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# "ICT in Educational Design. Processes, Materials, Resources" – Summary of the First Stage of the International Research Project

**Abstract.** The aim of this paper is to present first results of "ICTinED" project and the process of designing in the context of creative computer-aided didactic activity. We take under consideration the following content areas: 1) definition related to the scope and characteristics of designing; 2) solving problems in relation to spawning of ideas and creative success; 3) the process of designing in relation to computer-aided education. The reflections indicate at methods of conception which condition "creative success" and efficient (in the spirit of praxelogy: practical, efficacious and economical) endeavors in the designing of didactic processes, materials and resources.

**Keywords**: research project, design process, creative didactic activity, computer-aided education, designing didactic processes, materials and resources.

## Introduction*

The primacy of the omnipresent information/communication technology (ICT) turns it into a natural environment for didactic/educational processes. Its dynamic transformation affects social, economic and cultural

* Issues raised in the article, indicating the educational design and the basic assumptions of the project "CTinED", were presented at the 29th International Scientific

preconditions of the process, among others. The publication is mainly meant to indicate the areas and forms of application of ICT in education, but it will also attempt to flag post potential perils accompanied by the newly introduced applications. The divagations will mainly focus on two main aspects of the problem: on changes in new tendencies in ICT, and on creativity manifested in independent designing of educational materials, processes and resources.

In recent years, the progress in ICT has manifested itself in continual development of mobile technologies. Nowadays, a netbook, an ultrabook, a smartphone and especially a tablet have all become synonymous with the notion of a computer. The sales of mobile devices are increasing mainly in the wake of the development of the technology of fast data transmission instigated by mobile phone operators. The LTE (Long Term Evolution), which constitutes a step forward towards the so called fourth generation of mobile telecommunication, makes it possible to surf the Internet with the speed of 150Mb/s, a speed that not long ago was only possible with the use of terrestrial permanent links. Smartphones, tablets and mobile broadband networks not only constitute the future of ICT technology, but possibly also the future of education. The development of mobility is additionally enhanced by the expansion of cloud computing technology, in which a network cloud provides access to programs, data and diverse services, such as information, communication and broadly understood entertainment (see: Baron-Polańczyk, 2011, p. 95–119). Unquestionable success of such social networking sites as Facebook, Twitter or NK in Poland or such new technology giants as Apple or Google is based on the principle of concentration in a single location of all complementary services required by users. In consequence, they spend considerable amount of time logged on to the portals, which directly translates into financial benefits reaped by their owners by means of fares collected from advertisers. The number of unique visits constitutes another monthly indicator of popularity of such portals. In this model even very simple hardware device with a browser and access to Internet, with all necessary

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Conference, "Technology Education as a Part of Common Education" in Veľká Lomnica, Slovakia. See: E. Baron-Polańczyk, *International Research Project "ICT in Educational Design – Processes, Materials, Resources" (Results of First Stage)*, "Technika a Vzdelávanie" 2013, R. 2, No 2, pp. 100–102.

resources, such as software, data, multimedia or entertainment accessible in the cloud is an educational tool. Not by chance, the main theme of 10th World Conference on Computers in Education (WCCE 2013) is "learning while we are connected". ICT development finds its reflection in contemporary theories of teaching/learning. From cognitive sciences point of view educational processes supported by ICT are from their nature self-regulated, permanent, lifelong lasting but also accidental, shallow and vulnerable to cyber threats.

Educational applications of the modern ICT are very promising, as, in accordance with the controversial theory of connectivism, knowledge may be nested in network resources, i.e. outside of human mind (see: Morbitzer, 2010, p. 185–194). In the wake of evolutionary determinants, human knowledge increases in linear fashion, whereas the knowledge accessible in the network increases exponentially. Connectivism, promotes the dominance of the network, as its nodes incessantly compete for new connections, thus keeping the network alive and constantly learning. Making new connections and finding information have nowadays become basic skills. The subscribers to the theory maintain that pupils, when connected to the Internet, find much more than unverified clusters of information there. The discoveries of neurobiology and mathematical networking models make them believe that the structure is of self-learning character and incorporates knowledge which exceeds individual perceptual capabilities. People are no longer confined to cognition limited by their personal features, as they may replace their own memory with the limitless "external memory". Yet, there is still an open question as to what will happen in case the connection is down?

The ever-diminishing cost of the new technology is also consequential, as it radically facilitates its popularisation and turns its former elite connotation into an omnipresent egalitarian value.

In the context of creativity and designing, the outcome of the TED (*Technology, Entertainment, Design*, 2016) conferences is also worth mentioning. It was aimed at the popularisation, according to its motto, of 'ideas that are worth spreading'. The TED conferences annually feature a lively discussion on the model of contemporary education, which, according to many, is incompatible with the surrounding reality. The deficiencies in the shaping of creative and innovative attitudes seem to emerge as one of the most pressing problems of our time. What should be done in

companies, schools and organisations to develop (support) creativity and resourcefulness in a constructive and systematic fashion? One of participants, Ken Robinson (2011) locates the solution in fundamental reconstruction of schooling systems, so that they are capable of nurturing creativity and recognising the diversity of types of intelligence and talents. All the examples above may attest to ceaseless underestimation of the importance of self-creation and creativity in the contemporarily existing models of education. By and large, creativity in education may manifest itself in creative and innovative approach to the task of designing of didactic processes and resources, to planning curricula and didactic methods, as well as to unconventional use of accessible educational resources. Taking into consideration the openness of new generations to technological novelties and entertainment, the introduction of edutainment (education and entertainment in one), as a didactic method, appears to be an excellent solution. The fashionable neologism has every chance of becoming a synonym to modern entertainment-assisted education. Naturally, mere creation of entertaining presentations must not become an aim in itself. Instead, the objective of forwarding valuable (educational) content in modern disguise must constitute the main driving force here.

## Definition – Scope and the Process of Educational Designing

Designing an educational process, its materials and support resources is meant to prepare an educational act and/or a corresponding product in accordance with socially approved estimations and with preordained didactic-educational objectives. Regarding designing for the sake of educational practice, we must consider actions performed by teachers and pupils and the products of the actions, i.e. designs which were conceived by both teachers and pupils in their attempts to change the didactic reality.

We must also direct our attention to the differentiation of the spheres of manifestation of targeted activities directed at the satisfaction of needs and expectations in contemporary didactic procedures. In this respect, we may isolate three basic procedural areas: 1) designing the didactic-educational process – planning and organization of lesson units (methodological, educational) supported by IT tools and methods; planning and

organization of classes (of all didactic strategies: associative, problem, exposing and operational) making use of multimedia didactic tools (digital media); 2) designing multimedia didactic materials – educational media (display materials, computer programs, internet programs, multimedia coursebooks, didactic packs etc.); 3) designing ICT infrastructure and ICT resources necessary for the functioning of educational media – educational platforms, e-learning, ICT tools (hardware and software).

An extension of this approach to design from the point of view of permanent improvement and quality management is so called PDCA (plan-do-check-act or plan-do-check-adjust) cycle, which was made popular by W. Edwards Deming. The concept of PDCA is based on the scientific method, which can be written as "hypothesis" – "experiment" – "evaluation" or plan, do and check. A fundamental principle of the scientific method and PDCA is iteration, once a hypothesis is confirmed (or negated), executing the cycle again will extend the knowledge further. Repeating the PDCA cycle can bring us closer to the goal, usually a perfect operation and output (Moen, Norman, 2013).

The theoretical premises have been based on the axiom that in the process of designing, and consequently evaluating multimedia materials (MMD), we must take two basic areas into account: engineering/technical and pedagogical, especially with emphasis on the methodology of particular subjects. On the basis of the analysis of subject-matter literature and practical experiences, it has been established that the essence of MMD designing addressed to contemporary pupils is captured in the quality values of the materials in the following categories:

1. Cognitive and utilitarian values:
    a. Accurate content – academic level, congruency with up-to-date academic findings;
    b. Didactic value – congruency with educational values and objectives, congruency between the content and the topic (curricular content), projected competence of pupils (the extent of possessed knowledge and skills), congruence with the principles of psychology of learning (motivational and activating values).
2. Technical values: esthetics, communicativeness, interactivity, ergonomics, modernity, software stability;

3. Ethical values, legal and social/economic: costs of purchase and maintenance, possibility of utilizing various, also older hardware platforms; security of information, intellectual property protection, licenses for software (Baron-Polańczyk, 2007, p. 13).

From the point of view of a learning organization (educational institution), optimal designing of ICT infrastructure and ICT resources, indispensable in computer-aided didactic process, are very important constituents. The optimization must be administered on multiple planes, and the implicated persons (teams) must display interdisciplinary skills and knowledge. On the technical plane, a selection of hardware and software plane is a fundamental issue, which ensures the creation of the most typical, friendly and easily accessible technological environment. No less important is the issue of providing IT security, especially protection against cyber-crime. At the same time, the environment must secure the possibility of demonstrating the newest and most variable ICT trends and applications of MMD, or more generally of media, in their broadest extent. Universal application of the process of virtualization and cloud computing. Optimization on economical plane equals provision of the most cost-efficient purchase conditions, long-term service support, low-priced exploitation and intensive (effective) utilization of the purchased IT infrastructure. The stage of analyses of tender specifications should involve detailed inspection of accessible support programs and special conditions of hardware and software delivery provided by many producers for educational institutions. Another important, but frequently not taken into consideration, element is infrastructure maintenance cost. The fact that cheap devices require costly maintenance is often ignored. It is, therefore, advisable to check energy consumption before purchasing hardware, to ensure that it is dependable in long term and that maintenance materials and administrative costs are within long-term financial reach. Effective exploitation of purchased hardware denotes its maximal utilization in the course of school lessons as well as provision of easy access to it outside of class time, so that the still omnipresent syndrome of barred and dead-locked computer room, utilized only under strict supervision of an IT teacher for a few hours a week, disappears from our educational institutions. It is a potential source of considerable losses, especially in the context of moral wear of IT infrastructure and drastically limited means of its upgrading at disposal of educational institutions. On the didactic

plane the accessibility and universality of a designed ICT infrastructure must be thoroughly verified, so that it can be used for teaching multiple subjects and is able to provide pupils with the most secure, valuable and progressive ICT trends. It is especially difficult to comply with the requirement, as the still freshly cropped digital revolution is still serving many instances of developmental "dead ends". All in all, designing ICT infrastructure and other ICT resources for the purpose of education is a complex process, entailing extensive technical, economic and didactic knowledge and interdisciplinary approach. Considering the fact that the resources are supposed to ensure utilization of ICT in the course of many subjects, the problem encompasses a very wide spectrum of disciplines.

## Conclusions

Assumptions introducing the issues were presented in detail in "ICT in Educational Design. Processes, Materials, Resources" vol. 1, vol. 9 (see: Baron-Polańczyk, 2012; p. 13–36; Baron-Polańczyk, 2016; p. 9–36) and they focus on the process of designing in the context of computer-aided creative educational activity. In this context, it analyses the definition, scope and properties of designing; the process of meeting expectations in the aspect of purposefulness of the undertaken endeavours; solving problems from the point of view of creation of ideas and creative success, as well as the process of designing in the context of computer-aided education. It indicates methods of conception that condition 'creative success' and it also identifies efficient (praxeologically: practical, capable and economical) procedures to be undertaken in the process of designing materials and didactic resources.

The authors contributing to international "ICTinED" project (see: *International Research Project…*, 2016) share their experience, considerations, reflections, and also academic pragmatism, by raising certain aspects selected from the broad field of information/communication technology. The project also incorporates an interdisciplinary perspective on ICT, which is situated at the borderlines of pedagogical and technical disciplines, both in their theoretical and practical dimensions.

During the first stage of "ICTinED" project (in 2011–2016) 11 volumes (compilations) have been created owing to international cooperation of 70 researchers and scientists hailing from 7 countries and 26

following research institutions: 1) University of Szczecin, University of Warszawa, School of Exact Sciences USKW in Warsaw, Nicolaus Copernicus University in Toruń, The Kazimierz Wielki University in Bydgoszcz, Institute for Sustainable Technologies, National Research Institute in Radom, Lower Silesian University of Entrepreneurship and Technology in Polkowice/Jan Wyżykowski University, AGH University of Science and Technology of Cracow, Pedagogical University of Cracow, TenStep Western Poland – TenStep Regional Partner, University of Zielona Góra (Poland); 2) University of Ostrava, VŠB-Technical University of Ostrava, Palacký University Olomouc (Czech Republic); 3) Constantine the Philosopher University in Nitra, Matej Bel University of Banská Bystrica, Comenius University in Bratislava, University of Economics in Bratislava, Technical University in Zvolen (Slovak Republic); 4) Russian State Technological University K.E. Ciolkowskiego in Moscow, Moscow State University of Railway Transport (Russia); 5) National University of Water and Environmental Engineering, Lutsk National Technical University (Ukraine); 6) Brandenburg University of Technology Cottbus-Senftenberg (Germany); 7) Nesna University College/Nord University Bodø, Nord-Trøndelag University College/Nord University Bodø (Norway).

The crowning of the first stage of the project was open scientific workshop, which took place on 1–2 September 2016 in Zielona Góra. This event was funded by International Visegrad Fund's Grant No. 11540556. More information can be found on the project websites: *http://www.ictined.eu* and facebook fanpage: *https://www.facebook.com/ICTinED/*.

The problem of designing plays a crucial role in purposeful didactic activity, including computer-aided didactic procedures. In educational designing, encompassing designing of the didactic process, the designing of multimedia didactic materials and designing the ICT infrastructure and accompanying resources, we must take into consideration the spheres of activity directed at the satisfaction of needs and expectations of modern education. Therefore, our fundamental guidelines must take into consideration the capabilities and expectations of pupils in terms of their professional competence, including ICT competence, such as utilization and designing of ICT tools. Based on the analysis of the literature and first results of the project working hypothesis appeared: that in practice learning strategies using ICT do not fully meet the needs and expectations of

students. Therefore, there is a need of deeper knowledge of educational practice including establishing:

- level and forms of use by students of modern ICT tools and methods and student reflection on the practical work undertaken to promote the use of ICT in the face of new trends, new tasks posed by the rapidly changing reality;
- expectations and preferences of the students in the use of modern ICT tools and methods in the design: 1) the process of teaching-learning (education and self-education), 2) work process (development and career);
- factors differentiating the level and extent of the use by students of ICT methods and tools in educational practice.

These assumptions constitute the objectives of research during next stage of ICTinED Project, which we plan to carry out in the years 2017–2019.

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