

The Factors Affecting the Level of Digital Entrepreneurial Competences of University Students

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ABSTRACT

This paper represents an overview of the academic literature in regards to digital entrepreneurial competences (DEC) and an effort to outline the research which will be focused on measuring the level of DEC of university students in Serbia. The paper proposes the creation of DEC assessment framework and the corresponding methodology which could be used for online DEC assessment tool development. The tool would enable the assessment of digital entrepreneurial competences of the university students in Serbia and the analysis of the factors underlying different levels of digital entrepreneurial competences. Factors ranging from personal characteristics of the students to contextual and socio-economic factors are taken into consideration.

Key words: *digital entrepreneurial competences, University education effectiveness, competence levels, online competence assessment tool*

JEL Classification: L26, J24, M13

INTRODUCTION

Digital entrepreneurial competences (DEC) represent a mixture of general digital competences and entrepreneurial competences. DEC became very important with the advance of information technology and the emergence of IT based business models. Today's entrepreneurs are expected to possess necessary set of competences to be able to anticipate changes on the market, react to them and initiate them (Radovic-Markovic et al.2019)

Main objective of this paper is to identify the types of factors which would have an impact on the level of DEC the university students in Serbia acquire during their university education. This paper should serve as a literature review of the similar research conducted in other competence areas in order to provide insight and a basis for a planned DEC university students in Serbia research.

The basic assumption of this paper is that the system of formal education in Serbia doesn't provide university students with the necessary set of skills and competences in the area of digital entrepreneurship. The academic literature doesn't provide evidence of the mechanisms for measuring the level of DEC a person possesses and acquires during the course of his/her education. Some evidence in regards to general entrepreneurial education suggests that the lack of commonly accepted metrics for measuring the impact of entrepreneurial education represents the biggest challenge (Egerova, 2016). Having in mind the novelty of our approach

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the same statement applies in the area of digital entrepreneurial education. Wilson et al. (2009) identify 3 levels of impact measures of higher education entrepreneurship:

1. level 1 refers to individual participants attitudes and beliefs held towards entrepreneurship and self-employment,
2. level 2 refers to entrepreneurship education course/program in regards to participation of departments, participation of students, junior or senior faculty members,
3. and level 3 refers to university wide output measures such as number of created new businesses and jobs, patents, technology licenses.

The introductory part of the paper brings the relevant research and the current knowledge in the area of digital entrepreneurial competences with the special emphasis on the existing general digital and general entrepreneurial competence frameworks. The following part outlines the key aspects of the overall research of the level of the digital entrepreneurial competences of the students in Serbia which will be based on the DEC framework and corresponding DEC methodology. The results of that research will provide the first empirical evidence of the level of DEC the students in Serbia acquire during their university education in universities in Serbia. Next chapter explains the methodology which will be used for the purpose of DEC data processing in order to identify and analyze the factors affecting the levels of DEC the students acquire during their university education. This chapter is followed by final considerations and a conclusion.

DIGITAL ENTREPRENEURIAL COMPETENCES BACKGROUND

As stated in the introductory part of this paper, the main purpose of this paper is to investigate the existing academic literature in search of the factors which would be important in terms of their impact on the level of DEC of university students. To do so, this paper will, firstly address the relevant aspects of DEC, which is a relatively new concept and in focus of a relatively small group of scientists, for now.

Following the strategic documents of the European Union (European Commission, not dated (n.d.)), creativity, entrepreneurship, learning-to-learn, digital competence and other 21st century skills and competences are emerging as more and more important for innovation, growth, and participation in a digital society and economy (EU Science Hub - European Commission, 2020).

Reference Framework for lifelong learning identifies the digital competences as one of eight key competences for lifelong learning (The European Parliament, 2006). They are associated with the use of full range of the digital technologies for communication, information and basic problem solving in different aspects of life (Digital competence: the vital 21st century skill for teachers and students, 2020).

Digital entrepreneurial competences (DEC) are a mixture of general digital competences and entrepreneurial competences. They are critical for the success of digital entrepreneurship as outlined by the World Development Report 2016 (Van Welsum, 2016). Digital entrepreneurship is broadly defined as creating new ventures and transforming existing businesses by developing novel digital technologies and/or novel usage of such technologies, (European Commission, 2015). Ngoasong (2017) defines DEC as a set of knowledge and skills required to search and acquire new information, to identify and pursue entrepreneurial opportunities and to innovate. The interest in DEC is driven by the rising importance of digital entrepreneurship which has been viewed as a critical pillar for economic growth, job creation and innovation by many countries including the Member States of the European Union (Zhao & Collier, 2016). Van Welsum, (2016) proposes communication skills, new business opportunities identification and data exploitation as critical DEC. They may be acquired through formal education as per Fayolle & Gailly, (2015) European Union's Entrepreneurship 2020 Action Plan. (European Commission,

2020) emphasizes that the implementation of the entrepreneurship education in schools, colleges and universities is the strategic goal for all member countries. The overall social welfare is driven by the students' entrepreneurship (Scuotto & Morellato, 2013). The universities are more and more seen as driving force of the entrepreneurship in addition to their educational and research purpose (Farsi et al. 2017).

Due to their tight association with general digital and general entrepreneurial competences DEC are also tightly associated with relevant competence frameworks. The following frameworks are especially important:

- Digital Competence Framework for citizens - DigComp (Vuorikari et al., 2016) which recognizes 21 digital competences in total.
- Relevant competence areas and specific competences of DigComp framework are represented in the following Table.

Table 1. DigComp framework competence areas

DigComp framework	
Competence area	Specific competences
Information and data literacy	<ol style="list-style-type: none"> 1. Browsing, searching and filtering data, information and digital content 2. Evaluating data, information and digital content 3. Managing data, information and digital content
Communication and collaboration	<ol style="list-style-type: none"> 1. Interacting through digital technologies 2. Sharing through digital technologies 3. Engaging in citizenship through digital technologies 4. Collaborating through digital technologies 5. Netiquette 6. Managing digital identity
Digital content creation	<ol style="list-style-type: none"> 1. Developing digital content 2. Integrating and re-elaborating digital content 3. Copyright and licenses 4. Programming
Safety	<ol style="list-style-type: none"> 1. Protecting devices 2. Protecting personal data and privacy 3. Protecting health and well-being 5. Protecting the environment
Problem solving	<ol style="list-style-type: none"> 1. Solving technical problems 2. Identifying needs and technological responses 3. Creatively using digital technologies 4. Identifying digital competence gaps

Source: *The Digital Competence Framework 2.0 - EU Science Hub - European Commission, n.d.*

- e-Competence Framework which incorporates 40 digital competences divided into five proficiency levels (Council of European Professional Informatics Societies, n.d). This framework is relevant due to its focus on workplace digital competences. Table 2 represents an overview of competence areas under e-Competence Framework.

Table 2. e-Competence framework competence areas

e-Competence framework	
Competence area	Specific competences
Plan	<ol style="list-style-type: none"> 1. IS and business strategy alignment 2. Service level management 3. Business plan development 4. Product / Service planning 5. Architecture design 6. Application design 7. Technology trend monitoring 8. Sustainable development 9. Innovating
Build	<ol style="list-style-type: none"> 1. Application development 2. Component integration 3. Testing 4. Solution deployment 5. Documentation production 6. Systems engineering
Run	<ol style="list-style-type: none"> 1. User support 2. Change support 3. Service delivery 4. Problem management
Enable	<ol style="list-style-type: none"> 1. Information security / Strategy development 2. ICT quality strategy development 3. Education and training provision 4. Purchasing 5. Sales proposal development 6. Channel management 7. Sales management 8. Contract management 9. Personal development 10. Information and knowledge management 11. Needs identification 12. Digital marketing
Manage	<ol style="list-style-type: none"> 1. Forecast development 2. Project and portfolio management 3. Risk management 4. Relationship management 5. Process improvement 6. ICT quality management 7. Business change management 8. Information security management 9. IS governance

Source: Council of European Professional Informatics Societies, n.d

- Besides digital competences entrepreneurial skills are also considered as one of the key competences in accordance with Reference Framework for lifelong learning. (The European Parliament, 2006). In order to improve entrepreneurial capacity of European citizens and organizations Joint Research Centre (JRC) of the European Commission on behalf of the Directorate General for Employment, Social Affairs and Inclusion (DG EMPL) has created the Entrepreneurship Competence Framework also known as EntreComp (Bacigalupo et al., 2016). EntreComp consists of 15 specific entrepreneurial competences (European Commission, n.d). EntreComp has 3 competence areas:
 1. Ideas and opportunities

2. Resources
3. Into action (Bacigalupo et al.,2016)

Table 3. EntreComp framework competence areas

EntreComp framework	
Competence area	Specific competencies
Ideas and opportunities	<ol style="list-style-type: none"> 1. Spotting opportunities 2. Creativity 3. Vision 4. Valuing ideas 5. Ethical and sustainable thinking
Resources	<ol style="list-style-type: none"> 1. Self-awareness and self-efficiency 2. Motivation and perseverance 3. Mobilizing resources 4. Financial and economic literacy 5. Mobilizing others
Into action	<ol style="list-style-type: none"> 1. Taking the initiative 2. Planning and management 3. Coping with uncertainty, ambiguity and risk 4. Working with others 5. Learning through experience

Source: Bacigalupo et al. (2016)

Besides Europe, digital competence frameworks exist in other parts of the world. An example of competence frameworks in other parts of the world is the Digital Competence Framework which was developed in 2019. This framework consists of 12 competence areas (Québec, Ministère de l'Éducation et de l'Enseignement supérieur, 2019).

FUTURE RESEARCH PROPOSAL

This paper represents a fragment of a larger endeavor aimed at measuring the exact levels of DEC the students in Serbia acquire during their university education at HEIs offering IT and entrepreneurship courses in their curriculums.

The key challenge in regards to DEC is to identify and bridge the gap between the competences the students acquire through formal education and the competences needed in real-life situations. To do so, the research needs to develop mechanisms for measuring the actual level of DEC the students in Serbia acquire during the course of their university education. Around 33,47 % of higher education institutions (HEI) in Serbia (both state-owned and private) offer entrepreneurial courses in their curriculums alongside IT (digital) courses. The data of the Statistical Office of the Republic of Serbia (Serbian Bureau of Statistics, 2020) shows that in 2018 the number of HEI graduates in Serbia was around 42.500. It can be estimated that out of that number around 14.000 graduates leave the HEI in Serbia each year in possession of some level of DEC. Based on this estimation it can be assumed that by 2030 (with respect to the expected decline in total number of students in Serbia) the number of these graduates would be between 100.000 and 120.000. No one knows and no one ever tried to measure the level of their DEC and their readiness for the labor market. Simovic & Domazet (2020) propose the creation of the DEC framework and corresponding methodology which can be used for the purpose of measuring the level of DEC the students acquire during their formal university education.

The most ambitious objective of the future research is to develop a completely new framework for DEC. To do so, the research team need to:

- use the existing digital and entrepreneurial competence frameworks,

- conduct the analysis of the contemporary academic literature on this subject,
- use its own experience in this field and periodical consultations with all interested stakeholders (policy makers in the field of education and science; academic institutions; students organizations; scientific research organizations; industry (companies)).

This would be the first time that the existing general and entrepreneurial competence frameworks will be used to create a new DEC methodology. Using expert workshops and IT lab experiments the draft version of DEC methodology will be validated before being used to develop an online assessment tool which will measure the level of DEC of the students in Serbia. The tool will be used to measure the level of DEC of the students in Serbia and will provide an answer on the effectiveness of the system of university education in Serbia in this regard. The DEC methodology and the corresponding tool will focus on both cognitive and non-cognitive aspects of DEC, as proposed by Lackeus (2015).

The only way to measure DEC at the later stage of the research is to develop relevant framework as a set of fundamental competence areas. The DEC framework will be used to develop a methodology for measuring DEC the of the students in Serbia. The methodology will later be used for development of an online DEC assessment tool. Similar attempts were made in other countries in regards to general digital competences. In the EU the DigComp framework and corresponding methodology was used to develop an online digital competence assessment tool called The Digital Competence Wheel (Skov, 2017). This tool is used to measure the level of digital competences and to find the ways to improve the critical ones.

e-Competence Framework was used in Estonia to help the universities develop the curriculums which would be better aligned with the market needs. An online tool developed on the basis of this framework is called e-CF Profiling tool and is used to match the users profile with the one of 23 ICT professional profiles built in the system (European Commission, n.d.).

The DEC framework and associated methodology will be used to create an online tool which will be used for assessing the DEC of the students who are attending the undergraduate and graduate programs in HEI that offer IT and entrepreneurial education in their curriculum. The online assessment tool will be developed using the best practice of other online competences assessment tools (the Digital Competence Wheel, e-CF Profiling, etc.). The subcontractors will be hired to develop the tool upon precise specifications. The assessment tool will be hosted at the Institute of Economic Sciences (IES) servers and the participating students will be able to access it from anywhere via the Internet. The tool will collect the data on students' DEC which will be processed to draw valuable conclusions at the later stage.

One of the main purposes of the planned research is to conduct the gap analysis. The purpose of gap analysis is to determine whether the system of formal IT and entrepreneurial education on university level in Serbia provides necessary DEC to students which would enable them to start their own digital entrepreneurial projects and be a part of startup teams. The gap analysis will cover 2 aspects of DEC of the students in Serbia:

- The perceived level of DEC by the students using self-assessment method
- The actual level of DEC measured using real life scenarios and assignments

The assessment of DEC of the students in Serbia will cover both dimensions using self-assessment and real life assignments integrated in the associated online assessment tool. The DEC assessment of the students in Serbia will provide valuable data which will be further processed using qualitative and quantitative methods in order to provide the realistic assessment of the efficiency of the educational system in Serbia in the area of DEC and policy recommendations for improvements.

Besides measuring the actual levels of DEC the students in Serbia acquire during the course of their formal education, the research should also answer the critical question whether the level of DEC is preconditioned by different factors and if so, what factors would have more significant impact on the level of students DEC than the others.

THE FACTORS UNDERLYING THE LEVEL OF DEC

The assessment of students DEC would provide valuable data which could further be processed in order to determine the factors underlying different levels of students DEC. Considering the importance of DEC for future growth and improved employability of the students on one side and the planned future research in this regard, it would be essentially important to identify the set of factors which would have the greatest impact on the level of DEC.

The analysis will cover the association of DEC and different external factors (gender, age, education of parents, state/private university, educational profile, the age of the professor, etc.) to determine whether some factors have a greater impact on the level of students DEC than the others.

The analysis of the data collected using an online DEC assessment tool will be conducted using two sets of statistical methods. At the first stage the methods of multivariate analysis to determine associations between the core DEC and relevant predictors and control variables, such as main socio-demographic variables (gender; age; education of parents, etc.), contextual variables (region; year of study; private/state university, etc.), characteristics of courses (educational profile: economy, management, organization, engineering, science; characteristics of teaching staff: gender, age of professor, etc.), will be used.

The data will be collected in a cross-sectional framework due to a final-year students will be targeted and the survey is anonymous. The point of applying the appropriate statistical technique is to assess the efficacy of the educational program in providing students with DEC that will be helpful in building the comparative advantages and would increase employment chances of young graduates on the one hand or would be persuasive in choosing the entrepreneurial career on the other. In that respect, at least several types (groups) of DEC will be recognized: starting with the basic (core) one which will be followed with more advanced competences.

Using the framework of structural equation modeling (SEM) we will conduct both the confirmatory factor analysis and the explanatory factor analysis in order to validate the applied measurement scales and confirm the exact number of factors (Anderson & Gerbing, 1988). The set of variables that will be included in the analysis includes different scales of measurement. The self-assessment of the competences will be ranked on a four-point Likert scale like in Kuzminska et al. (2019), while other control variables will include nominal scale of evaluation (personal data) or categorical scale (binomial or multinomial) for characteristics of educational programs, gender, region and alike. In the following step, the principal component analysis (PCA) will be used to extract the factors (Kovačić, 1994). In SPSS statistical software that will be used for data analysis, for example, the Kaiser-Guttman rule will be applied for the selection of the exact number of factors with eigenvalues greater than one. Goodness-of-fit indices will be undertaken for testing the specified measurement model. After acceptable empirical test values, the variables for further analysis will be calculated as unweighted arithmetic means of respective item scores.

In the second step the linear probability and multiple response regression models will be employed. The dependent variables will be constructed using grades associated with each competence or if the data are grouped with the group of competences (DEC; core / more advanced). Predictor variables will be chosen from a pool of the variables that represent personal characteristics of students, contextual variables and characteristics of courses. Appropriate goodness-of-fit statistics will be conducted to test for adequacy of constructed models. These models will be estimated so that the more reliable predictors of the current state of the level of student competences can be evaluated. Not only single predictors will be examined, but also the interaction terms will be constructed (using, for example, gender of students of teachers in interaction with the other predictors) that will moderate the effects of

single factors and help to better understand what causes the current level of student self-assessment of competences.

Also, potential gaps between the theoretical knowledge (students' self-assessment based on the survey questionnaire) and the practical one (assessed by supervisor through practical experiments) will be estimated. Using the same set of the predictors the difference in the level of competences can be tested by using the battery of statistical tests (for example, Chi-square or Student t-test). Also, a Chow-test can be applied for testing structural differences in the estimates of parameters (Chow, 1960). Furthermore, in order to provide policy-oriented recommendations it would be useful to see whether there are the differences among the supply of the educational programs that offer courses for advancement of DEC as well as are those differences associated with the ownership status of HEI or educational profile of the studies.

FINAL CONSIDERATIONS

This paper was trying to address one very important aspect of university education and that is to propose and outline the research aimed at measuring the exact levels of DEC the students in Serbia acquire during their university education. Universities on one side offer a combination of entrepreneurial and IT courses in their curriculums which should provide students with some levels of DEC necessary for real life situations. The problem is the absence of research which would provide empirical evidence on the efficiency of those educational programs.

This paper provided a draft of the DEC related research and measurement which would be based on the use of DEC online assessment tool based on the corresponding methodology. The tool will integrate two types of assessment mechanisms: self-assessment tools and real life scenarios in the form of practical assignments as in the case of Van Deursen and Van Dijk (2011).

Self-assessment tools will evaluate the DEC of the students using four estimation levels as proposed by Kuzminska et al. (2019): foundation, intermediate, advanced and highly specialized. Four point Likert scale will be used for this purpose as in the case of Lopez-Meneses et al. (2020).

Real-life scenarios will be based on practical assignments designed to measure specific types of DEC: digital literacy, communication and collaboration, problem solving, data security, business plan development, risk management, financial literacy, business opportunities identification, etc. Real-life scenarios will be developed with the help of all stakeholders and especially digital entrepreneurs in order to represent the competence requirements of the contemporary market.

The data regarding the level of DEC the students in Serbia acquire during their university education will further be used in order to determine the factors with the highest possible impact on the level of students DEC. Different factors ranging from personal to socio-economic and contextual will be examined in order to identify those with the highest impact on students' competences. This finding would be important in order to maximize the factors with positive and minimize the factors with negative impact thus improving quality of the overall educational process on universities in Serbia.

CONCLUSION

This paper introduced new insights into the area of digital entrepreneurial competences in terms of developing a mechanism for university students DEC assessment. The paper and the corresponding future research provide important advances beyond the state of the art in several key areas. Different competence frameworks (DigComp, e-Competence Framework, Digital Competence Framework, EntreComp) cover different aspects of general digital and entrepreneurial competencies as addressed in the introductory part of this paper. No DEC framework exists up to date. This paper proposes systematization of the current knowledge in

the area of general digital and entrepreneurial competences and the use of the existing competence frameworks in order to provide the basis for a completely new (DEC) framework.

Competence frameworks all have corresponding methodologies which are used for different kinds of assessments. In the case of DigComp, the methodology which included 54 measurable aspects of digital competences that substantiate 16 competences under four main competence areas was developed on the basis of this framework. No DEC methodology exists up to date. The existing digital competencies assessment methodologies are focused on digital competences in general and/or entrepreneurial competences. The proposal presented in this paper is more specific and provides an advance in terms of developing methodology focused on the DEC of the university students. The corresponding DEC framework will serve as a basis for DEC methodology development.

Competence assessment tools based on relevant frameworks and methodologies are used in various research. One research in Ukraine conducted by Kuziminska et al (2019) showed that the level of competency of professional usage of IT is much higher for students than for teachers. Another research was conducted by Lopez-Meneses et al. (2020) on a sample of students from one Italian and two Spanish universities in three areas of DigComp 2.1: information and data literacy, communication and collaboration and digital content creation.

One of the main deliverables of the future research outlined in this paper is an online DEC assessment tool which will be based on DEC framework and corresponding methodology, also developed under the same research. This tool will be the only of its kind in the field. This research will, for the first time, conduct assessment of university students DEC and provide the data on the levels of DEC the students acquire during their formal university education.

Besides DEC tool development and university students DEC assessment, this research will provide evidence on the association of different levels of DEC of university students and different socio-demographic and contextual factors.

The methodology and corresponding online DEC assessment tool will enable the system of formal education to effectively assess the level of DEC the students acquire during the course of their studies and to conduct necessary adjustments and improvements in accordance with the results. It has been more than 3 years after the strategic documents regulating the development of IT entrepreneurship and overall digital competences in Serbia were adopted and now is the right time to assess the level of competencies the student acquires through the system of formal education. The potential for future extensions lies in the fact that in other relevant areas of formal education similar methodologies (and corresponding assessment tools) may be developed in order to assess the functional knowledge and skills of the students.

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