroscientific discoveries as they may contribute significantly to the effectiveness of the teaching process. Expertise in pedagogy and educational psychology appears to be insufficient, given the new multidisciplinary field, i.e. educational neuroscience, the principal goal of which "is to achieve a broader understanding of the neurocognitive mechanisms underlying successful learning and to develop effective interventions based on the accumulated evidence."[16] Understanding the architecture of the human brain and its

[14] See L. Korporowicz, *Przestrzeń kulturowa w społeczeństwie konceptualnym*, [in:] *Kultura informacyjna w ujęciu interdyscyplinarnym – teoria i praktyka*, ed. H. Batorowska, vol. 1, Uniwersytet Pedagogiczny im. KEN, Instytut Bezpieczeństwa i Edukacji Obywatelskiej, Katedra Kultury Informacyjnej i Zarządzania Informacją, Kraków 2015, p. 9107.

[15] Morbitzer (2016) points to the inspiring activity of professor Michał Ostrowicki vel Sidey Myoo and *Academia Electronica* which he set up in *3D Second Life* in 2007. It clearly illustrates the mergence of the two worlds as *Academia Electronica* is a *Second Life* university where lectures are held by real life academics and the obtained titles are valid in the real world.

[16] E. Stern, R.H. Grabner, R. Schumacher, *Educational Neuroscience: A Field Between False Hopes and Realistic Expectations*, "Zeitschrift für Psychologie", no. 224(4), 2016, p. 237.

functioning, as well as neuroscientific research into human learning may enrich considerably teachers' professional knowledge and help them realise how memory system works and what to do to ensure that information discussed during lessons is easily remembered by students and will become ingrained in their long-term memory.

Today, a lot of focus in didactics goes to the relation between teachers and learners and the pleasant atmosphere that teachers need to create in their classrooms to make students more relaxed and their memory more retentive. Neuroscientific awareness may also be valuable in keeping proper student-teacher relations, which are already undergoing a significant change due to technological development. David Sousa underlines that positive emotions play a very important role in knowledge acquisition and enhance the learning process significantly.[17] He points out that "the two structures in the brain mainly responsible for long-term memory remembering are located in the emotional area of the brain." Also, Gerald Hüther in his book *Was wir sind und was wir sein könnten* postulates that teaching is a cognitive-affective process whose effectiveness relies to a great extent on the quality of relations in the classroom.[18]

Understanding and sympathizing with other people is possible thanks to the so-called mirror neurons, which are asserted to be located in various parts of the human brain.[19] Evidence for the existence of a mirror neuron system in humans, though largely indirect, is rich and comes from neurophysiological and brain imaging experiments.[20] First discovered in the brains of monkeys, mirror neurons are a class of neurons that activate when an animal performs an action or sees another monkey perform the same action. Moreover,

[17] D.A. Sousa, *How the Brain Learns*, Corwin Press, Thousand Oaks, CA 2017, p. 20.

[18] See M. Żylińska, *op. cit.*, p. 125.

[19] See P. Borroni et al., *Mirroring Avatars: Dissociation of Action and Intention in Human Motor Resonance*, "European Journal of Neurocience", no. 34, 2011, pp. 662-669; R. Mukamel et al., *Single-neuron Responses in Humans Turing Execution and Observation of Actions*, "Current Biology", no. 20(8), 2010, pp. 750-756; T. Singer, *Empathy for Pain Involves the Affective but Not Sensory Components of Pain*, "Science", no. 303, 2004, pp. 1157-1162; after: M. Żylińska, *op. cit.*, pp. 120-122.

[20] See R. Cook et al., *Mirror Neurons: From Origin to Function*, "Behavioral and Brain Sciences", no. 37, 2014, p. 179.

mirror-neurons are supposed to get activated in the same way even when monkeys do not see the action being performed but they have clear premises that it is taking place, e.g. when they hear sounds which indicate the action, like the sound of a sheet of paper being torn or the sound of a crushed nut.[21] It was also observed that mirror neurons were activated on seeing the hand of the researcher move to seize an object even though the object itself was hidden. Such tendencies show that mirror neurons allow to see the objective of an action irrespective of the transparent realizations of this action. Observation of other people and their reactions stimulate mirroring reactions in our brains, the intensity of which is a matter of gradation i.e., as individuals, we differ in respect of our reactions to stimuli, e.g. pain.

All things considered, mirror neurons enable humans to comprehend not only what other people do, but also how they feel, by copying the states and feelings of the people we see.[22] In other words, one of the main functions of mirror neurons is understanding the intentions behind the actions undertaken by others, while the mechanisms and the phenomena connected with them seem to play a fundamental role in explaining the social behaviour of man. As Giacomo Rizzolatti, Leonardo Fogassi and Vittorio Gallese put it:

> Such a mirror mechanism for understanding emotions cannot, of course, fully explain all social cognition, but it does provide for the first time a functional neural basis for some of the interpersonal relations on which more complex social behaviours are built.[23]

The potential of mirror neurons has always been used by artists, like in the case of actors whose acting makes the audience scared or

[21] See B. Sosnowska, *Czy neurony lustrzane stanowią współczuciowy podkład ludzkiej moralności?*, [in:] *Neurokognitywistyka w Patologii i Zdrowiu 2009-2011. Sympozja I*, ed. I. Kojder, Pomorski Uniwersytet Medyczny w Szczecinie, Szczecin 2011, p. 24.

[22] G. Rizzolatti, L. Fogassi, V. Gallese, *Mirrors in the Mind*, "Scientific American", no. 295(5), 2006, pp. 54-61.

[23] G. Rizzolatti, L. Fogassi, V. Gallese, *op. cit.*, p. 60. They also note that dysfunction in this mirroring system may lead to disorders consisting in empathy deficits, like autism.

moved.[24] Knowledge about the nature of mirror neurons may also have practical implications for teaching. What we teach is equally important as how we teach, and teachers can be artists in their own profession. Everyday attitude to our students, our gestures, or the way we speak may either be motivating or discouraging for our learners.

Let us note at this point that human mirror neurons responsible for movement functions are partly correlated with Broca's area.[25] According to Kaczmarzyk, it may be the case that language is in some sense an extension or complementation of mirror neuronal mechanisms that is specific to human beings.[26] Traditionally, the main language functions are considered to be localized in the perisylvian cortices of the left hemisphere: for instance, the so-called Broca's area (a left frontal region) is involved in language production whereas the Wernicke's area (a left temporal region) is associated with language comprehension. We owe these claims to Karl Wernicke, a German neurologist, who in 1874 formulated them on the basis of his own research, as well as the research of Paul Broca, a French physician.[27] Their formulation was possible as a result of the observation of speech impairments of aphasic patients. Those patients who suffered from injuries in the part of the brain identified as Broca's area would produce 'agrammatic' speech, with lots of hesitations and pauses, while patients with injuries in the proximity of Wernicke's area would produce speech that was difficult to make sense of.

Modern methods of neuroimaging available nowadays shed morelight on the place and the way language is processed in the brain. For one thing, judging from neuronal activations in the brain, Broca's area is not specific only to language production as it is related to a variety of language tasks other than language production, as well as other cognitive tasks.[28] Similarly, Wernicke's area is not specific to language comprehension since the observation of neuronal ac-

[24] M. Kaczmarzyk, *Zielony Mem: Światy, Mózgi i Emocje*, Śląski Ogród Botaniczny, Mikołów 2012, p. 20.

[25] G. Rizzolatti, L. Fogassi, V. Gallese, *op. cit.*, p. 61.

[26] M. Kaczmarzyk, *op. cit.*, p. 20.

[27] See E. Fedorenko, N. Kanwisher, *Neuroimaging of Language: Why Hasn't a Clearer Picture Emerged*, "Language and Linguistic Compass", no. 3, 2009, p. 2.

[28] E. Fedorenko, N. Kanwisher, *op. cit.*, pp. 1-27.

tivity shows its relevance to a variety of language functions, as well as non-linguistic tasks. Moreover, neuroimaging studies of language revealed activation of a number of areas of the brain outside the classical left frontal/temporal regions: the right frontal / temporal regions, regions in the parietal and even occipital lobes, the cerebellum, and some subcortical structures, e.g. the basal ganglia and the thalamus.

Additionally, examination of patients with brain damage leads to conclusions undermining the localization view of the language function. While lesions in and around both Broca's and Wernicke's areas do not necessarily lead to deficits in language production and comprehension respectively, there are cases of patients who suffer from such deficits without having lesions in the two regions. All in all, as Fedorenko and Kanwisher note, these findings point to the existence of a much larger network on which language relies than the originally assumed left frontal/temporal regions.[29]

It also has to be noted that processing information does not take up exactly the same amount of time in the case of language production and comprehension. Since speaking requires an activation of the whole speech apparatus, an average speaker is capable of producing about 100-150 words per minute.[30] This is in contrast to the average speed (500 words per minute) at which decoding information without any greater effort is possible on the part of the listener. The speaker is not able to produce as many words as the listener may process and that is why their attention is often attracted by some other external stimuli. The consequences of such a state of affairs can be observed during lectures. Students will naturally find it difficult to stay tuned to a lecture after about 10-15 minutes, precisely because of the differences in the processing time described above. Telling a joke or changing the topic by a lecturer can help to attract the attention of the students again. Speaking slower will not help but it will create even more room for getting distracted.

David Sousa claims that today's teenagers have shorter attention span and find it difficult to focus on a task for more than twenty

[29] *Ibidem*, p. 3.

[30] See M. Kaczmarzyk, *op. cit.*, p. 17.

minutes. Therefore, he suggests that lessons be divided into segments comprising the so-called prime- and down-time. During prime-time new information should be provided and then followed by practice or review during down-time, which is much shorter, but extremely important for meaningful learning. Sousa advises teachers to go off task between segments and allow learners to slacken off for a short period of time as it renders them more attentive during the next segment of the lesson. He asserts that today's students respond better to the unique and novel and recommends that technology be incorporated into lessons to "enhance, enrich, and present their content more efficiently."[31]

By studying literature on educational neuroscience, teachers may thus learn about the architecture of the brain and find out how the brain learns and how to organise lessons to make the teaching process more effective. Besides, knowing the intricacies of the human brain, educators are more likely to understand young people's needs and expectations, and to prepare teaching materials or tools that will prove efficacious and will be more appealing to students. Following Manfred Spitzer, it should be emphasized that every teacher should acknowledge recent findings of neurobiologists because the brains of the learners is their workplace, and this knowledge is invaluable as far as effective teaching is concerned.[32]

LO- OR HI- TECH EDUCATION?

The fast-changing world has necessitated a great number of changes in education as well. No longer do schools have to familiarise students with a code of conduct only in real-life situation, but they also need to teach them how to behave in a virtual space. Teachers have to obtain all the necessary knowledge concerning online behaviour and online safety so as to impart it to their learners. They themselves must become digitally literate in order to instruct their learners how to optimise the use of ICT tools and how to protect themselves

[31] D. Sousa, *op. cit.*, p. 35.

[32] M. Żylińska, *op. cit.*, p. 168.

against online threats. They need to be aware of hazards associated with technology, which, when sensibly used, is bound to bring incontestable benefits.

We would venture to claim that never before has the generation gap between students and teachers been so wide as nowadays. Born in a digital age, children grow up surrounded by modern gadgets and they know instinctively how to operate a good many of them. Children develop as if the sixth sense – a digital one, thanks to which they interact with tech advances with bewildering ease. Technological devices are intrinsic to the digital world that children are born into, so "[w]hen they enter educational settings [...] [they] bring with them extensive understanding and experience of digital devices, applications and environments."[33] Young people use modern applications for pleasure, for keeping in touch with their acquaintances and also to gain knowledge. They are so accustomed to those tech advances that they are eager to make them an indispensable part of their school life as well.

There are voices against digitalisation of the teaching process, but the truth is that, especially in view of the challenges encountered during the coronavirus lockdowns, the process of technological development will not stop, and technology is already becoming an unavoidable aspect of school education. Teachers thus need to show their learners from the very early years how to use modern devices for educational purposes, warn them against possible threats and familiarize them with the rules of the netiquette. Neil Postman emphasises that "[e]very technology is both a burden and a blessing; not either-or, but this-and-that."[34] In his opinion, it is at the same time both friend and enemy, and as Abraham Lincoln claimed, "the best way to destroy an enemy is to make him a friend." That is why even those who oppose the integration of technology in education should understand that it is extremely vital to teach children the wise use of technological devices, as they are intrinsic to the world they happen to live in.

[33] C. Burnett, *op. cit.*, p. 7.

[34] N. Postman, *Technopoly: The Surrender of Culture to Technology*, Vintage Books, New York 2018, p. 5.

CHALLENGES FOR THE 21ST CENTURY TEACHERS AND SCHOOLS

The 21st century teachers have been witnessing a digital transformation in schools and a prodigious modification of the teaching and learning processes. Digital tools are becoming more and more popular with students and teachers and, since it is impossible to turn the clock back and dispose of all those technological innovations, teachers should treat them as worthwhile teaching tools. Still, they do not have to accept automatically all the choices and learning styles preferred by digital learners, since not all of them lead to effective learning. To capture students' attention, teachers need to understand that the world, as well as the students, has changed and that they have to adapt their teaching styles to the new generation of learners. To start with, educators should become adept at utilising digital devices and have to be eager to incorporate them into their teaching practice. They need to immerse in their learners' hybrid reality so as to get an insight into their world and comprehend the mechanisms responsible for their learning. They have to accept the fact that their role has changed significantly as a result of technological development. No longer is the teacher regarded as knowledge bearer and the major source of information.[35] Nowadays students tend to refer to online resources to find out more about the topic of their interest or even to check their teachers' erudition. Teaching becomes more student-centred, and the teacher is a facilitator and a guide in learners' quest for knowledge. Consider a method of a flipped classroom which is currently gaining in popularity. Developing students' interest in learning, a flipped classroom combines online learning at home with traditional teaching. The teacher prepares the material to be analysed by students in the confines of their own homes and then during the lesson learners complete assignments and do various activities. Karen Muldrow[36] points out the following advantages of a flipped classroom:

[35] J. Morbitzer, *O wychowaniu w świecie nowych mediów – zarys problematyki*, "Labor et Educatio", no. 2, 2014, pp. 119-143.

[36] K. Muldrow, *A New Approach to Language Instruction – Flipping the Classroom*, "The Language Educator" 2013, p. 29, https://studylib.net/doc/8261315/a-new-approach-to-language-instruction%E2%80%94flipping-the-class (19.09.2022).

> Students can view and review material at their own pace and according to their own needs; teachers can structure class time to optimize individualised attention to students; and students have the opportunity to make use of the material they are learning in a reinforced setting.

Traditionally, we conceive of teaching as a process taking place in a classroom during a given amount of time. Such a perspective implies that, frequently, when the term 'educational space' is used it is equated with the 'school space', in the sense of architectural space.[37] The school space, however, is only a component of a more complex phenomenon that educational space constitutes. According to Morbitzer, educational space is a multidimensional concept that denotes the social space in which educational processes, comprising teaching and breeding, take place. Educational space in his sense can be "both material and non-material, global or local, technological, cultural, institutional and non-institutional"[38] (authors' translation).

According to Morbitzer, such an interpretation of the concept of educational space takes into account the ongoing technological boom, the accompanying socio-cultural transformations, and importantly, the emerging model of a new man: a digital native. The technological boom enforces changes in education. On the one hand, schools become equipped with modern aids, especially computers with the Internet access, although these are often used in a limited way.[39] More importantly, changes in the scope of educational space are inevitable. The Internet and its virtual space become a new area for learning, accessible from anywhere at any time. In fact, a great amount of students' practice has been shifted online. Schools offer e-learning courses or provide blended or hybrid learning programs which combine face-to-face classroom teaching with online learning. This, in turn, requires technologically advanced educators.

Given the rapid pace of digital technology development and a high reliance of young people on mobile devices, teachers may

[37] See J. Morbitzer, *O nowej przestrzeni...*, p. 412.

[38] *Ibidem*, p. 413.

[39] *Ibidem*, p. 414.

establish better relationships with learners and their parents. Social networking sites enable teachers and students to keep in touch even outside school buildings and forge a long-lasting bond. Similarly, educators may communicate with parents and inform them about all the school-related matters. However, not all parents are equally technically skilled, and they need to be educated to be able to use modern communication tools. Besides, they may also be reluctant to log into e-registers to learn about their children's achievements, which is highly evident from the study conducted by Żebrok and Smyrnowa-Trybulska in 2015.[40] 140 parents were asked via the e-register to complete a questionnaire concerning the functioning of electronic registers in selected school in the Silesian province and only 8 of them issued their responses. This may indicate that either they do not use e-registers at all or were not eager to take part in the study. Still, it is the school and the teachers' role to show the advantages of electronic registers and to encourage parents to make full use of this software. Unfortunately, there is also a threat that some parents may lose personal contact with the school as the information about their children's educational results is easily accessible via digital tools. Teachers have to find a way to attract parents to schools as face-to-face meetings are essential for developing a strong parent–teacher relationship and are paramount to monitoring children's progress at school.

For e-registers to operate efficiently, schools need to be well-equipped and have sufficient connection, as well as secure Internet access. Until recently, a great number of schools in Poland have lacked appropriate technology infrastructure. Rather, the equipment has been flimsy and out-of-date and their Wi-Fi connection unreliable. Żebrok and Smyrnowa-Trybulska found out that 94.11% of the surveyed teachers are strongly in favour of electronic record–keeping, but at the same time 81.25% of them point out that the main problem they have to face is "disruption in Internet service, [and] lack of

[40] P. Żebrok, E. Smyrnova-Trybulska, *Electronic Registers in the School and Determinants of Their Effective Implementation*, http://www.przemyslaw.zebrok.pl/files/e_register.pdf (5.08.2018).

access."[41] The experience of the COVID-19 pandemic made us realize that, although technological development is progressing with a lightning speed, schools do not always manage to keep pace with it. With high-tech classroom equipment being often beyond their reach, it is necessary for teachers to utilise the digital tools available and exploit online resources to evoke students' interest in the lesson and increase their motivation to learn and to equip them with practical knowledge concerning the application of modern technology in real-world situations. Teachers should confute a French philosopher, Albert Camus, who claimed that "the school prepares us for life in the world that does not exist."[42] Though it is impossible to foresee what changes will take place in the future, it is irrefutable that it will be the future of hyperadvanced technology, and the new generation has to be prepared to live in such a computerised and digitilised world.

Leaving aside the question whether schools in Poland are underequipped or not, they lack digitally adept teaching force.[43] This may be due to the fact that teachers are an aging group of professionals,[44] which Mariola Rachubka's report illustrates. It contains the analysis of teachers in Poland and their age in year 2014/2015 as provided in the table 1.

It appears that the largest group of teachers comprised people aged 46-50, and only 2.57% of them were in their early- or mid-twenties. The trend seems to continue, which is illustrated by the data published by Eurostat in October 2022. According to the statistics, 39% of teachers in European schools are 50 years or older.[45] Judging by the age, it could be surmised that the majority of teachers are not necessarily computer savvy, and they are more than likely to constitute the group of digital immigrants. They probably favour traditional teaching methods and are rather reluctant to use digital tools during their lessons. They are unlikely to be creative users of modern

41 P. Żebrok, E. Smyrnova-Trybulska, *op. cit.*, p. 105.

42 http://statusmind.com/smart-quotes-1921/ (24.10.2022).

43 J. Morbitzer, *O wychowaniu w świecie...*, p. 136.

44 G. Leśniewska, *Gotowość do zmiany nauczycieli szansą edukacji XXI wieku*, „Studia i Prace WNEIZ US", nr 46(1), 2016, pp. 39-49.

45 https://glos.pl/eurostat-pokazal-najnowsze-dane-dotyczace-zawodu-nauczyciela-w-2020-r-tylko-7-proc-nauczycieli-w-ue-mialo-mniej-niz-30-lat (19.09.2021).

technology and do not seem to exploit online resources to diversify their teaching methods.

Table 1. Teachers' age in 2014-2015
Source: Own representation based on the report of Rachubka.[46]

Teacher's age												
20-25	26-30	31-35	36-40	41-45	46-50	51-55	56-60	61-65	66-70	71-75	76-80	81-90
2,57%	9,88%	13,88%	15,48%	15,12%	16,94%	15,5%	7,6%	2,24%	0,62%	0,14%	0,03%	0,006%

Though these may seem to be far-fetched assumptions, it cannot be denied that most teachers in Poland have only basic IT skills and find it difficult to accept that students' learning methods have changed due to excessive exposition to modern media and digital technology. There is no need for the New Millenium Learners to rack their brains trying to remember all the facts and figures or trying to do all the calculations[47] as digital devices are easily accessible and are as if an extension of young people's memory.[48] David Sousa underlines that "[t]he capacity of working memory appears to be decreasing for reasons we do not yet understand"[49] but at the same time visual working memory is increasing. The C generation are said to place image above word, and screen above written text.[50] They find it difficult to concentrate on the linear flow of traditional textbooks and on the spoken word of academic lectures.[51] Assailed by

[46] M. Rachubka, *Nauczyciele w roku szkolnym 2014/2015*, Biblioteka cyfrowa Ośrodka Rozwoju Edukacji, Warszawa 2015, http://bc.ore.edu.pl/dlibra/docmetadata?id=808&from=&dirids=1&ver_id=&lp=1&QI=.

[47] J. Taylor, *Digital Technologies and Cognitive Development Or Can our theories of learning help us understand what people are doing when they learn through interaction with networked, integrated, interactive digital technologies?*, https://www.semanticscholar.org/paper/Digital-Technologies-and-Cognitive-Development-Or-%2C-Taylor/210a40349efab53996421a0c26ec0f6b87d884d.

[48] J. Morbitzer, *O wychowaniu w świecie...*

[49] D. Sousa, *op. cit.*, p. 51.

[50] J. Morbitzer, *O wychowaniu w świecie...*, p. 127.

[51] *Ibidem*.

a plethora of stimuli, young people tend to respond better to visual material and their retention seems to increase when both verbal and visual components of working memory are involved.[52] They "develop a better ability to sift through large amounts of information rapidly and decide what's important and what isn't" and their "ability to multitask without errors is improving."[53] Affected by the rapidly-evolving world and susceptible to the excessive use of digital technology, children often have difficulty in concentrating on the same topic for a long period of time.[54] They do need quick changes and novelty in their classrooms as well, hence technology appears to prove an invaluable teaching tool.

DO POLAND'S TEACHER EDUCATION PROGRAMMES NEED TO CHANGE?

Education is one of the top priorities of each government. It plays a vital role in the development and the growth of a country as it shapes minds of young generation and equips them with knowledge and skills which are indispensable for their future lives. Undoubtedly, good school infrastructure is highly conducive to learning but the quality of the teaching force seems to be even more significant. As David Sousa claims, teachers are 'brain changers' and are thus partially responsible for country's future well-being. They exercise a tremendous and far-reaching influence upon the society and, therefore, their professional and content knowledge is of cardinal importance.[55]

The significance of educating the society whose members are computer-literate is captured in the recommendations of the Ministry of Education and Science that have been formulated over the past few years, according to which, among priorities there remain: developing the digital competences in both learners and teachers, with special focus on the safe and responsible use of the Internet re-

[52] D. Sousa, *op. cit.*, p. 106.

[53] G. Small, G. Vorgan, *op. cit.*, p. 49.

[54] D. Sousa, *op. cit.*, p. 104.

[55] *Ibidem.*

sources, as well as developing teachers' methodological skills in the correct and effective use of information and communication technologies in educational processes.[56] Recommendations concerning the promotion of the digital competences of students and teaching staff are also formulated in the document dedicated to public policy towards lifelong learning, namely the Integrated Skills Strategy 2030.[57]

Education and Training Monitor 2021, prepared by European Commission, shows strengths and weaknesses of national education and training systems in European countries. The report clearly states that "Poland continues improving digital education, but challenges persist" and that "[w]hile the digital competences of teachers have improved, challenges remain: the time-consuming process of distance teaching, equipment shortages, stress and fatigue."[58] It appears to be high time to start thinking about teacher education in Poland and to ponder whether it prepares educators who are able to work with digital-age learners. The USA has already begun fervent discussions about teacher education and the following quotation from the report seems to be applicable to teacher education in Poland as well as it illuminates the core of the problem:

> Many assert that the existing system of educator preparation is not developing teachers with the skills needed to enable their students to be successful in the 21st century. In many ways, teacher educators are working with one foot in the future and the other in the past. Their graduates will serve the most digitally savvy, social networked generation in history. [...]. Yet teacher candidates continue to be immersed in antiquated preparation programs that equip them to deliver primarily tra-

[56] https://www.gov.pl/web/edukacja-i-nauka/podstawowe-kierunki-realizacji-polityki-oswiatowej-panstwa-w-roku-szkolnym-20222023 (30.12.2022).

[57] https://www.gov.pl/attachment/d878ece0-503d-4b91-a9a1-68e8b3c9a375 (12.10.2022).

[58] European Commission, Directorate-General for Education, Youth, Sport and Culture, *Education and training monitor 2021: Poland*, Publications Office of the European Union, 2021, p. 10, https://data.europa.eu/doi/10.2766/175514 (20.08.2022).

> ditional stand-alone, text-based instruction in self-contained classrooms.[59]

Teacher education in Poland encompasses both general education and professional training, which is otherwise referred to as pedagogical preparation. Redefined in 2019, national standards cover five modules which are the following:

- subject-specific training;
- teacher training, including psychology and pedagogy, and teaching and learning processes, including the basics of teaching and learning;
- voice production;
- training for teaching a main or an additional subject or conducting main or additional classes.[60]

Much emphasis is put upon professional knowledge and students have at least 420 hours of teacher preparation courses. According to national standards, teachers should possess basic IT skills and should be able to use technology in the classroom. National standards, as well as Polish Qualifications Framework, do not, however, specify how many hours of IT preparation the would-be teachers should have, which poses the question whether students who enrol in teacher education programmes are prepared to work in the digital age? We have analysed 18 teacher education programmes[61] preparing teachers of the English language so as to check how many teaching hours is devoted to IT. All the programs that underwent closer scrutiny were available online. Out of 18 academic institutions whose programmes were analysed,12 are universities, 5 are universities (academias) of applied sciences, and 1 has the status of academia.

It appears that most programmes (72%) include either IT or ICT courses. On a closer examination, it can be deduced that they can be labelled as 1-3 ECTS introductory courses to IT, most of which last 30 hours and three of which last 15 hours. The exception is one of

[59] http://sites.edb.utexas.edu/uploads/sites/144/2017/10/SummitReport.pdf, p. 1 (20.08.2022).

[60] https://www.european-agency.org/country-information/poland/teacher-education-for-inclusive-education (20.08.2022).

[61] The analysed programmes were valid for the 2022/2023 academic year.

the programmes in which the IT course is scheduled for 60 hours of teaching and for which 4 ECTS points can be received. One fifth of the programmes additionally contain courses devoted to the development of digital competences in teaching, such as Computer as a Teaching Tool and Modern technologies in teaching English as a foreign language. Three out of four schools in which those programmes are used are universities of applied sciences.

Undoubtedly, teacher education programmes do not go in pair with technological development. Students seem to acquire their IT skills outside their universities which do not prepare them well to work with digital-age learners. National standards for teacher education have stagnated and do not take into account the rapidly changing world, which has a significant impact upon learners. Although it is a tremendous undertaking, educator preparation programmes need to be reinvented and 'new teachers for new school' and new types of learners should be created, in line with the observation that "[s]chools must be transformed from teaching organisations into new kinds of learning spaces, and teachers must be trained in these new learning spaces so they are ready to work in the schools of the future."[62] Educators teach digital learners, use digital teaching tools, work in the digital age, and thus need to become digital themselves.

CONCLUSIONS

While many of us are willing to acknowledge that the world we live in is a world dominated by technology and the consequences it brings about, equally many would admit that our schools seem to be somewhat immune to changes. It was our aim to bring to light how crucial the technological boom and the results of the ongoing research of the human brain and its function are for education. We claim that successful teaching is hardly possible without implementing both modern teaching methods (consider educational neuroscience) and modern technology and devices. The same should be

[62] http://sites.edb.utexas.edu/uploads/sites/144/2017/10/SummitReport.pdf, p. 1 (05.08.2018).

acknowledged by academic institutions as well as other institutions responsible for training of future teachers. The purpose of the present article was not to provide conclusive remarks but rather to draw attention to the challenges the 21st century creates for education in general. Still, it seems unquestionable that national standards for teacher training should be modified, if not reinvented, and they should incorporate some elements of educational neuroscience. Besides, teacher education graduates need to be both digitally literate and digitally aware and they ought to know how to use modern tools for educational purposes. Although the Ministry of Education and Science seem to be cognizant of the need to develop teachers' digital competencies, it is not reflected enough in the realm of teacher education. It seems to be the right time to start looking ahead and to ruminate on the quality of teacher education in Poland as well, since such far-reaching changes cannot be introduced overnight and require thorough analysis.

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ABSTRACT

Education in the Digital Age: Some Implications for Teaching and Teacher Training

The paper focuses on the present-day education in view of the technological boom and the ongoing digitalization of our lives, as well as on the neuroscientific discoveries which shed more light on the nature of learning and thus have consequently influenced teaching strategies. We would like to argue that successful teachers have to, on the one hand, understand the intricacies of the human brain in order to organize the teaching process better; and on the other hand, they must observe and adapt their teaching strategies to the needs and expectations of the digital-age learners. The 21st century teachers have to be able to use technological tools on everyday basis to make education attractive to the young generation who live on the edge of the two worlds: a real and a virtual one. The new type of learners requires different teaching methods and a hands-on or a digital approach to teaching.

A natural question that arises, therefore, is whether the importance of digital education is reflected in teacher training programmes? Are Polish academic institutions effectively preparing graduates who are ready to work in the digital age? These are the questions which inspired the authors to write the present article as there does seem to be a need to attend to the

state of the education system in Poland and to ponder on the potential modifications of teacher training programmes that ought to be introduced.

Keywords: digital natives, virtual reality, neurosciences, teacher training programmes

Współczesny świat, w którym obecny jest człowiek, tworzą dwie wzajemnie przenikające i uzupełniające się przestrzenie: klasyczna i wirtualna. Ich zróżnicowana funkcjonalnie konfiguracja, umożliwiająca wzajemną dynamiczną koegzystencję i swobodny przepływ przy zachowaniu odmienności oraz względnej niezależności, tworzy rzeczywistość hybrydalną. Ta ostatnia staje się podstawą modyfikacji otaczającej rzeczywistości, łącząc to, co tradycyjne, z elementami umożliwiającymi realizację nowych oczekiwań człowieka.

Rzeczywistość hybrydalna ma charakter dynamiczny, przeobraża dotychczasowe schematy konstruowania, opisywania, analizowania i w konsekwencji transformacji świata. Ekspansywność tych przemian wyprzedziła nie tylko praktykę analiz, lecz także jej konceptualizację. Rzeczywistość hybrydalną należy poznać i zrozumieć, aby można było zainicjować procesy wspomagające rozwój człowieka. Pomimo braku jednoznacznych określeń, którymi można byłoby opisać ten nowo powstały świat połączonych i zespolonych dwóch różnych rzeczywistości, autorzy książki podjęli próbę jego zdefiniowania, a także zrozumienia zachodzących w nim procesów. Książka nie zawiera gotowych wzorów pozwalających odpowiedzieć na pytania: „Jak wykorzystać szanse, które daje powiększony wirtualnie świat?", „Jak rozwiązać problemy, które generowane są dynamizmami rozwoju, ale i zagrożeń?". Zawarte w niej teksty autorów reprezentujących różne dyscypliny naukowe pobudzają do refleksji nad możliwościami wykorzystania oraz kontrolowania rzeczywistości hybrydalnej.

Monografia stanowi element wyjściowy do rozważań nad kondycją dzisiejszego człowieka, jego tożsamością oraz obecnością we współczesnych cywilizacji i społeczeństwie. Zawiera wskazówki pozwalające na zaprojektowanie działań edukacyjnych, ale przede wszystkim wychowawczych, które wykreują nową kulturę rzeczywistości hybrydalnej.

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