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ICT-Enabled Education – Need for Paradigm Shift

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Abstract

Contemporary schools have not changed significantly since the 19th century. From primary level (elementary schools) to tertiary level of education (colleges and universities), the predominant approach to teaching is ex-cathedra teaching with assessment system based on grades. What has changed over the years are teaching and learning tools, but the methods have remained the same. In this context, information and communication technology is viewed as a tool supporting the traditional education systems.

The new, hyper-digital era is based on ubiquitous computing that is radically transforming the way we live and work, and consequently, the way we teach and learn. Contemporary technologies lead to disruptive innovations in all sectors. As such, traditional education system fails to perceive the necessity to rethink the fundamental paradigms of education based on institutional framework (schools). This paper examines the evolution of education in the context of information and communication technologies and analyses the strengths and weaknesses of traditional, school-based education, as opposed to ubiquitous education based on information and communication technology, which has not been formally acknowledged within education systems, but which depends on effort invested by individuals instead. It also examines disruptive innovations in education systems that have a potential to transform formal education processes dramatically.

Key words: *disruptive innovation; education system; ICT.*

Introduction

Information and communication technologies (ICT) are omnipresent and are thus being taken for granted in all aspects of life. This term is usually used as a synonym for personal computers, mobile phones and various other high tech devices that we use in everyday life. However, ICT is much more; it represents the main transformational

enabler of every organization and the entire society. Negroponte (2014) best described the power and influence of ICT when he said that "computing is not about computers anymore. It's about living". There are various definitions of ICT but most of them can be summed up in a definition by Blurton, who defines ICT as "a diverse set of technological tools and resources used to communicate, and to create, disseminate, store, and manage information"(Blurton, 1999). For the purpose of this paper, ICT is defined as a set of technological means used to support information systems, where information systems refer to "synchronized arrangements of resource-based, organizational, and technical elements that meet the need for information" (Picot, Reichwald, & Wigand, 2008, p. 118). In other words, ICT is a major tool for managing all organizational inputs and outputs, not limited to information.

Education System, Pedagogy and Digital Era

The roots of the present education system go far back to ancient times, with educational goals that have mostly remained the same, with some minor changes. In that manner, ancient Greeks can be viewed as founding fathers of the idea of contemporary education, or as Giusepi (2015) states, "for most Greeks, the end of education was to produce a good citizen, and a good citizen meant a well-rounded individual". This idea was taken over by the Romans and has been supported up to now. In that manner, education system needs to fulfill three broad goals: political, economic and individual. These goals must be viewed from the perspective of the society because the goals of education usually reflect political and economic interests of the main stakeholders (Cohen, 2006). That is evident in predominant, traditional factory–based approach to education. Furthermore, the three-tier system of education that closely resembles today's system of education divided into elementary school, high school and higher education was introduced in ancient Rome, by the end of the first century AD. The task of primary school was to teach the basic literacy skills (reading, writing and arithmetic), while grammar school for boys was focused on Greek and Latin literature aimed at developing critical thinking. Finally, the third tier included special schools where students were introduced to rhetoric (Kamm, 2008, p. 123).

The concept of education is often used alongside with the concept of pedagogy, but it must be stressed that education is focused primarily on the fulfillment of societal goals, while pedagogy is concerned with teaching and learning practices. As Beetham and Sharpe state, pedagogy is concerned with "learning in context of teaching, and teaching that has learning as its goal"(Beetham & Sharpe, 2013, p. 2). Pedagogy is focused on the process of teaching and learning, while the education system provides a context. When the process of teaching is viewed, it has remained the same for more than 100 years; schooling is still based on a classroom, ex-cathedra approach to teaching with the teacher at the center of the teaching process. The goal of the teacher is to present predefined material based on the curricula approved at the national level which, basically, prescribes the national teaching standards. From

the organizational and technological perspective, the only thing that has changed are the tools supporting the old practices; instead of blackboards teachers are using smart boards, instead of overhead projectors teachers are using computer–interactive presentations, instead of regular pencil and paper, students are using word processors, etc., but the organizational framework has remained the same. As Bill Gates (2005) stressed in his speech at the National Summit on High Schools, "our high schools were designed fifty years ago to meet the needs of another age". In other words, new ICTs are continuously being integrated with older teaching technologies and the existing organizational framework that actually limits the possibility of seizing the full potential of technological advancements (Blurton, 1999). This is a textbook example of automating approach (Figure 1) to adding value to companies (in this case, educational institution), that is based on application of ICT to the existing processes that makes them faster, cheaper, and potentially more accurate (Valacich & Schneider, 2014, p. 84). The focus of education is still on solving the issues that were contemporary in the 19th and 20th centuries, while the issues of the 21st century remain neglected. According to Oblinger and Grajek (2012), in the United States 76% of the IT budget in education is spent on ongoing operations (administration and business as usual processes), while only 9% is spent on transformative initiatives, and 15% on growth. As November (2010, p. 2) stresses, "the same processes solve the same problems", and therefore the automating approach just makes education more efficient but the quality of final product (i.e. graduated students) remains the same or even decreases. The main reason for such situation is that the current education system is not aligned with the "real world" where contemporary technologies have dramatically changed the way we live and work, making the traditional education system, based on the national curricula and grades, a remnant of the past. In other words, teaching and learning have not been transformed – they have remained the same and the mastery of students is still based on assumptions (grades) and not on proof (actual skills).

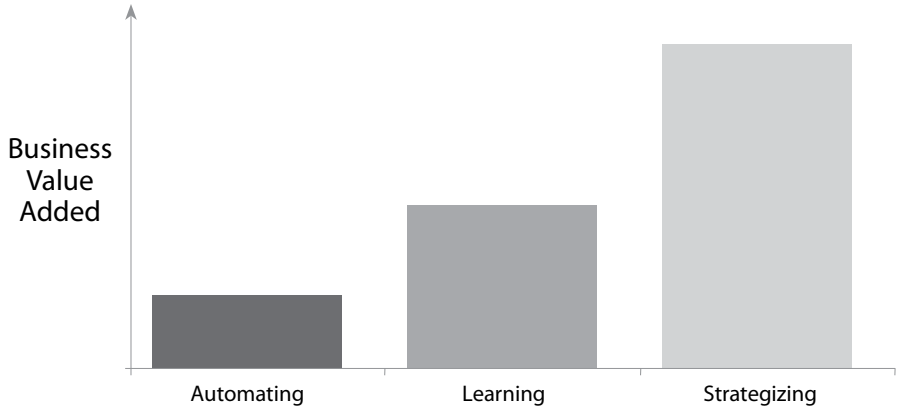

Figure 1. The business value added from automating, learning, and strategizing with information (Valacich & Schneider, 2016, p. 55)

Disruptive Innovation

Clayton M. Christensen introduced the terms *disruptive technologies* and *disruptive innovations* when he examined the causes of failure of well-established companies. The term disruptive technology generally refers to making products that "are typically cheaper, simpler, smaller and more convenient to use" (Christensen, 1997, p. 11). The entire concept of disruptive innovation refers to the application of technology "in a way that creates a simpler, more affordable product for a new group of customers, who, in most cases, were not buying (or succeeding in) the traditional offering" (Soares, 2012). Initially, disruptive technologies are used by a small number of enthusiasts (in marketing usually referred to as innovators, followed by early adopters), but as the functionality improves and the product becomes cheaper, it starts to dominate the market. Ultimately, disruptive technology becomes better in performance compared to the existing technologies, thus replacing them. Some of the typical examples of disruptive technologies include cars that replaced horses and carriages, personal computers that replaced mainframe computers and mobile phones that replaced landlines.

One important thing to stress is that the history has taught us that organizations are incapable of introducing disruptive technologies into their own product lines because of prioritizing innovations based on their current product portfolio (Weise & Christensen, 2014). The reason for this lies in the low profit margins of disruptive products compared to their traditional ones. The same is true for education: implementation of contemporary ICT solutions to traditional teaching methods is more simple and more profitable.

School and the Value Proposal

Disruptive innovation predominantly addresses unfulfilled needs that are usually not met by the existing dominant market players. In the era of globalization and ubiquitous computing virtuality is becoming the norm. From that perspective, value proposition offered by educational organizations is diminishing and is being replaced by other variants. In other words, the hyper-digital world defines quality in education completely differently from the existing education system (Horn & Staker, 2015, p. 2). To answer the challenges posed by disruptive technologies, educational institutions must redefine what they are offering (the value proposition of their customers – parents and students) and change the mode of delivery of educational content (redefine their processes). The necessity for redefinition of value proposition is most evident in higher education: university degree no longer guarantees a good job or even employment, and therefore potential students are less willing to pay for increasing tuition costs.

Therefore, the main issue is the definition of baseline value proposal of educational institutions and transformation of the existing instruction practices. Today's value proposal common to all educational institutions engaged in the provision of

formal educational services (primary and secondary schools and higher education institutions) is earning a degree (diploma) that allows a graduate to pursue better education or a better job. This value proposal is met by the common core curriculum with grading system as a quality control mechanism and it is founded on age-based stratification where students are grouped according to age and where each age group has to meet the predefined curriculum-based standard. Education is based on seat time requirement where the time spent in school is constant and learning is variable among learners (Horn & Mackey, 2011). This is a typical factory-based model of education prevalent for more than 100 years, where the students are instructed in the manner of mass production assembly lines. Each age group is a batch (class) ready to be transformed in the factory (school). This approach facilitates the job of the instructor but it is insensitive to the varying needs and skills of students. Also, the instructor commands what students need to learn to fulfill the requirements prescribed by the curriculum, making students "average" and neglecting the individual needs of students (such as gifted students or students with special needs). Furthermore, the factory-based model is not as efficient as it is supposed to be. According to studies conducted in Croatia, 44% of 7th and 8th grade elementary school students regularly attend some form of private lessons (Ristić, Dedić, & Jokić, 2014) and between 54% and 56% of freshmen and sophomores attend private lessons, too (Ristić, Dedić, & Jokić, 2011). Authors state that key factors that influence students to take private lessons are:

- "Incompatibility of education levels with educational cycles
- 'Dictatorship' of syllabi and textbooks
- Very demanding mathematics syllabi
- Inadequate education of the teaching staff
- Inadequate student learning skills and low motivation
- Inadequate communication between the teaching staff, parents and students."

Apart from systemic inefficiencies, the factory-based model of education cannot adapt to the constant change in basic input – new information and knowledge. There are different estimates about the speed of new knowledge generation, but it is enough to say that the estimate is that Google indexes around 50 billion pages and that new knowledge is doubled every 18 months (Greenstein, 2012, p. 1). With that kind of new information flow our textbooks are becoming outdated immediately after publishing. In addition to literature, the national curriculum has not changed frequently enough to reflect the changes in society, technology and environment. In case of Croatia, Elementary School Curriculum was defined in 2006 (The Ministry of Science, Education and Sports, 2006) and the National General Curriculum was defined in 2010 (The Ministry of Science, Education and Sports, 2010) and since then they have not changed. The present education system, which has been based on the assumptions of cognitive and related disciplines since the 1920s, has not changed due to organizational constraints, special interests of the educators and their unions, and expectations of the community (parents) that schools should be the same as they were

when they were children (Resnick, 1998, pp. 89-118). From the educational process perspective, the major obstacle to change is the idea of standardization where it is attempted to make all students fit the same mold when actually all people are different.

Today, there is a big pressure for change in education because of technology. The old paradigm based on the teacher as supervisor is becoming obsolete because the teacher (together with textbooks) is not considered to be the primary source of knowledge anymore. The knowledge that teachers provide is frequently missing the point because today's learners are "replacing the didactic idea of "*I will tell you what I know*" and relying more on the assertion that "*I will find out what I need to know*" (Bryant, Coombs, Pazio, & Walker, 2014). Therefore, the basic paradigm of education should change from factory lines to those of learning communities where all participants would be engaged in learning and instruction as well. Under those conditions the value proposal common to all educational institutions should be transformed from earning a degree to that of skills development, which leads to better life opportunities (jobs and schooling). Delivery of educational content should be based on student-driven instruction where the student should master one level of skills to get the opportunity to master the following one. This concept of education is usually referred to as *competency education* (Patrick & Sturgis, 2013, p. 6) or competency-based education, where "students advance upon mastery, competencies include explicit, measurable, transferable learning objectives that empower students, assessment is meaningful and a positive learning experience for students, students receive timely, differentiated support based on their individual learning needs, and learning outcomes emphasize competencies that include application and creation of knowledge, along with development of important skills and dispositions". As Klein-Collins (2013) stresses, under competency-based system "an educated person is someone who does not just *know* but can also *do*. In that manner, educational cycle is not finished until all necessary levels have been mastered, regardless of time and place. This concept greatly resembles that of video games where the player should master one level to start playing the following one. This approach takes into account the differences among student population in regard to skills and previous knowledge, making educational program more suited to the individual needs of students, leading to elimination of redundant work and enabling students to have self-paced education. In that case scenario, standards can be applied only to mastery (the final product of educational process) and not the process itself. In other words, educational institutions should transform their business from graduate production to knowledge production where grading, as a quality control system, should be abandoned because mastery should be the only criteria of excellence. Therefore, the pace of mastery becomes the only differentiating factor.

The Paradigm Shift

A paradigm is defined as "a theory or a group of ideas about how something should be done, made, or thought about" (Merriam-Webster, 2015). Factory-based paradigm,

based on teacher-centered education served its purpose in the previous century - the century of blue- and white-collar workers and clear distinction between jobs, where people were educated for clear and predictable lifelong career paths. Economies were based on manual work where thinking was an issue, not an advantage, or, as Henry Ford complained, "that when he hired a pair of hands, he also got a human being" (Bollier, 2011, p. 3). The twentieth century was a century of mass production and standardization where the average or the bell curve was the norm. This tendency is still evident in education. Learning is separated from doing and it is aimed at fulfilling institutional (school) objectives where students are passive consumers of knowledge aimed at achieving certain grade that is based on the recollection of specific content presented to them during their studies. This kind of education is static, not being able to adapt to the needs of changing environment that rewards innovation and people that challenge the existing practices. The existing paradigm is out of date and not adequate to the needs of society.

Life in the 21st century requires a different skill set and knowledge that the old educational paradigm cannot provide. New ICTs have improved mobility that has removed the boundaries between space and time. Interconnectivity is paving the way where learning will not anymore be exclusivity of educational institutions. New paradigm is characterized by:

The shift from seat time concept to competency development concept where the major benchmark is not below or above "the average" but sufficient or not sufficient. Basically, students can take the final tests immediately, regardless of the time spent studying. In that manner, traditional course-based approach to learning is challenged because "competencies have a unique architecture as they break learning into discrete modules that are not inextricably tied to courses or topics" (Weise, 2014).

Education not limited by time or place, but it occurs anytime, everywhere. Every person experiences the world in different ways and therefore can use these experiences for learning.

Just-in-time education. Demand for different knowledge is fluctuating and individuals must educate themselves on "as-needed" basis.

Students are taking the ownership of their learning and open education is gaining in value. It challenges the traditional view of educational institutions as exclusive gatekeepers of information and knowledge (Watling, 2012). This leads to the crisis point that is not the one of teacher or school performance but the one of systems design. In that manner, institutionalized education is on the way to lose its dominance because non-formal ways of education are more flexible and better suited to the needs of an individual, thus making education student-centered. In that case scenario the major challenge for the education system would be how to develop credentialing system independent of formal education, so that individual learning efforts can be awarded. This is of the utmost importance in the 21st century because the role of education system should shift from educating people for stable and predictable career

paths to educating people for constant change and the jobs that will emerge in the future (Gordon, 2014, p. 388). Static, classroom-based educational institutions with fixed curricula are simply too inert to cope with such changes and will inevitably be transformed into some sort of learning communities or will cease to exist.

Conclusion

The old paradigm of education, still prevalent in the entire world, cherishes the dominant role of the teacher and sees students as passive consumers of teaching materials. This approach to education makes education system more and more distant from the workforce – the graduates it produces are not competent for today's job requirements because mastery is based on assumptions, and not on proof. It actually separates learning from doing. The role of ICTs in traditional approach is that of sustaining innovation, where new technologies are used to increase the value of the existing educational practices. However, improving the old system under the old paradigm simply supports the existing practices and eventually makes them more efficient.

For the new, digital world, a new paradigm is needed, the one that will enable education system to cope with constant change and empower individuals to personalize education according to their own needs and preferences. The new paradigm should be based on an approach that teaches students how to learn, to enable them to actively engage and interact with learning material and, consequentially, prepare them for emerging jobs yet to be recognized by formal educational system.

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Obrazovanje utemeljeno na informacijsko komunikacijskim tehnologijama – potreba za promjenom paradigme

Sažetak

Uobičajene škole današnjice nisu se suštinski mijenjale od 19. stoljeća. Cijela vertikala školovanja, od osnovne škole do fakulteta, temelji se na ex cathedera poučavanju i na sustavu evaluacije znanja koji se temelji na ocjenama. S vremenom su se promijenili alati za poučavanje, ali su metode ostale iste. Gledano iz te perspektive, informacijske i komunikacijske tehnologije smatraju se alatima za podršku tradicionalnih metoda poučavanja.

Novo, hiper digitalno doba, temelji se na sveprisutnom računalstvu koje za posljedicu ima radikalnu transformaciju našeg života, a u skladu s time i promjenu načina poučavanja i učenja. Suvremene tehnologije potiču razvoj disruptivnih inovacija u svim sektorima pa tako i u obrazovanju. Tradicionalni pristup obrazovanju onemogućava promjenu temeljne paradigme obrazovanja u okvirima institucija (školskih ustanova).

Ovim se radom analizira evolucija obrazovanja u kontekstu informacijskih i komunikacijskih tehnologija te snage i slabosti tradicionalnog obrazovanja utemeljenog na institucionalnom okviru školskih ustanova. Taj okvir uspoređuje se sa sveprisutnim obrazovanjem koje je utemeljeno na informacijskim i komunikacijskim tehnologijama, a koje nema formalno priznanje u obrazovnim sustavima, već je rezultat individualnog napora pojedinca. Također, radom se prezentiraju disruptivne inovacije koje imaju potencijal radikalne transformacije obrazovnih procesa.

Ključne riječi: *disruptivna inovacija; obrazovni sustav; IKT.*