Polskie Forum Psychologiczne, 2023, tom 28, numer 1, s. 99–112
DOI: 10.34767/PFP.2023.01.06

SOCIO-TECHNOLOGICAL REVOLUTION: CONSEQUENCES TO EDUCATION

Tina Lindhard[1], Marzanna Farnicka[2]

Summary. We live in an era where cultural and social changes influence human growth and development, which is relevant to individuals as well as entire groups. We owe this to the technological revolution and changes in the way of living, aspects that are widespread and, in some respects, long-standing phenomena. This is particularly important for the development of individuals as well as entire groups. The contemporary psychology faces, in times of existential challenges connected with a time of technological changes that occur between biological or social determinism, extreme individualism, subjectivity and technologisation and utilitarianism.
In this article the emphasis is placed on the consequences of introducing modern tools linked to technological development into psychology and education, especially through the process of "unrooting" by the separation of students from teachers and students from their environment, which are the source of goals and motivation.
Key words: aims of education, developmental environment, innovations in education

Introduction

The dynamics associated with rapid changes in the way of using technology are a challenge for researchers who study and diagnose psychological processes such as personal development and therapy (Paluchowski, 2001; Maryniak, Ondruch, Roszkowski, 2010; Kim, Steiner, 2016). Technology and related inventions reflect the need for improving the quality of life and enable the improvement of

[1] Faculty Mentor International University for Professional Studies (IUPS), Hawaii, US; President of the Centre for Conscious Awareness Spain (CCASpain); Chair of Consciousness Research CICA International, ORCID: 0000-0002-1305-2550.

[2] Instytut Psychologii, Uniwersytet Zielonogórski, Polska (Institute of Psychology, University of Zielona Gora, Poland), ORCID: 0000-0002-4274-1646.

Mailing address: Marzanna Farnicka,
m.farnicka@wpps.uz.zgora.pl

existing everyday use of appliances and treatment methods. These changes affect the living environment of all generations.

New technologies are undoubtedly changing developmental environments. What does it mean for psychology? Research, diagnosis and educational tools are changing, we have new fields of cognition (cognitive psychology) and several issues related to neuropsychology and neurodidactics. However, this is only the tip of the iceberg. The changing environment affects the context of life as stated in the psychology of human development (Trempała, Cieciuch, 2016).

Focusing on models such as Vygotsky's theory (1972), we can induce that the experimental environment of children and young people will significantly impact their developmental experiences. Vygotsky identified that development involves the internalization of external tools in the development of all mental functions (1972). This means that the development of thinking, as well as other cognitive functions, are, to a considerable extent, determined by the quality of an individual's environment and the capability of transferring knowledge, information and skills from outside to inside (1972). According to Vygotsky, the transfer occurs mostly through language (1972). Therefore, one of the most essential functions of education should be to support the development of a comprehensive and effective spoken language of the child that reflects the quality of the surrounding culture and, in addition, provides an opportunity to diagnose and determine both the current and the near future sphere of the child's development and internalized the behaviour and motivation function. In this article the emphasis is placed on the consequences of introducing modern tools linked to technological development into psychology and education. The reflection focuses on the nature and significance of these new tools for the diagnosis process, the methodology of the social sciences and the everyday practice of psychologists, teachers and researchers concerning the information we obtain but also what remains hidden.

To respond to the above concerns, we have divided the article into two parts. In the first, we discuss issues related to high technology and neurodidactics, sometimes called neuroeducation, and in the second, we focus on the implications and methodological applications of the issues raised above.

The phenomenon

Today, in 2022, it is a fact that fast technological changes have transformed the conditions of human development. After almost two years of online or hybrid teaching experience due to the COVID pandemic, we can speculate about what we have learned about the impact of new technology from this experience.

We have new tools and new possibilities. Since the beginning of 21st century, the solution to the problem of innovative development of education is no longer limited to the introduction of only information technologies in the educational process (Pawlak, 2020). They become the basis for the emergence of new directions, such as robotics, additive technologies, 3-D, and FDM-printing. The use of high technologies requires the formation of a different worldview and technological culture among specialists. The need for highly qualified specialists trained in related specialties is determined by the development of science and technology. Knowledge, technologies, methods and ways of solving production and scientific problems that characterize the current level of development of society, contribute to the formulation of solutions to problems which require interdisciplinary training (Abramova, Kamenev, 2017).

We know that network participants can create their own worlds to suit their needs. The created world/s may be an alternative to reality, and the network user can switch back and forth between the real and the virtual domain while retaining his or her core identity. However, a person may not feel psychologically attached to the actual physical location where he or she is situated and, although physically close to us in proximity, maybe living in a world that is unattainable and distant, because it is artificially created. Digital usage has not only altered how we communicate, organize information, search for knowledge and accumulate it but has also modified our time-spending habits (Chaney, 2013). As a result, we have witnessed changes not only in the way people think about the world (content) but also in the thinking process, such as education.

The following examples are some studies that address the problem of technology-connected transformations in education. It has been observed that computer games have influenced cognitive processes of their users. Peripheral vision and attention switching functions are improved, multi-tasking dominates, mental reactions and decision-making processes are sped up (Zajonc, 2000; Nigg, 2017). Another noticeable change is a different mode of cognitive functioning in learning (Olson, Torrance, 1996; Alfred, Neyens, Gramopadhye, 2018; Ballarotto, Volpi, Tambelli, 2021). Reflections for psychological consequences and educational problems relate to the separation of the students from the teachers, from their natural environment and their motivation in the learning process.

The quality of change determines both the level of development of technologies in society and it plays a vital role in building the didactic process involving the level of training of future specialists. The natural occurring criteria are related to the extent a person can be ready (or not ready) to assimilate, create and implement high technologies. Based on the application of the theory of the information society, Gattie and colleagues (2011) attempt to determine the socio-cultural prospects for the development of society under the influence of the development of high technologies. The study of their influence on mentality and technological order made it possible to predict possible changes in a person's lifestyle. It is pivotal to clarify that not all new technologies are found to be appealing; they can be rejected or supported depending on society's recognition of the need to develop the proposed innovations (Kamenev et al., 2018). Misunderstanding and non-recognition can be caused by various reasons:

- lack of a vision of the feasibility of using this technology due to an unformed need
- insufficient level of materiality culture of society for the implementation of the innovation
- insufficient level of technical training of people for its use
- cultural conflicts causing cognitive dissonance, etc.

From the point of view of systems theory, it needs to be underlined that high technologies cause change not only in the field for which they were developed but have a wider impact on the entire socio-cultural system and each individual in particular. We are thinking about both: high technology and neurotechnology (Alfred, Neyens, Gramopadhye, 2018). They give the new developmental experiences and new learning methods. Some research is aimed at identifying the constructive and destructive nature of using high technologies in the education system. The institutional approach is an assumption of study, which makes it possible to consider the impact of high technologies on society as a certain institutional structure, whereas the socio-cultural approach helps to identify the interconnections between technologies, society and human beings. The result of studies led by Kamenev with his team (2018) showed that constructive changes in education can be viewed as processes of transformation of teaching didactics. The concept of "high educational (pedagogical) technologies" has appeared. The differences between high technologies and high educational technologies were formulated by Zhukova: "we are talking about the technology of creating a computer and about technology using a computer" (2008, p. 95). The emergence of "high pedagogical (educational) technologies" directly depends on the level of development and implementation of "high technologies" in the educational process. This is commonly referred to as technology-enhanced learning (TEL) integration (Bradley et al., 2007; Bagarukayo et al., 2012; Gregory, Lodge, 2015; Law et al., 2016). Researchers have shown that the technological accessibility of TEL improves students' thinking, provoking them to create different ideas and expand their horizons, as well as qualitatively transforming the learning process (McCraty, Atkinson, Bradley, 2004).

Neurodidactics

Progress in the use of medical methods for diagnostic and educational use has been made possible by the development of techniques for analyzing and visualizing brain activities. Functional magnetic resonance imaging (fMRI) and its derivatives such as diffusion tractography (DT), positron emission tomography (PET), quantitative electroencephalography-electroencephalography (QEEG) and other research methods allow us to discover the mechanisms of mental function. These research methods also reveal what changes occur in the subtle structure of brain connections during the learning processes. This redevelopment involves changes that have been known for centuries (Herzyk, Jodzio, 2008; Żylińska, 2013; Giedd, 2015).

Switching to one of the many operational levels, we propose tracing the concepts of neuropsychology, neuroeducation or neurodidactics. In psychology, neuropsychological diagnosis may be considered as a form of assessment of human functioning separate from the psychological description. The methods of neuropsychological diagnosis are mainly observation, examination of products and multiple experimental tests. These are used to determine the appropriateness of behaviour, communication and/or emotions concerning age, health and the strength of a situational stimulus applied. It aims to enhance therapeutic activities and support the adaptation of interventions to an individual's abilities (Jodzio, 2011). In neuroeducation, an essential element for cognition and a better understanding of the learning process involves the functioning: of the brain as an organ that enables learning and as having control over all aspects of our lives, the mind as a system of processing information, and education as a process that leads to self-regulation in the area of emotions, cognitive processes and actions. The term "neurodidactics" is believed to have first been used by the German didactician Gerhard Preiβ (after Juszczyk, 2012, p. 46) who wrote, "school pedagogy and general didactics need to pay closer attention to the fact that learning depends on brain processes and the cognitive outcome of learning increases along with brain development of the learning child and the conscious use of its capabilities". Therefore, in controlling changes at the cerebral level, the process is mainly concerned with improving elementary processes – perception, attention, memory and cognitive control, as well as developing complex processes such as thinking and language (Farnicka, 2017). To demonstrate the scope of the discussed topic, figure 1 shown below, illustrates the different ways of thinking proposed by Chojak (2020). In her work, she presents a brain-based learning structure that encompasses and integrates mind, brain and education science (Tokuhama-Espinoza, 2010).

Example. Skillful use of neurodidactic theories may lead to optimization of teaching conditions, exploitation of students' potential (which can increase teaching effectiveness and in a more profound understanding of the taught content), conscious construction of knowledge basics, creativity in solving problems, correct reasoning, perception of facts and relations between them, and the ability to raise questions. This model combines individualized teaching with traditional classroom organization and provides students with an opportunity to become real subjects of education. The continuous process of searching for more effective teaching strategies is linked to the assessment of past teaching failures and the identification of destructive factors in the teaching profession. Simultaneously, new forms of working need to consider the young individual's characteristics and also the new IT technologies associated with these forms. These technologies also become tools for research and didactic work. An example is the increasingly common and widely practiced electroencephalographic (EEG) testing. Electroencephalographic findings provide new knowledge about brain functions that are used in preventive health care. They also provide valuable information on how specific areas of the brain react to planned research such as how the brain reacts to sensory input.

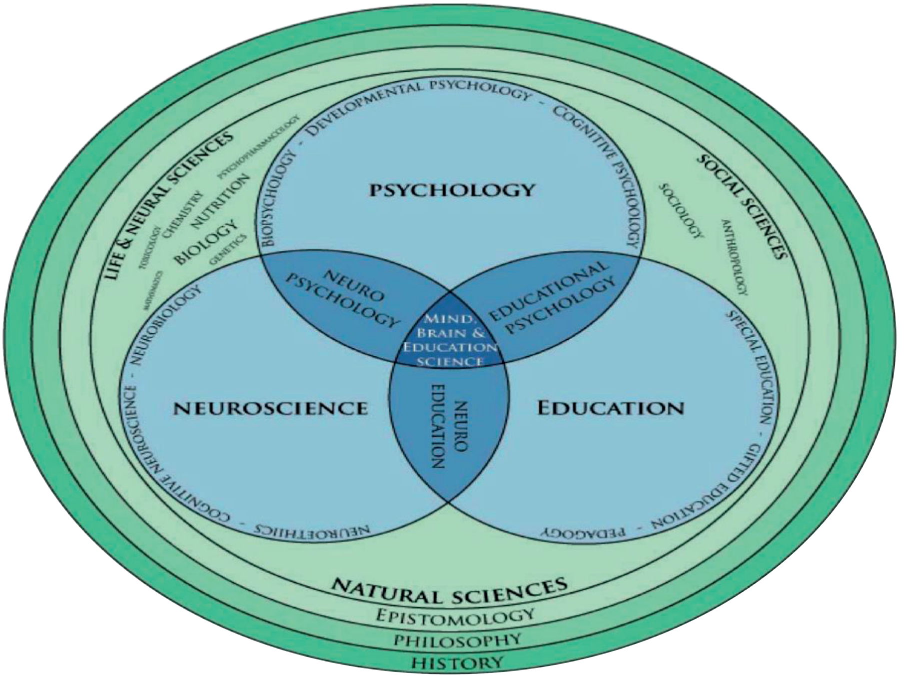

Figure 1. Brain and mind research opportunities vs. conventional psychology, education and neuroscience
Source: Chojak (2020).

In this field, assessment of the effectiveness of education may be carried out through statistical analysis such as student's grades, as well as through observation of changes occurring in the human brain when exposed to external stimuli (EEG test). To illustrate this, we present a study conducted by Prauzner (2016). His research aimed to analyse pilot data as part of an evaluation of the effectiveness of using deterministic computer simulations in technical education. The study involved part-time students attending electronics and electrical engineering workshops. The use of the EEG method was to assess the level of teaching effectiveness by analyzing the recorded signals from the brain map. A comparison was made between brain activity during sessions based on the teaching method (lecture) and the problem-based method using computer simulation. Previous research conducted by the author demonstrates that the group of computer simulations, defined as deterministic simulation programs, may be used in technical education to improve the efficiency of the didactic process as per the theory of multilateral education (Prauzner, 2013). During the lecture test (first case), the brain reacted more intensively to Theta waves in the temporal and frontal regions (central part), whereas during the work with the simulation program, the intensity of waves was considerably reduced. In the case of computer simulation, a wider area of activity with comparable potential of the parietal lobe was observed. Regarding Beta 1 waves, it was observed that in the first case there was a greater activity of waves, especially in the left temporal lobe and a generally larger area of the whole brain. Gamma waves were also greater in the first case, especially in the left temporal lobe. Although the analysis of the data provides limited medical or physical findings, it demonstrates significant differences between these two methods. It may be concluded, that in this case the method of using computer simulations in the teaching process did not provide the expected results with students showing more cognitive activity during the lecture. These inconclusive results suggest that simulation programs do not necessarily encourage more active work involvement than classical methods. According to the authors, the causes of this phenomenon should be sought primarily in study-related factors. A detailed analysis of the histogram, in particular wave phases, demonstrates limited activity during the computer simulation (comparable to the sleep phase). The question arises as to why the study did not identify the expected (greater) activity during computer simulations. The answer was provided by data obtained from a short interview in which respondents shared their opinions on the attractiveness of the sessions. The primary factor affecting brain activity was general physical fatigue and lack of motivation to engage in mental work requiring more effort with the computer program. The computer program required students to be more active which was contrary to individual expectations and abilities and therefore resulted in weariness. The lecture proved to be a less disruptive and more relaxing method for the brains of the participants. The results do not define the teaching method itself as bad or good, but they suggest that external factors should be considered before the selection of the teaching method. The results of research conducted by neuroscientists are interesting and inspiring for various researchers. It is important to note that from a neurobiological perspective, learning processes are reflected in changes in the strength of synaptic connections between nerve cells. However, the learning activity aimed at acquiring and accumulating individual experience, is what leads to changes in human or animal behaviour (Włodarski, 1974). Therefore, the study and management of learning processes require knowledge about its mechanisms, strategies, conditions of learning and the meta-cognitive components of this process. In neuroeducation, such knowledge should result in inner-directed skills that come from the awareness of one's learning, its condition, context, purpose and the ability to model and correct. It is important to remember that essential learning mechanisms involve observation, experience, model examples, deliberate practice, elaboration, visualization, generation, analogies, contrasted cases, questions, reversal, production and dreaming. Among the meta-cognitive components of learning, Schwartz, Tsang, and Blair (2017) also highlight imaginative play, clarification, self-explanation, self-efficacy and teaching others.

In understanding the potential consequences of the neurotechnology impact, one needs to distinguish the details of the context and the enabling of a new type of meta-analyses and generalizations related to elements inherent in the research itself. According to Vygotsky (1978), this leads to another question about the language of explanation and a question about the theories known to us. Does research in the new reality complement the existing knowledge and help science develop cumulatively or, on the contrary, do we have a problem of a revolutionary nature? Thus, do we need to replicate the existing research? From this perspective, replications are a great opportunity to study universal changes, general laws and cause-and-effect relations, and to understand and interpret phenomena. The new times showed that we as psychologist need to exchange experience, interpret, give meaning to action, and to (re)construct the meanings of actions undertaken from the perspective of the subject, the object, and the observer and compare the results of different studies (Farnicka, 2019). In person-environment interaction, we have new questions related to technology, but the technology can be consciousness (eg. phone, internet) or unconsciousness (neurotechnoeducation). Because of that, the study of psychological consequences of innovation is interdisciplinary (is a part of many kinds of innovations). It is worthy to underline that we should also ask about the functions which are omitted or developed because of innovation and the relation of these to the subject being studied (see Table 1).

Table 1. The question "in action" in psychology

Innovation	Consciously perceived	Unconcius bias
Example	New app, phone, new tool,	Neurodidactic, being part of technological or marketing environment
Questions	Relation to…	Consequences of being "in", "into"
Problems	Functioning of tools, what function is replacement or omitted, how long in time it is used, what are developmental changes, what new skills are developed?,	What is improved? Habituated? time of the duration? What is the content of the change and impact?
Possibility of	Making the decision "Being without or with"	Being apart, or separated from technology

Source: authors own work.

Summary and conclusions

Even in times of revolution in psychology, the choice of education interventions is determined by the adopted paradigm and its ontological and epistemological assumptions (Brzeziński, 2015). Despite the solutions suggested in the literature that is to help the educator find a suitable model to understand and interpret phenomena examined between the reality (assumptions of the teacher, psychologist), action (procedure and its capabilities) and subject of the study (the reality of the student), we face many problems, tensions and conflicts related to their choice that requires reflective consideration. Owing to the discoveries in neuroscience, we can observe these effects in terms of behaviour, attitudes, and changes in the body's physiological processes. Moreover, current knowledge tells us that the implementation of new devices and methods has short and long-term effects that should be controlled.

The introduction of high technologies, integration processes in science, technology and production have a great impact on the transformation of the goal and content of education which must ensure not only the formation of knowledge, skills and abilities but also the development of vital interests, moral values, capabilities and abilities of a person. It becomes necessary to train a master as an innovator who is ready to master new technologies, develop original solutions and promote them to the market (Dare, Ellis, Roehrig, 2018).

The requirements for variability and flexibility of the educational process imply a completely different methodology and technology of research focused on the creative search and the development of a holistic concept from the point of view of the methodology for the implementation of human activities.

Thus, it becomes necessary to change the structural component of the organization of the study process to innovations involving technology and content. This lens creates the possibility of obtaining effects based on the conditions of the modern technological order. Underlining challenging thoughts about research in the 21st century, we must consider that researchers, methodologists, or practitioners also change, from the role of a theoretician and observer to the role of a designer of the human developmental environment.

And as a final thought, we would also like to stress that for a truly interdisciplinary holistic understanding of the impact of new technologies on individuals and society, we need to include cardiac variables such as the measurement of heart rate variability in educational research. It has been found that the heart sends more signals to the brain than vice versa (McCraty, 2009) and various techniques and meditation methods have a positive effect on the heart-brain relationship and foment coherence between cardiovascular phase synchronicity and the interconnection of various bodily subsystems (McCraty, Zayas, 2014; Lindhard, Hermann, Edwards, 2021). It also seems that the heart might be involved in intuitive or Gnostic knowing (Louchakova, 2005, 2007) and the processing and decoding of intuitive information (McCraty, Atkinson, Bradley, 2004). Although cognitive psychologists have centred on conscious intellectual activity mainly associated with the brain, the term cognition is derived from the Latin word cognoscere, meaning 'to know' or 'to come to know' and is a compound of *co-* ("together") and *gnōscere*, an early form of *nōscere* ("to know") (Partridge in Chaney, 2013, 2.2. para. 2). For these reasons, these authors feel that in times of revolutionary technological changes it is important that psychologists also embrace technologies related to developmental environment and its supplies and the way of implementation all the possibilities to our human cognitive, personal and psychological needs, potential and possibilities (Wygotski, 1978; Farnicka, Liberska, 2014).

References

Abramova, M.A., & Kamenev, R.V. (2017). High technology in the innovative development of higher education. *Filosofiia obrazovaniia, 4*(73), 153–163, doi: 10.15372/PHE20170415, http://www.phil-ed.ru/images/pdf/2017_4_73.pdf (In Russ.).

Abramova, M.A., & Krasheninnikov, V.V. (2018). High technologies as a sociocultural determinant of transformation of society. *Sibirskii filosofskii zhurnal, 16*(1), 91–101, doi: 10.25205/2541-7517-2018-16-1-91-101, https://elibrary.ru/download/elibrary_35134808_ 99569833.pdf (In Russ.).

Alfred, M., Neyens, D., & Gramopadhye, A. (2018). Comparing learning outcomes in physical and simulated learning environments. *International Journal of Industrial Ergonomics, 68*, 110–117, https://doi.org/10.1016/j.ergon.2018.07.002

Allen, P.M., & Varga, L. (2007). Complexity: The Co-evolution of Epistemology. *Axiology and Ontology. Nonlinear Dynamics, Psychology, and Life Sciences, 11*(1), 19–50.

APA Presidential Task Force on Evidence Based-Practice (2006). Evidence-Based Practice in Psychology. *American Psychologist, 61*(4), 271–285.

Arnett, J.J. (2011). Emerging adulthood(s): The cultural psychology of a new life stage. In L.A. Jensen (Ed.), *Bridging cultural and developmental approaches to psychology: New syntheses in theory, research, and policy* (pp. 255–275). Oxford: Oxford University Press.

Bagarukayo, E., van der Weide, Th.P., Mbarika, V.W., & Kim, M.S. (2012). The impact of learning driven constructs on the perceived higher order cognitive skills improvement: Multimedia vs. text. *International Journal of Education and Development Using Information and Communication Technology, 8*(2), 120–130, http://ijedict.dec.uwi.edu//viewarticle.php?id=1433

Ballarotto, G., Volpi, B., & Tambelli, R. (2021). Adolescent Attachment to Parents and Peers and the Use of Instagram: The Mediation Role of Psychopathological Risk. *International Journal of Environmental Research and Public Health, 18*(8), 3965.

Bernstein, R.J. (1971). *Research methods in education, Praxis and Action*. Philadelphia: University of Pennsylvania Press.

Bradley, R.V., Mbarika, V., Sankar, C.S., Clayton, H.R., & Raju, P.K. (2007). A study on the impact of GPA on perceived improvement of higher-order cognitive skills. Decision Sciences. *Journal of Innovative Education, 5*(1), 151–168, doi: 10.1111/j.1540-4609.2007.00131.x, https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1540-4609.2007.00131.x

Brain-Based Learning: The Neurological Findings About the Human Brain that Every Teacher Should Know to be Effective [on line], http://globadvantage.ipleiria.pt/files/2011/06/ working_paper-77_globadvantage.pdf

Brzeziński, J. (2015). *Badania eksperymentalne w psychologii i pedagogice*. Warszawa: Wydawnictwo Naukowe Scholar.

Carter, S.M., & Little, M. (2007). Justifying Knowledge, Justifying Method, Taking Action: Epistemologies, Methodologies, and Methods in Qualitative Research. *Qualitative Health Research, 17*(10), 1316–1328.

Chamberlain, K., Creamer, G., & Finch, H.W. (2020). Methods in psychology: Opening a dialogue. *Methods in Psychology, 2*, 2590–2601, doi: 10.1016/j.metip.2020.1000

Chaney, D.W. (2013). An overview of the first use of the terms cognition and behavior. *Behavioral Sciences (Basel, Switzerland), 3*(1), 143–153, doi: 10.3390/bs3010143

Chojak, M. (2019). *Neuropedagogika, neuroedukacja i neurodydaktyka. Mity i fakty*. Warszawa: Difin.

Chojak, M. (2020). *Neuropedagogika wśród dyscyplin naukowych – próba doprecyzowania nazewnictwa* [Neuropedagogy Among Scientific Disciplines – an Attempt to Clarify Terminology]. *Studia Edukacyjne, 56*, 369–384, doi: 10.14746/se.2020.56.20

Coolican, H. (2014). *Research Methods and Statistics in Psychology*. 6th ed. Hove: Psychology Press.

Czerniawska, M. (2010*). Kolektywizm versus indywidualizm – zmiany wartości i postaw młodzieży w okresie przeobrażeń ustrojowych. Studium interdyscyplinarne*. Białystok: Oficyna Wydawnicza Politechniki Białostockiej.

Dare, E.A., Ellis, J.A., & Roehrig, G.H. (2018). Understanding science teachers' implementations of integrated STEM curricular units through a phenomenological multiple case study. *International Journal of STEM Education, 5*(1), 4, doi: 10.1186/s40594-018-0101-z

Denis, D., & Young, B. (2019). Methodology in Psychology. In R. Sternberg, & W. Pickren (Eds.), *The Cambridge Handbook of the Intellectual History of Psychology* (pp. 29–62). Cambridge: Cambridge University Press.

Elizalde, E. (2017). On How the Cyberspace Arose to Fulfill Theoretical Physicists' Needs and Eventually Changed the World: Personal Recallings and a Practitioner's Perspective. In *Cyberspace*, 3–21. Cham: Springer International Publishing, doi: 10.1007/978-3-319-54975-0_1

Farnicka, M. (2017). The impact of cyber-activity on human development. *Humanities and Social Sciences Letters, 5*(2), 43–53.

Farnicka, M. (2019). Action Research as an Element of Integrative Research Model in Social Sciences/ Badania w działaniu jako element integracyjnego modelu badań w naukach społecznych. *Przegląd Badań Edukacyjnych (Educational Studies Review), 1*(28), 219–233.

Farnicka, M., & Liberska, H. (2014). Tworzenie środowiska sprzyjającego uczeniu się – analiza wybranych czynników. *Teraźniejszość. Człowiek. Edukacja, 3*(67), 57–71.

Gattie, D.K., Kellam, N.N., Schramski, J.R., & Walther, J. (2011). Engineering education as a complex system. *European Journal of Engineering Education, 36*(6), 521–535, doi: 10.1080/03043797.2011.622038, https://asu.pure.elsevier.com/en/publications/engineering-education-as-a-complex-system

Giddens, A. (2020). *Nowoczesność i tożsamość*. Warszawa: Wydawnictwo Naukowe PWN.
Giedd, J.N. (2015). Zadziwiający mózg nastolatka. *Świat Nauki, 7*, 25–29.
Gregory, M., & Lodge, J. (2015). Academic workload: The silent barrier to the implementation of technology-enhanced learning strategies in higher education. *Distance Education, 36*(2), 210–230, doi: 10.1080/01587919.2015.1055056, https://www.tandfonline.com
Habermas, J. (1992). *Postmetaphysical Thinking: Philosophical Essays*. Cambridge: Cambridge University Press.
Herzyk, A., & Jodzio, K. (2008). Charakterystyka i perspektywy rozwoju neuropsychologii. In K. Jodzio, & W. Nyka (Eds.), *Neuropsychologia medyczna – wybrane zagadnienia* (pp. 14–66). Gdańsk: Wydawnictwo Arche.
Isaacson, W. (2011). The Genius of Jobs. *The New York Times*, https://www.nytimes.com/2011/10/30/opinion/sunday/steve-jobss-genius.html
Jodzio, K. (2011). *Diagnostyka neuropsychologiczna w praktyce klinicznej*. Warszawa: Difin.
Juszczyk, S. (2012). Neuronauki w edukacji. Nowe możliwości w procesie nauczania–uczenia się. *Chowanna, 2*, 39–57.
Kamenev, R.V., Krasheninnikov, V.V., Farnicka, M., & Abramova, M.A. (2018). High technology and transformation of the education system: Constructive and destructive. *Novosibirsk State Pedagogical University Bulletin, 8*(6), 104–119, doi: 10.15293/2226-3365.1806.07
Kemmis, S. (2005), Exploring the relevance of critical theory for action research: Emancipatory action research in the footsteps of Jurgen Habermas. In P. Reason, & H. Bradbury (Eds.), *Handbook of Action Research: Participative Inquiry and Practice* (pp. 91–102). London: Sage.
Kim, Y., & Steiner, P. (2016). Quasi-experimental designs for causal inference. *Educational Psychologist, 51*(3-4), 395–405.
Law, N., Niederhauser, D.S., Christensen, R., & Shear, L. (2016). Multilevel system of quality technology-enhanced learning and teaching indicators. *Journal of Educational Technology & Society, 19*(3), 72–83, https://pdfs.semanticscholar.org/0165/0268c7cce552e1c49629466377d9c0c92e47.pdf
Lewin, K. (1946). Action research and minority problems. *Journal of Social Issues, 2*(4), 34–46.
Lewin, K. (1951). *Field Theory in Social Science: Selected Theoretical Papers*. New York: Harper & Row.
Lindhard, T., Hermann, C., & Edwards, S. (2021). HeartMath Coherence Model Throws New Light on Arka Dhyana Intuitive Meditation. *Healthcare, 9*, 1162, doi: 10.3390/healthcare90911622021
Lofland, K.B. (2016). The Use of Technology in the Treatment of Autism. In T.A. Cardon (Ed.), *Technology and the Treatment of Children with Autism Spectrum Disorder. Autism and Child Psychopathology Series* (pp. 27–35). Cham: Springer, doi: 10.1007/978-3-319-20872-5_3

Louchakova, O. (2005). On Advantages of the Clear Mind: Spiritual Practices in the Training of a Phenomenological Researcher. *The Humanistic Psychologist, 33*(2), 87–112, doi: 10.1207/s15473333thp3302_2

Louchakova, O. (2007). Spiritual Heart and Direct Knowing in the Prayer of the Heart. *Existential Analysis, 18*, 81–102.

Maryniak, A., Ondruch A., & Roszkowski, M. (2010). Neuroobrazowanie funkcjonalne u dzieci w praktyce klinicznej. In K. Jodzio, & E.M. Szepietowska (Eds.), *Neuronalne ścieżki poznania i zachowania. Rozważania interdyscyplinarne* (pp. 203–216). Lublin: Wydawnictwo UMCS.

McCraty, R. (2009). The coherent heart–brain interactions, psychophysiological coherence, and the emergence of system-wide order. *A Transdisciplinary Transcultural Journal, 5*(2), 11–114.

McCraty, R., Atkinson, M., & Bradley, R.T. (2004). Electrophysiological evidence of intuition: Part 1. The surprising role of the heart. *The Journal of Alternative & Complementary Medicine, 10*(1), 133–143.

McCraty, R., & Zayas, M.A. (2014). Cardiac coherence, self-regulation, autonomic stability, and psychosocial well-being. *Frontiers in Psychology, 5*, 1090, doi: 10.3389/fpsyg.2014.01090. Retrieved from http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4179616/

Nigg, J.T. (2017). Annual Research Review: On the relations among self-regulation, self-control, executive functioning, effortful control, cognitive control, impulsivity, risk-taking, and inhibition for developmental psychopathology. *Journal of Child Psychology and Psychiatry, 58*, 361–383, doi: 10.1111/ jcpp.12675

Olson, D.R., & Torrance, N. (Eds.), (1996). *Modes of Thought: Explorations in Culture and Cognition*. New York: Cambridge University Press.

Paluchowski, W.J. (2001). *Diagnoza psychologiczna. Podejście ilościowe i jakościowe*. Warszawa: Wydawnictwo Naukowe Scholar.

Pawlak, B. (2020). Brain, mind and education – we have found the way, whether we are wandering along the wilderness?, *Man, Disability, Society, 48*(2), 59–68, doi: 10.5604/01.3001.0014.1672

Piaget, J. (1971). *Biology and knowledge*. Chicago: University of Chicago Press.

Piaget, J. (1976). *To understand is to invent: The future of education*. New York: Macmillan.

Prauzner, T. (2013). Information Technology in Contemporary Education – Individuals' Researche. *American Journal of Educational Research, 1*(10), http://www.sciepub.com/journal/ education/CurrentIssue (access date: March 27, 2016).

Prauzner, T. (2016). Interactive Computer Simulation as a Response to Contemporary Problems of Technical Education. *Society. Integration. Education.* Proceedings of the International Scientific Conference, doi: 10.15584/eti.2016.2.25

Schwartz, D.L., Tsang, J.M., & Blair, K.P. (2017). Jak się uczymy. 26 naukowo potwierdzonych mechanizmów. Warszawa: Wydawnictwo Naukowe PWN.

Susman, G.I, & Evered, R.D. (1978). An Assessment of the Scientific Merits of Action Research. *Administrative Science Quarterly, 23*, 582–603.

Todd, Z., Nerlich, B., McKeown, S., & Clarke, D.D. (2004). *Mixing methods in Psychology: The integration of qualitative and quantitative methods in theory and practice*. London: Psychology Press.
Tokuhama-Espinosa, T. (2010). *Mind, Brain, and Education Science: The new brain-based learning*. New York: Columbia University Teachers College Press.
Trempała, J., & Cieciuch, J. (2016). The analysis of change in behavior and development: On some errors and possibilities to correct them. *Current Issues in Personality Psychology, 4*(2), 65–74, doi: 10.5114/cipp.2016.60168
Włodarski, Z. (1974). *Psychologiczne prawidłowości uczenia się i nauczania*. Wyd. 3. Warszawa: Wydawnictwa Szkolne i Pedagogiczne.
Wygotski, L.S. (1978). *Narzędzie i znak w rozwoju dziecka*. Warszawa: Państwowe Wydawnictwo Naukowe.
Zajonc, R.B. (2000). Feeling and thinking: Closing the debate over the independence of affect. In J.P. Forgas (Ed.), *Feeling and thinking: The role of affect in social cognition* (pp. 31–58). Cambridge: Cambridge University Press.
Zhukova, E.A. (2008). Challenge of high technologies to the content of education. *Vysshee obrazovanie v Rossii, 9*, 94–98, http://www.ipr-tomsk.narod.ru/zhukova_N9-08_c_94-98.pdf (In Russ.).
Żylińska, M. (2013). *Neurodydaktyka. Nauczanie i uczenie się przyjazne mózgowi*. Toruń: Wydawnictwo Naukowe Uniwersytetu Mikołaja Kopernika w Toruniu.

REWOLUCJA SPOŁECZNO-TECHNOLOGICZNA: KONSEKWENCJE DLA EDUKACJI

Streszczenie. Żyjemy w czasach, w których zmiany kulturowe i społeczne wpływają na rozwój jednostki. Zmiany te można obserwować w perspektywie zarówno indywidualnej, jak i całych grup. Zawdzięczamy to rewolucji technologicznej i akceleracji procesów zmieniających sposób życia. Zjawiska te są powszechne i pod pewnymi względami już długotrwałe. Procesy, których jesteśmy świadkami, mają znaczenie dla nauk o rozwoju oraz uczeniu (psychologia, edukacja). Współczesna psychologia i edukacja stoi w obliczu wyzwań związanych z pytaniami i propozycjami radzenia sobie i utrzymywania balansu między biologicznym czy społecznym determinizmem, skrajnym indywidualizmem i podmiotowością czy technologizacja i utylitarnością.

W artykule zwrócono uwagę na konsekwencje wprowadzenia nowoczesnych narzędzi związanych z rozwojem technologicznym w psychologii i edukacji, zwłaszcza poprzez proces "odkorzenienia", czyli oddzielenia uczniów od nauczycieli i uczniów od ich środowiska, które są źródłem celów i motywacji.

Słowa kluczowe: cele kształcenia, środowisko rozwojowe, innowacje w edukacji

Receipt Date: 25th November 2022
Receipt Date after correction: 15th February 2023
Print Acceptance Date: 26th February 2023