EXPLORING ICT EDUCATION AT MASTER LEVEL IN THE CONTEXT OF ADVANCEMENT OF DIGITAL ECOSYSTEM: THE CASE OF KAZAKHSTAN

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Abstract. *In order to achieve the aim of Kazakhstan's progressive development of the digital ecosystem, higher education sector has to harmonize ICT study programmes in accordance with updated professional standards and industry requirements for preparation of specialists. As competencies and skills permanently change, competencies and skills are to be enhanced lifelong. The purpose of the paper is to explore ICT education in the context of advancement of digital ecosystem underpinning empirical analysis of ICT education at master level in Kazakhstan and elaboration of a new research question. The method of the study is exploratory case study. The case study was carried out in December 2017. The findings of the empirical study reveal that a combination of Data Science and Information Security emerge in the context of the advancement of digital ecosystem in Kazakhstan. The new research question has been formulated: What are core courses of the hybrid study programme that combines Data Science and Information Security at master level? Directions of further research are proposed.*
Keywords: *ICT higher education, master level, digitization, digitalization, ecosystem, context, hybrid knowledge and skills.*

Introduction

As the cost of data collection, storage and processing continues to decline dramatically and computing power increases, social and economic activities are increasingly migrating to the Internet (OECD, 2017). Technologies, smart applications and other innovations in the digital economy can improve services and help address policy challenges in a wide range of areas, including health, agriculture, public governance, tax, transport, education, and the environment, among others (OECD, 2017).

In order to improve the quality of life of the population and competitiveness of Kazakhstan's economy, the President of Kazakhstan addressed "Third modernization of Kazakhstan: Global Competitiveness" to his Nation on the 31st January 2017. The address given by the President of Kazakhstan served as the basis for the elaboration of the Government Programme entitled *Digital Kazakhstan* (Digital Kazakhstan, 2017). The Government Program "Digital Kazakhstan" is scheduled for two phases: First phase: 2016-2019, and Second phase: 2020-2025. The goal of the Government Programme *Digital Kazakhstan* is the progressive development of the digital ecosystem in Kazakhstan. The Government Programme *Digital Kazakhstan* specifically aims to facilitate Kazakhstan's digital modernisation by focusing on four key priorities:
- creating a high-speed and secure digital infrastructure;
- digital transformation within all appropriate sectors of the economy;
- government proactivity in digital affairs; and
- the development of competencies and skills to permit a creative and digital society.

The Government Programme *Digital Kazakhstan* highlights that more professions and working positions emerge that require «hybrid knowledge and skills», namely a combination of knowledge and skills in ICT and another professional domain that focuses on automatisation of professional activity (Digital Kazakhstan, 2017; p. 14).

Realisation of the Government Programme *Digital Kazakhstan* shifts the paradigm in higher education (Digital Kazakhstan, 2017; p. 44)
- from preparation of students as specialist
- to the promotion of students to develop their professional careers.

The Government Programme *Digital Kazakhstan* implies the establishment of the close connections between the system of education and employers (Digital Kazakhstan, 2017; p. 44). On the one hand, competence centres as part of universities are to be initiated, on the other hand, ICT departments as part of enterprises are to be organised in order to provide students with modern labs for practical work (Digital Kazakhstan, 2017; p. 44).

For Kazakhstan's progressive development of the digital ecosystem, higher education sector has to harmonize ICT study programmes in accordance with updated professional standards and industry requirements for preparation of specialists (Digital Kazakhstan, 2017; p. 44). As competencies and skills permanently change, competencies and skills are to be enhanced lifelong (Digital Kazakhstan, 2017; p. 45).

The purpose of the paper is to explore ICT education in the context of advancement of digital ecosystem underpinning empirical analysis of ICT education at master level in Kazakhstan and elaboration of a new research question.

The method of the study is exploratory case study. The empirical study was carried out in December 2017. Seven respondents took part in the semi-structured interviews.

Conceptual framework

The present research is based on such concepts as *conceptual framework, digitization, digitalization, digital ecosystem, ICT education, study programme at master level, context* and *hybrid*.

A framework means the specific viewpoint (Ahrens & Zaščerinska, 2014) on a phenomenon. In research, frameworks are differentiated into theoretical and conceptual as illustrated in Figure 1.
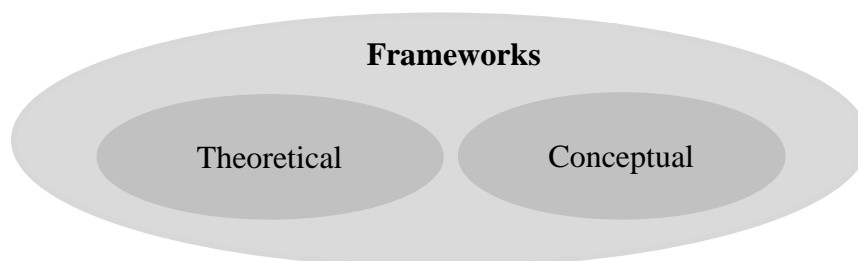

Figure 1. **Types of frameworks in research**

A theoretical framework includes the combination of concepts together with their definitions as well as existing theory. In turn, as a concept is defined to be a verbal abstraction drawn from observation of a number of specific cases (Watt & van den Berg, 2002), a conceptual framework means the unity of concepts that are used for a particular study (Ahrens & Zaščerinska, 2014).

Digitization refers to "the action or process of digitizing; the conversion of analogue data (esp. in later use images, video, and text) into digital form" (Brennen & Kreiss, 2016). Digitalization, by contrast, refers to "the adoption or increase in use of digital or computer technology by an organization, industry,

country, etc" (Brennen & Kreiss, 2016). By digital ecosystem, an interdependent group of actors (enterprises, people, things) sharing standardized digital platforms to achieve a mutually beneficial purpose (Gartner Inc., 2017) is meant. By ICT education, a sector of education devoted to Information and Communications Technologies (ICT) as a diverse set of technological tools and resources used to communicate, and to create, disseminate, store, and manage information (Blurton, 1999) is identified.

Study programme at master level means that the programme refers to higher education of Level 7 or second cycle (M. A.) within the eight-scale European Qualifications Framework (Commission of the European Communities, 2006, p. 19). The eight-scale European Qualifications Framework reflects stages in a lifelong learning process (Commission of the European Communities, 2006: p. 19). Outcomes of Level 7 in the European Qualifications Framework (Commission of the European Communities, 2006: p. 19) include

– knowledge as highly specialized, some of which is at the forefront of knowledge in a field of work or study, as the basis for original thinking; critical awareness of knowledge issues in a field and at the interface between different fields,

– skills as specialized problem-solving required in research and/or innovation in order to develop new knowledge and procedures and to integrate knowledge from different fields,

– competence to manage and transform work or study contexts that are complex, unpredictable and require new strategic approaches; take responsibility for contributing to professional knowledge and practice and/or for reviewing the strategic performance of teams.

Context means certain relationships that exist simultaneously and are important for an individual or a group (Beļickis, et al., 2000).

Hybrid means a combination of phenomena's elements. It should be noted that *hybrid, mixed, integrative* and *blended* are often used synonymously. For example, blended educational methods include

- traditional educational methods such as lecture, explanation, exercise and examination as well as

- modern educational methods such as use of modern technologies in the educational process.

Analysis of the terms *hybrid, mixed, integrative* and *blended* allow concluding that a combination of phenomena's elements includes two contrasting modes, namely traditional and modern. Hence, such a phenomenon obtains or exhibits two contrasting modes or forms. A phenomenon that obtains or exhibits two contrasting modes or forms is identified as bi-modal phenomenon (Ahrens & Zaščerinska, 2014). Consequently, the term *bi-modal* as well as *hybrid, mixed, integrative* and *blended* could be used synonymously.

Empirical Study

The present part of the contribution demonstrates the design of the empirical study, survey results and findings of the empirical study.

The design of the present empirical research comprises the purpose and question, sample and methodology of the present empirical study.

The research question is as follows: What is stakeholders' opinion on ICT education in Kazakhstan?

The purpose of the empirical study is to analyze stakeholders' opinion on ICT education in Kazakhstan.

The empirical study was carried out in December 2017. The present empirical study involved seven respondents. In order to save the information of the present research confidential, the respondents' names and surnames were coded as R1 (Respondent 1), R2 (Respondent 2), R3 (Respondent 3), R4 (Respondent 4), R5 (Respondent 5), R6 (Respondent 6) and R7 (Respondent 7):

- Respondent 1 belonged to the Committee on Statistics of the Ministry of Education and Science (MES) of the Republic of Kazakhstan (RK),
- Respondent 2 – the rating agency Career Cast (USA),
- Respondent 3 – management staff member of International Information Technology University (IITU),
- Respondent 4 – a bank in Kazakhstan,
- Respondent 5 – a state agency serving electronic government,
- Respondent 6 – the Marketing Department in one of the biggest malls of Almaty - 'Dostyk Plaza', and
- Respondent 7 – academic staff member of International Information Technology University (IITU).

All 7 respondents obtained different degrees in different scientitifc fields. Working experience of the respondents was different, too. The respondents represented different professional cultures such as banking, education, business, etc. As the respondents with different cultural backgrounds and diverse educational approaches were chosen, the sample was multicultural. Thus, the group (age, field of study and work, mother tongue, etc.) is heterogeneous.

The interpretive paradigm was used in the empirical study. The interpretive paradigm aims to understand other cultures, from the inside through the use of ethnographic methods such as informal interviewing and participant observation, etc (Taylor & Medina, 2013). Interpretative paradigm is characterized by the researchers' practical interest in the research question (Cohen et al., 2003). Researcher is the interpreter.

The case study research has been applied as "case studies […] are generalizable to theoretical propositions and not to populations or universes. In doing a case study, your goal will be to generalize theories (analytical

generalization) and not to enumerate frequencies (statistical generalization)" (Yin, 2003: p. 10). Case study research is a qualitative research design (Kohlbacher, 2005). The exploratory type of the case study research has been applied (Zainal, 2007) in the present empirical study as case studies have an important function in generating new research questions, hypotheses and building theory (Kohlbacher, 2005). Exploratory case studies set to explore any phenomenon in the data which serves as a point of interest to the researcher (Zainal, 2007). The exploratory methodology of the empirical study proceeds from exploration in Phase 1 through analysis in Phase 2 to hypothesis/research question development in Phase 3 (Ahrens, Bassus, & Zaščerinska, 2013: p. 104) as shown in Figure 2.
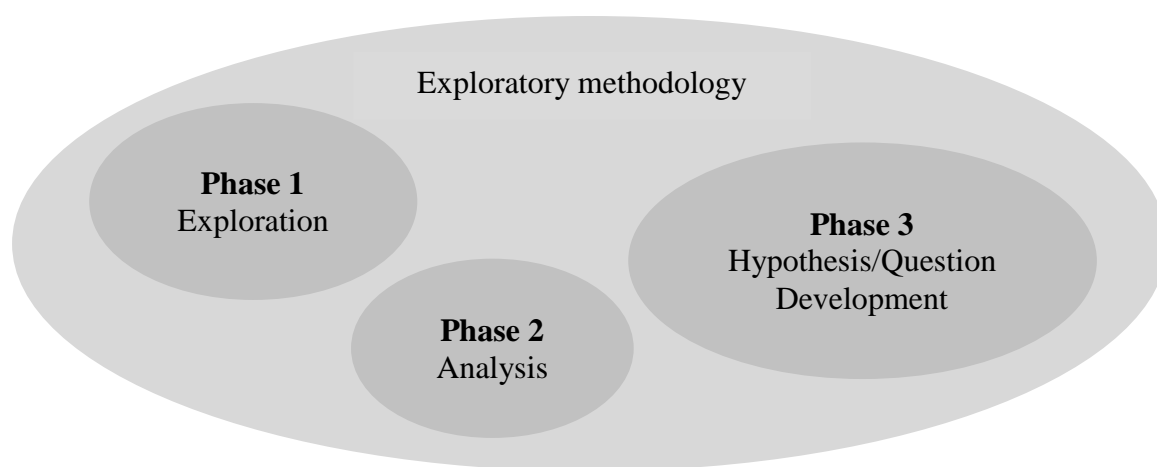

Figure 2. **Three phases of exploratory methodology**

The qualitatively oriented empirical study allows the construction of only few cases (Mayring, 2004). Moreover, the cases themselves are not of interest, only the conclusions and transfers we can draw from these respondents (Flyvbjerg, 2006). Selecting the cases for the case study comprises use of information-oriented sampling, as opposed to random sampling (Flyvbjerg, 2006). This is because an average case is often not the richest in information. In addition, it is often more important to clarify the deeper causes behind a given problem and its consequences than to describe the symptoms of the problem and how frequently they occur (Flyvbjerg, 2006). Random samples emphasizing representativeness will seldom be able to produce this kind of insight; it is more appropriate to select some few cases chosen for their validity.

Semi-structured interviews were used as the researchers had obtained the initial knowledge on the research field (Kroplijs & Raščevka, 2004). The semi-structured interviews included the following question: What is your opinion on ICT education in Kazakhstan?

Respondent 1 reveals that among the graduates of ICT specialties, the least amount falls on the study programme "System of Information Security" (SIS), total: 417 people in 2013-2015. In the period 2013-2015 only 180 grants were awarded at the bachelor's degree on SIS in Kazakhstan, 9 at MA and 4 PhD degrees. The number of allocated grants for the number of SIS students is very small. Analysts pointed the deficit of information security specialists in Kazakhstan that contradicts with the Address "Third modernization of Kazakhstan: Global Competitiveness" to the Nation of the President of Kazakhstan on 31 January 2017. In the Address the Head of State indicated the importance of active introduction of digital technologies for the development of the country's economy and referring to the message of the fight against cybercrime, commissioned the creation of the "Cybershield of Kazakhstan". It proves the urgent necessity of specialists in Information Security.

According to the analysis of Respondent 2, programmers, web developers and information security specialists appear in the ranking of the most popular specialities for 2017-2024, which leads to the possibility of increasing the training of specialists in "System of Information Security" (SIS).

Respondent 3 highlighted that, in International Information Technology University (IITU), the number of applicants for the "System of Information Security" (SIS) is growing every year. In 2015, 13 students were enrolled, in 2016 - 67, in 2017 - 83 students, which indicates the relevance and popularity of this area of study not only in IITU, but in the Republic of Kazakhstan.

Respondent 4 emphasized that data scientists are a new breed of analytical data expert who have the technical skills to solve complex problems – and the curiosity to explore what problems need to be solved. They are partly mathematician, partly computer scientist and partly trend-spotter. As they straddle both the business and IT worlds, they are highly sought. According to Respondent 4, the poll performed by KDnuggets website shows that the most popular areas of data science application in 2016 are CRM/Consumer analytics - 16.3 %, Finance - 15.0 %, Banking - 13.4 %, Advertising - 12.0 %, Science - 12.0 %, Healthcare - 12.0 %. In particular, further applications seem very attracting: Internet Search, Digital Advertisements (Targeted Advertising and re-targeting), Image Recognition, Speech Recognition, Gaming, Price Comparison Websites, Airline Route Planning, Fraud and Risk Detection, Delivery logistics. According to the information from recruiting companies in the region of Commonwealth of Independent States (CIS) (Russia, Ukraine, Belarus, and Kazakhstan) currently there are ~33 business analysts and ~11 data scientists job positions in Kazakhstan.

Respondent 5 outlined that like many other developing countries, Kazakhstan is heading towards the technologically developed electronic government. Thousands of services are provided to the citizens every day. The

egov.kz is a huge source of data which holds tons of useful information to be processed. The list of the sources may be increased considerably, involving financial, retail, mineral resources production and mining, social networks and media sectors.

Respondent 6 considers that there are few universities that include courses related to Data Science in their curricula (e.g. Machine learning, Statistics, noSQL DB, Data visualization, Data Mining, etc.). One of the leading banks of Kazakhstan – Kaspi Bank has launched the study program 'Kaspi Lab'. The program aims at training highly-qualified specialists in Data Science capable of solving practical problems in financial, search engine optimization (SEO) and fast-moving consumer goods (FMCG) sectors. Respondent 6 states that the application of Data Science technologies allows the department to predict the trends in customers' demands and tastes, consequently increasing commodities turnover and customers flow. Currently, the banking sector is one of the most active consumers of Data Science in Kazakhstan. A big trend of the recent few years is digital banking. Such banks as Astana Bank and Altyn Bank present themselves as digital banks with minimum services provided to the customers in person, and a high number of services provided online. Respondent 6 disclosed that according to Bruce Harpham British Petroleum, the U.K.-based energy leader established a Center for High-Performance Computing in Houston, Texas, where researchers apply data analytics to production improvement. Oil and gas companies are the key players in the economics of Kazakhstan, forming around 25 % of the revenue of the State budget of the Republic of Kazakhstan. Acknowledging that oil prices are very unstable, the producers should consider the reduction of costs in all the phases, i.e. exploration, drilling, production. This is where Data Science might become a valuable tool for achieving these goals.

Respondent 7 reveals that International Information Technology University (IITU) experiences a significant deficit of teachers as only one university trains MA students in SIS in English. A research on curriculums of various well-known education platforms such as edX, Coursera and DataCamp shows that only half of the main courses required for data scientists are in the study program of International Information Technology University (IITU). Thus, training and retraining of IT specialists in the direction of IT security is needed. At the same time increase in the number of teaching staff with a degree requires to open postgraduate education (magistracy and doctoral) in this speciality, to enhance the content of education in the form of specialized courses on the main trajectories of studies in the field of Information Security and Data Science, to develop the new skills and competencies. Respondent 7 is sure that ICT education at master level will contribute to the development of the direction "Digital Kazakhstan", which, as the President of Kazakhstan emphasized, is necessary to increase the competitiveness of enterprises and the country as a whole, and to improve the

quality of life of the population.

Summarizing content analysis (Mayring, 2004) of the data reveals that there is an urgent need in ICT specialists in Kazakhstan. Enterprises and industry require specialists with "hybrid knowledge and skills". Such a combination as Information Security and Data Science is on high demand in most enterprises and industry. Universities has to focus on ICT education at master level in order to increase the number of teaching staff with a scientific degree for ICT education quality assurance.

Conclusions

The theoretical findings of the present research allow drawing the conclusions that the terms *hybrid, mixed, integrative*, *blended* and *bi-modal* are synonymous.

The empirical findings of the research allow concluding that a hybrid study programme is relevant to the local context of the advancement of digital ecosystem in Kazakhstan in terms of educational policy and curriculum innovation. The findings of the study reveal that Data Science and Information Security emerge in the context of the advancement of digital ecosystem in Kazakhstan. Hence, a study programme as a combination of Data Science and Information Security is of great importance in the context of the advancement of digital ecosystem. A hybrid study programme that combines Data Science and Information Security at master level facilitates the increase in the number of teaching staff with a scientific degree for ICT education quality assurance. A hybrid study programme is also a combination of traditional studies and on-line, distance and blended studies.

The following new research question has been formulated: What are core courses of the hybrid study programme that combines Data Science and Information Security at master level?

Validity and reliability of the research results have been provided by involving other researchers into several stages of the conducted research. External validity has been revealed by international co-operation as following:
- the research preparation has included individual consultations given by other researchers,
- the present contribution has been worked out in co-operation with international colleagues and assessed by international colleagues, and
- the research has been partly presented at international conferences.

The present research has *limitations*. The inter-connections between *conceptual framework, digitization, digitalization, digital ecosystem, ICT education, study programmes at master level, context* and *hybrid* have been set.

Another limitation is the empirical study based on one case only, namely Kazakhstan. Therein, the results of the study cannot be representative for the whole area. Nevertheless, the results of the research, namely the extension of the row of the synonymous terms such as *hybrid, mixed, integrative*, *blended* and *bimodal*, may be used as a basis of analysis of study programmes. If the results of other cases had been available for analysis, different results could have been attained. There is a possibility to continue the study.

Further research tends to focus on designing a hybrid study programme that combines Data Science and Information Security at master level. Modelling a favourable hybrid educational environment, namely traditional studies and on-line, distance and blended studies within a hybrid study programme that combines Data Science and Information Security at master level, is proposed. ICT students' opinion on hybrid studies has to be investigated. Empirical studies on ICT education in Kazakhstan in other institutions are to be implemented. Another direction of further investigation is considered as evaluation of efficiency of a hybrid study programme. And a comparative research of different countries could be carried out, too.

References

Ahrens, A., Bassus, O., & Zaščerinska, J. (2013). Engineering Students' Direct Experience in Entrepreneurship. Proceedings of 6th ICEBE International Conference on Engineering and Business Education *Innovation, Entrepreneurship and Sustainability*, Windhoek, Namibia, 7 - 10 October 2013, pp. 93-100. Published by University of Wismar, Germany. ISBN 978-3-942100-03-8.

Ahrens, A., & Zaščerinska, J. (2014). Students' Attitude to Interdisciplinary Research. *Society, Integration, Education.* Proceedings of the International Scientifical Conference. Volume I. 2014, pp. 13-23. – Rēzekne: Rēzeknes Augstskolas Izdevniecība, 2014. – p 616.

Beļickis, I., Blūma, D., Koķe, T., Markus, D., Skujiņa, V. (vad.) & Šalme, A. (2000). *Pedagoģijas terminu skaidrojošā vārdnīca. Termini latviešu, angļu, vācu, krievu valodā.* Rīga, Latvia: "Zvaigzne ABC".

Blurton, C. (1999). *New Directions of ICT-Use in Education.* Downloaded from http://www.unesco.org/education/lwf/dl/edict.pdf.

Brennen, J., Scott, Kreiss, D. (2016). Digitalization. In K. B. Jensen and R. T. Craig (Eds.). *International Encyclopedia of Communication Theory and Philosophy*, (pp. 556-565). Boston: John Wiley & Sons. doi: 10.1002/9781118766804.wbiect268.

Cohen, L., Manion, L., & Morrsion, K. (2003). *Research Methods in Education.* London and New York: Routledge/Falmer Taylor & Francis Group.

Commission of the European Communities. (2006). *Proposal for a Recommendation of the European Parliament and of the Council on the Establishment of the European Qualifications Framework for Lifelong Learning.* Brussels 05/09/2006. 21 p.

Digital Kazakhstan. (2017). Government programme. Downloaded from https://digitalkz.kz/en/.

Flyvbjerg, B. (2006). Five Misunderstandings About Case-Study Research. *Qualitative Inquiry, 12* (2), 219-245.

Gartner Inc. (2017). *Insights From the 2017 CIO Agenda Report: Seize the Digital Ecosystem Opportunity Gartner Executive Programs*. Downloaded from http://www.gartner.com/ imagesrv/cio/pdf/Gartner_CIO_Agenda_2017.pdf.

Kohlbacher, F. (2005). The Use of Qualitative Content Analysis in Case Study Research. *Forum Qualitative Sozialforschung / Forum: Qualitative Social Research*, *7* (1), Art. 21, http://nbn-resolving.de/urn:nbn:de:0114-fqs0601211.

Kroplijs, A., & Raščevska, M. (2004). *Kvalitatīvās pētniecības metodes sociālajās zinātnēs*. Rīga: RaKa.

Mayring, P. (2004). Qualitative Content Analysis. In U. Flick, E. Von Kardoff and I. Steinke (Eds). *A Companion to Qualitative Research*, pp. 266-269. SAGE, UK, Glasgow.

Organisation for Economic Cooperation and Development (OECD). (2017). *Key Issues for Digital Transformation in the G20.* Report prepared for a joint G20 German Presidency/OECD conference Berlin, Germany, 12 January 2017. Downloaded from http://www.oecd.org/G20/key-issues-for-digital-transformation-in-the-G20.pdf.

Taylor, P. C., & Medina, M. N. D. (2013). Educational Research Paradigms: From Positivism to Multiparadigmatic. *The Journal of Meaning-Centered Education*. Vol. 1, Article 2.

Watt, J. H., & van den Berg, S. (2002). *Research Methods For Communication Science*. Downloaded from http://www.cios.org/readbook/rmcs/rmcs.htm.

Yin, R. K. (2003). *Case study research, design and methods* (3rd ed., vol. 5). Thousand Oaks: Sage.

Zainal, Z. (2007). Case study as a research method. *Jurnal Kemanusiaan bil.9, Jun 2007*.