

CONCEPTUAL MODEL FOR QUALITY ASSESSMENT OF DIGITAL COMPETENCIES IN HIGHER EDUCATION SYSTEMS – A CASE STUDY OF THE RESEARCH PROCESS

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Abstract

Digitalization is undoubtedly of high significance after three years. As professional logisticians and supply chain experts, who are mainly involved with IT and related digitalization, trends and challenges in aforementioned fields are researched frequently. Despite constant progress and development, determining the quality of digital competencies poses a significant challenge. The literature offers a variety of frameworks, guidelines and standards for teaching, selection, and use of technologies for educational purposes, as well as provisions on quality education. Due to the burning topic, the purpose of this paper is to present ongoing research, which was produced on the basis of the European Digital Competence Framework for Educators (DigCompEdu) and the document Standards and Guidelines for Quality Assurance in the European Higher Education Area (ESG). The DigCompEdu framework ensures that quality objectives are set and achieved by promoting improvement, while the ESG document provides a set of standards and guidelines for internal and external quality assurance in higher education. Based on the latter, questionnaires were prepared for both educators and students, who were interviewed on digital competencies quality provision in higher education. The objective of this research is conceptual model development, from which questionnaires were derived for the comprehensive assessment of provision and quality of educators' and students' digital competencies in the international higher education systems. This paper presents foundation for further research on digitalization within aforementioned

fields, as it provides insight into the perception of the digital competencies' quality and the identification of the existing gap between perception of educators and students. Logistics is the foundation of a well-designed supply chain and its smooth operations. This research topics' significance is heightened through its advantages and challenges. The latter should be thoroughly examined to obtain comprehension about errors' elimination and higher education optimization.

Key words: digitalization, supply chain and logistics, quality assessment, digital competency, higher education

1. INTRODUCTION

Digitalization has transformed the world in every aspect of life during the last decades (What is Digitalization?, 2020). The access to various information and communication technologies (ICT) other services, increase of smartphones, computers, tablets, and social media usage have changed the way people communicate and interact, learn, work, and do business (Schelenz & Schopp, 2018; Parviainen et al., 2017). Daily life nowadays involves extensive use of ICT, including searching for information, products or services, processing, communication, or production of information, both for work and private purposes. All the latter is enabled due to the rapid development of ICT for private, public, and business purposes (Hatlevik et al., 2012). The IoT has changed our perception about space and time, and about the relationships between people and machines – today, people and technologies appear as inseparable elements. (Martínez-Bravo et al., 2022) The relationship with technology implies the appropriation of systems and tools for their transformation into technologies meant for learning and knowledge, and technologies meant for empowerment and participation (Reig Hernández, 2016).

The rise and development of digital technologies and their educational applications increasingly requires the development of digital skills among educators (European Commission, 2013) since technology is now permeating the deliverance of teaching and learning, reflecting in students' experience and interactions (Carey, 2019). As a result, the concept of digital competencies has emerged, where the development of digital competency prioritizes the creative, safe, and critical ICT usage for different purposes, such as personal development and leisure, education and learning, participation and establishing connections in society and employment (Ferrari, 2012).

Due to the epidemiological situation in the recent few years, many schools and universities had to migrate their learning, teaching, and assessment activities to digital environments. Even though this was necessary, it was done without an agreed, appropriate, or even unified online pedagogical method, which consequentially created an imbalance between the educational quality and new, required approaches (Crawford et al., 2020). Logically, the impact of such a migration has left significant consequences on academic communities – faculty members had been facing diminished time for planning, preparation, teaching, and quality measures' implementation while tackling students' attendance reduction (O'Keefe et al., 2020).

Furthermore, faculty members were then compelled to coordinate newly default online education method, instructional design of effective online education deliverance and student learning, provide adequate pedagogical support for students, assure high-quality learning experience of students, while preparing for contingency plans to deal with unexpected events and needs, arising from the new default educational process (Bao, 2020).

Even though students are exceptionally willing to use various ICT, they should adopt new technologies as part of their educational process (Lamb & Arisandy, 2020). Regrettably, many of them lack online learning experience which causes technical operational obstacles. Even after the COVID-19 pandemic, educators and students still face the aforementioned challenges, including a lack of online teaching and learning experience and/or support from educational technology teams (Duarte & Rodríguez, 2021). Thus, educational institutions should make the necessary provisions to reinforce the digital competencies of both educators and students (Bao, 2020). Before educational institutions can provide such provisions, it is necessary to determine the (state of) knowledge of digital competencies among educators and students. To accomplish the latter, a conceptual model for digital competencies quality assessment in higher education was developed. The foundation of the model are principles of quality management by ISO 9001:2015 standard. The conceptual model was further composed on the basis of European Digital Competence Framework for Educators (DigCompEdu) and the document Standards and Guidelines for Quality Assurance in the European Higher Education Area (ESG). Based on the developed conceptual model, two questionnaires were prepared for both educators and students, who were interviewed on digital competencies quality provision in higher education. The main objective of this research was to develop a conceptual model, from which questionnaires were derived for the comprehensive assessment of provision and quality of educators' and students' digital competencies in the international higher education systems. The results of this ongoing research and associated project will enable the analysis and comparison of both aspects of the included groups of respondents, an insight into the perception of the digital competencies quality and the identification of the existing gap between perception in higher education.

The purpose of this model is that institutions could independently perform the digital competencies quality assessment, premised on which a proposal and implementation of necessary changes could be conducted in order to ensure the best possible educational process. Furthermore, digital competencies are extremely important for the field of supply chain management, where the advancements in digital competency could improve the flexibility and responsiveness of supply chains and logistics, which consequently become competitive through operational strategy with IT integration (Gunasekaran & Ngai, 2004). Meanwhile, a "tendency towards higher qualifications and acquisition of IT competency and process understanding" (Sapper et al., 2021) is desired in the logistics field. There are various reasons why digital competencies are a prerequisite in the fields of supply chain and logistics, mainly extensive sets of data and information, their analysis, and interpretation (Sapper et al., 2021). Therefore, the need for supply chain and logistics workforce is to have the ideal digital competencies to be efficient and effective logistics 4.0 workforce (Abdul Rahman et al., 2019). Analysing competencies allow professionals

to derive requirements for qualifications and developments in occupational fields, with possibility to reveal impacts on future forms of job profiles and organizations (Sapper et al., 2021).

2. THEORETICAL BACKGROUND

To comprehend the challenge, a lifelong cycle of learning and development of new skills is required to adapt to change and the systems' complexity (Martínez-Bravo et al., 2022). The continuous development of digital infrastructures, universalisation of faster and securer network access and interconnection is giving preference to configuration of the global digital ecosystem in which numerous complex and disruptive processes take place (Jorge-Vázquez et al., 2021). This teetering digitalization is challenging the traditional structures and balances of social and economic organization (European Commission, 2013), which also includes the education sphere. Digital transformation and the use of digital technology in educational institutions have grown exponentially in the last decade, especially during the COVID-19 pandemic (European Commission, 2013). Technology is now permeating the deliverance of teaching and learning, reflecting in students' experience and interactions (Carey, 2019). Furthermore, the growing number of learning management systems, online courses, communication platforms, and social media have enormous impact on embedment of online teaching and learning process (Barnes, 2013; Becker, 2010; Bell & Shank, 2004). This new default online education paradigm offers a wide pallet of opportunities to be explored and implemented in the teaching–learning process of higher education (Jorge-Vázquez et al., 2020).

2.1. Digital competency

The term competency represents “a high-level know-how, requiring the integration of multiple cognitive resources when it comes to deal with complex situations” (Perrenoud, 1995). It can be stated that a competency is a combination of knowledge, skills, and attitudes appropriate to the context (Ala-Mutka et al., 2007). The term competency is used more than the term skill, which reflects the need for a more profound and wider content of the term (Martínez-Bravo et al., 2022). The relation between competency and skills is defined as (Ilomäki et al., 2011): “a competency is more than just knowledge and skills. It involves the ability to meet complex demands, by drawing on and mobilizing psychosocial resources (including skills and attitudes) in a particular context”. Key competencies can also be defined, that differ from the rest, because all individuals need them for active citizenship, personal fulfilment and development, social involvement, and employment (Martínez-Bravo et al., 2022).

The interpretations of digital competency differ from various academic literature, policy documents, teaching, and learning. The usage of ICT is intertwined with society – daily, more people are using technologies, for longer time intervals, for different purposes. The digitalization of society in general enabled the extensive ICTs use since many of the undertaken activities have a digital component. As society is

becoming digitalized, the necessary competencies are becoming diverse and multifaceted. (Ferrari et al., 2012)

There is still no mutual definition of digital competency among scholars; thus, the term has various interpretations, such as »internet skills«, »digital skills« and »abilities« (Van Deursen et al., 2009; Van Deursen & Hacker, 2003). Nevertheless, there are several examples of definitions of the »digital competency« concept:

- Digital competency is a confident use of electronic media for leisure, work, and communication associated with logical and critical thinking, information management and high-level communication skills (Bashkireva et al., 2020).
- Digital competency is a concept, describing technology-related skills (Ilomäki et al., 2011).
- Digital competency is the general term used to describe or explain the ability of a citizen, a student, an educator, etc., to use information technology (IT) in a specific context (Rizza, 2014).
- “Digital competency is the confident use of electronic media necessary to gain knowledge and skills in personal and professional development, due to a high level of logical and critical thinking aimed at managing the information and communication received” (Bashkireva et al., 2020).
- Professional digital competency is “the ability of the” educator “to work in the context of a digitally infused schooling education system, including teaching, manage the digital learning environment and the professional work of being a” (Starkey, 2020) educator.

Digital competency, as the key competency, goes beyond the operational use of technological tools and their application (Martínez-Bravo et al., 2022). It is assumed that all key competencies would immerse into the digital competency and the rest would represent its structural components (Bashkireva et al., 2020).

In preparation for professional activity and as a support for professional digital competency, digital competency should consider the age and psychological characteristics of students (Bashkireva et al., 2020). Being digitally competent today implies the ability to understand ICTs, search for information, be analytical about retrieved information and data due to widespread of the IoT, and to be able to communicate with others using various digital tools and applications (Ferrari, 2012).

At the institutional level, the European Union (EU) has promoted digital competencies’ development in a variety of frameworks, including DigCompEdu (Redecker, 2017), which aims to cover educator-specific digital competencies. Other institutions have also expressed their views on the subject (Fallis, 2018): “it is essential that” educators “have the competencies to integrate ICT in their professional practice to ensure the equity and quality of learning”.

Digital competencies are a fundamental key to students’ and educators’ ability to understand and use online method of applied education. Dahiya (2018) stated that the use of ICT in higher education was expanding quickly, is increasingly imperative and will proceed to develop, create, and be significant in the 21st century.

The use of ICT has brought inevitable changes in higher education systems: a) integration of ICT enabled endless possibilities in the education system; b) the use of ICT in education provides the facility of e-learning; c) traditional forms of teaching and learning were converted and diverted to online and virtual environments; and d)

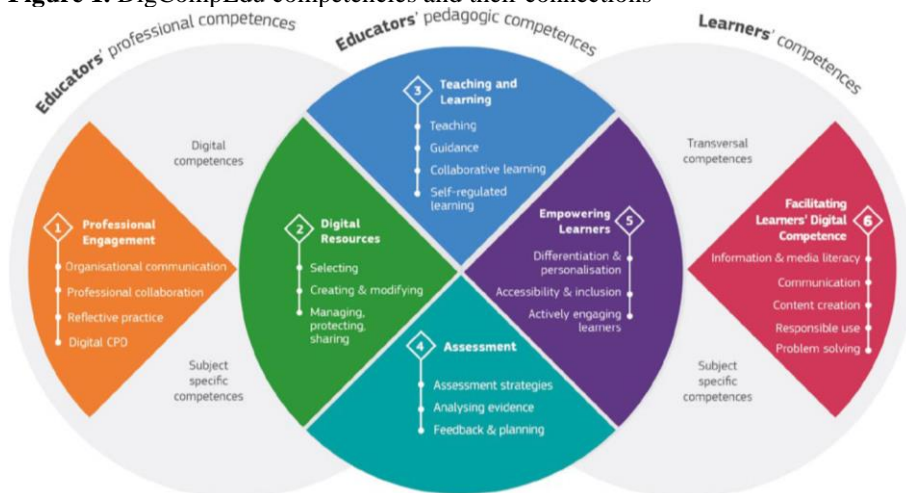
distance learning has been enhanced by the ICT implementation in the education systems. All the above is enabling quality enhancements in this century. (Richard, 2015) ICT infrastructure enables various benefits, such as: access to quality education; e-learning and virtual libraries (Fomunyan, 2020); enhancing the educational systems (Tamrat, 2022); ICT development is the main impetus of green growth (Li et al., 2022).

It is usually self-evident that higher education students and educators should have appropriate digital competencies, but this is not always the case. Many are unable to manage and cope with the required level of social, cognitive, and learning participation in a fully online education system. (Duarte & Rodríguez, 2021) This suggests that the development of digital competencies should and must be considered an educational priority (Blayone, 2018).

2.2. European Digital Competence Framework for Educators (DigCompEdu)

The DigCompEdu framework is a response to the growing needs of many EU member states, that are aware of the educators' need for a set of digital competencies, specific to their profession, which will enable them to exploit the potential of digital technologies to improve and innovate the education system (Redecker, 2017).

Figure 1. DigCompEdu competencies and their connections



Source: Redecker, 2017

The aim of the DigCompEdu framework is to display and describe a set of elementary digital competencies, which are divided into six areas and 22 competencies, specific to educators (Figure 1) (Redecker, 2017):

1. Area: Professional Engagement – refers to the wider professional environment and includes the use of digital technologies in professional communication.

2. Area: Digital Resources – includes the competencies needed for the efficient and responsible use of digital learning resources.
3. Area: Teaching and Learning – is intended for the management and organization of digital technologies' use in teaching and learning.
4. Area: Assessment – addresses the use of digital technologies to improve assessment.
5. Area: Empowering Learners – focuses on the potential of digital technologies for student-centred teaching and learning strategies.
6. Area: Facilitating Learners' Digital Competency – describes specific pedagogical competencies to assist students achieve digital competencies.

The core of the DigCompEdu framework is defined by areas 2 to 5. Collectively, these areas explain the digital competencies educators need to promote efficient, effective, inclusive, and innovative teaching and learning strategies (Redecker, 2017).

2.3. Standards and Guidelines for Quality Assurance in the European Higher Education Area (ESG)

The ESGs are used for internal and external quality assurance in higher education. This document does not represent quality standards (such as ISO 9001:2015), nor does it prescribe how quality assurance procedures are implemented, but it does provide guidelines and guidance, covering areas that are crucial for successful quality assurance and learning in higher education. The ESG focuses on quality assurance related to learning and teaching in higher education, including the learning environment and relevant connections to research and innovation. (ENQA et al., 2015) It describes quality as activities within the cycle of continuous improvement (assurance and improvement activities) and is thus in accordance with the principles of ISO 9001:2015 standard (ISO, 2015).

In the ESG, individual instructions are called »standards«, which are complemented by »guidelines«. Standards are defined, agreed, and accepted practices for quality assurance in EHEA and must therefore be observed and adhered to, in all terms and provisions for the higher education institutions' operations. The guidelines further explain why a standard (instruction) is important and describes how to implement a particular standard. Their implementation, of course, differs depending on the contexts in which they are implemented. The standards are divided into three groups (ENQA et al., 2015), amongst which the first set of standards were used (standards and guidelines for internal quality assurance) to conduct the research as they describe instructions and guidelines for internal quality assurance. They consist of ten standards, each described by guidelines. In the following, only the standards are presented, where the description has been redesigned for the purposes of conducting the research (ENQA et al., 2015):

- (1) Policy for quality assurance – The institution has a policy for quality assurance that is made public and forms part of their strategic management. Internal stakeholders should develop and implement this policy, while involving external stakeholders.

- (2) Design and approval of programs – The institution has processes for the design and approval of their programs. The programs should be designed so that they meet the objectives set for them, including the intended learning outcomes.
- (3) Student-centred learning, teaching, and assessment – The institution ensures that the programs are delivered in a way that encourages students to take an active role in creating the learning process.
- (4) Student admission, progression, recognition, and certification – The institution consistently applies pre-defined and published regulations covering all phases of the student “life cycle”.
- (5) Teaching staff – The institution assures itself of the specific digital competency of their educators.
- (6) Learning resources and student support – The institution has appropriate funding for learning and teaching activities in a digital environment and ensure that adequate and readily accessible resources are provided.
- (7) Information management – The institution ensures that they collect, analyse, and use relevant information for the effective management of their programs and other activities.
- (8) Public information – Institutions should publish information about their activities ensuring digital competencies, which are clear, accurate and objective.
- (9) On-going monitoring and periodic review of programs – The institution monitors and periodically review their programs.
- (10) Cyclical external quality assurance – The institution undergoes external quality assurance on a cyclical basis.

3. METHODOLOGY

The implementation of digital training programs in higher education systems requires a reliable measurement of needs and proficiency levels of competencies. A vast number of scales are intended for this purpose (Duarte & Rodríguez, 2021), where various measurement tools can be classified into two categories (Calvani et al., 2009):

- objective assessments – include class or section performance testing and automated performance testing on assessments and online platforms;
- subjective assessments – include self-reporting tools for digital skills perception.

Objective assessments are commonly used for the practical assessment of digital competencies in a particular field or area but are often limited to specific software programs that can leave knowledge and skills untested. On the other hand, subjective assessments are less specific and allow users to assess their attitudes regarding digital competency. (Maderick et al., 2015) Although subjective assessment can be inaccurate and have little correlation with the objective measurement results (Fite et al., 2009), they are used because of their practicality and capability to solve the problem of software specificity (Ghomi & Redecker, 2019). It is therefore advisable

to apply both objective and subjective assessment types of measurement tools to enable users to receive complete feedback regarding their skills (Carrera et al., 2011).

Digital competencies also vary between different countries, education levels, and cultural contexts (Manos & Montoya, 2018). Given this challenge, it is highly advisable to design appropriate measurement tools or at least adapt them to the specific conditions and requirements of education systems (Midoro, 2013).

Due to the burning topic, this paper presents research, which was produced on the basis of the DigCompEdu framework and standards set by the ESG. The DigCompEdu framework is a scientifically sound framework describing what it means for educators to be digitally competent and ensures that quality objectives are set and achieved by promoting improvement. It provides a general reference frame to support the development of educator-specific digital competencies in EHEA. DigCompEdu details 22 competencies organised in six areas, where the focus is not on technical skills – the framework aims to detail how digital technologies can be used to enhance and innovate education systems.

On the other hand, the ESG are a set of ten standards and guidelines for internal and external quality assurance in higher education systems. The ESG are not standards for quality, nor do they prescribe how the quality assurance processes are implemented, but they provide guidance, covering the areas which are vital for successful quality provision and learning environments in higher education systems. The key goal of the ESG is to contribute to the common understanding of quality assurance for learning and teaching across borders and among all stakeholders.

The questionnaires were divided into two parts: one for educators and one for students. Both questionnaires have the same structure, where questions are composed based on the six areas from DigCompEdu, and the statements within the questions illustrate ten standards based on ESG. These questions present the majority of the questionnaires and are of closed type, with immense details and examples to further elaborate the questions and associated statements (more on this topic in the following chapter). The reasons for closed questions are in the benefits of simple comparison of answers from both questionnaires and their analysis, the respondents can answer the questionnaires faster and easier which leads to higher probability of cooperation; advanced statistical analysis is enabled. Open-ended questions were used only for one of the questions in the demographic sections – for the residing country of the respondent.

The research focuses on the issue if necessary digital competencies are being provided by the respondent's institution for smooth operations of educational system and students learning. Questions can be answered on a three-point scale: »Yes«, »No«, and »I do not know«. Thus, this research is focused solely on the provision of much required digital competencies for educators and students.

The data collected on the basis of this research will be examined on the basis of statistical analysis for the individual countries of the respondents, where the results will then be compared amongst: a) individual countries; b) the group of respondents (educators or students); and c) the group of respondents and the residing country in order to identify possible differences that could appear, if they even occur. The results will enable insight into the perception of the digital competencies' quality and the identification of the existing gap between perception of educators and students from

different countries. However, the data and results will be examined and interpreted as a part of further and future research.

The following chapter describes the elaboration of the conceptual model, the function of the ISO 9001:2015 standard, the use of the DigCompEdu framework and ESG standards for the preparation and construction of two questionnaires, and the conduction of the research to determine the provision and quality of digital competencies in the international higher education systems.

4. RESULTS

4.1. Elaboration of the conceptual model

To determine the provision and quality of educators' and students' digital competencies in the international higher education systems, a conceptual model was elaborated for digital competencies quality assessment in higher education. The model is primarily based on the principles of quality management by ISO 9001:2015 standard. The standard sets out a quality management system in such a way that a commitment to quality is a strategic decision of the institution, which can help the latter to improve its overall implementation and provide a solid basis for sustainable development initiatives. (ISO, 2015)

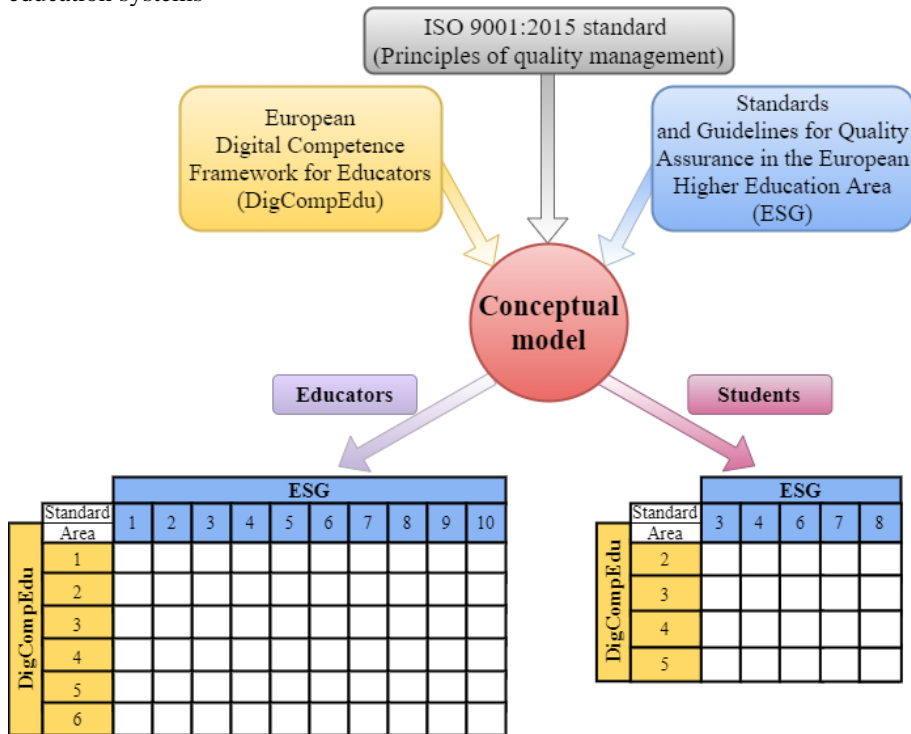
As predetermined, the targeted sector of this research is represented by educators and students of international higher education systems. As mentioned, the standard is based on the principles of quality management, and all the principles were followed in conduction of this research, as they are directly concomitant. Principles and their involvement in research are presented as:

- Engagement of people – the research is conducted with the aim of determining the state of provision and quality of digital competencies in international higher education systems.
- Customer focus – educational institutions must provide the necessary measures and knowledge for educators and students.
- Leadership – educational institutions, educators and students must be willing to participate in the research and make the necessary changes and improvements.
- Process approach – can be introduced as a PDCA cycle, where the degree of digital competencies' quality was assessed at a certain time interval, the corrections and advances were planned, necessary improvements were implemented, then the cycle was repeated.
- Improvement – are included based in the previous principle (improvements).
- Evidence-based decision making – is enabled with the results of the research.
- Relationship management – educational institutions must define and communicate the relations between individual entities and guide them in improving the current state of digital competencies' quality.

The figure below presents the composition and content of the digital competencies' quality assessment conceptual model in higher education. The conceptual model was based on all the above principles and their descriptions. The next step was to intertwine and implement the DigCompEdu framework and ESG

standards (Figure 2), based on which the questionnaire questions were designed. The questions are composed based on the six areas from DigCompEdu, presented vertically on the figure. The statements within the questions illustrate ten standards based on ESG, presented horizontally.

Figure 2. Digital competencies' quality assessment conceptual model in higher education systems



Source: Own source

The research was divided into two parts (ten ESG standards and six DigCompEdu areas), intertwined based on the foundation of principles of quality management from ISO 9001:2015. Consequently, two questionnaires were constructed, for the research' targeted sector: educators and student of international higher education systems.

4.2. Preparation and construction of questionnaires

Since the research is divided into two parts, the above figure also illustrates the composition and content of two questionnaires, one for educators (lower left figure part) and one for students (lower right figure part). The latter has fewer questions and statements presented, due to their relevance. To elaborate:

- Questions are based on areas from DigCompEdu – *Area 1: Professional Engagement* and *Area 6: Facilitating Learners' Digital Competency* refer exclusively to pedagogical competencies, which students cannot obtain.
- Statements are based on standards from ESG – (1) *Policy for quality assurance*, (2) *Design and approval of programs*, (9) *On-going monitoring and periodic review of programs*, and (10) *Cyclical external quality assurance* are standards that take place at the level of management, which is also cared for by the management.

The questions were designed based on the six areas from DigCompEdu framework. Thus, the first question was related to *Area 1: Professional Engagement*, where the considered area was shortly described with the help of corresponding areas' competencies. Afterward, the respondents were asked to assess whether their institution (faculty or university) is fulfilling the guidelines in correlation to considered competency. As an example, the first question that appears in the educators' questionnaire is presented:

»**Professional Engagement** refers to the educators' use of digital technologies in professional interactions with colleagues, students, and other interested parties, for their individual professional development and the organization's collective good. (**MORE 1.1**) Assess whether the **Professional Engagement** competency is following the presented guidelines in your institution (faculty or university):«.

The mentioned »guidelines« are formed based on the ten standards from ESG and the considered competency. Thus, the first question was related to guideline (1) *Policy for quality assurance*, where the considered guideline was shortly described with the help of some practical examples from the higher education sphere. As an example, the first statement that appears in the educators' questionnaire is presented:

»Our institution has a policy for quality assurance for **Professional Engagement** (e.g., use of licensed programs, online quizzes, and assignments, online training) that is made public and is a part of their strategic management. This policy is developed and implemented through appropriate structures and processes involving external stakeholders. (**MORE 2.1**)«.

All the resulting questions, both for educators and students are identical, with the difference that the number of questions for students is lower, as aforementioned. All the resulting statements were similar under the questions but are addressed from different aspects of individual competency. Thus, the respondents were posed with questions (six for educators and four for students) where they had to assess if their institution is providing the digital competency. Questions could be answered on a three-point scale (»Yes«, »No«, »I do not know«). The questioned educators were thus posed with six questions, ten statements each; and the questioned students were posed with four questions, five statements each. Questions about demographic data were posed at the beginning of the questionnaire, such as: age, gender, country of residence or education, the level of highest education attained, current employment status, and (for students) education level and field of study.

Within the question and statement, there is a word MORE written in parentheses and the number next to it. This indicates an additional document that contains a more detailed description of either the corresponding competency or guideline. Two

documents with more detailed descriptions were prepared: areas and competencies according to DigCompEdu, and standards according to ESG.

The research is ongoing since it is intended for educators and students of international higher education and represent a broader, complex research. Specific aspects and details about the questionnaires cannot be disclosed at this point, as it is part of ongoing research and project, where the disclosure of sensitive information could impair the results' significance. The duration of the research was set to approximately one year due to the desire to receive as many responses as possible. The questionnaires were shared with the respondents through the open-source web application for conducting online questionnaires.

As mentioned earlier, there are two types of competency measurement tools. In this research, a subjective measurement was used because the quality of educators' and student's digital competencies was being assessed – the respondents had to assess their attitudes regarding digital competency and the subjective measurement enables the respondents to receive complete feedback regarding their skills.

5. CONCLUSION

As a summary, the concept digital competency is an emerging concept and related to the development of technology as well as the political aims and expectations for citizenship in a knowledge society. It consists of a variety of skills and competencies, and its scope is on several areas: media and communication, technology and computing, literacy, and information science. Digital competency is regarded as a core competency in policy papers; in research, however, it is not yet a standardized concept. (Ilomäki et al., 2011)

Digital competency is essential in today's world, in which technological innovations are transforming the labour market and the skills employers are looking for. It is therefore vital that teaching practices and programs be adapted and include digital competency in order to prepare future workers for the challenges of tomorrow. Digital competency is closely tied to professional development for all 21st-century workers: everyone needs to be able to use available digital resources – such as communities of practice and online training or tutorials – in order to keep their professional skills up to date. (Bawden, 2001)

The objective of this research was to design conceptual model development, from which questionnaires were derived for the comprehensive assessment of provision and quality of educators' and students' digital competencies in the international higher education systems. The aim of the ongoing research is to determine the state of knowledge and to assess the quality of digital competencies of educators and students in higher education systems, with the degree of provision of these competencies by the respondents' institutions. The results of this international research will enable the analysis and comparison of both aspects of the included groups of respondents, an insight into the perception of the digital competencies quality and the identification of the existing gap between perception in higher education. Based on the final findings, suggestions can be made to improve the quality of digital competencies of educators and students in all fields, especially in the field of supply chains and logistics, where

the acquisition of digital competencies is a prerequisite and considered as an important factor in the technology environment that Logistics 4.0 is situated (Abdul Rahman et al., 2019). The digital competent workforce requires process of academic literacy, through which information and ICT literacies are developed (Guzman-Simon et al., 2017). In the education sphere, digital competency, digital literacy, digital technology, and standards of educational programs are interconnected (Javorský & Horváth, 2014), where the recipient is (virtually) the workforce of Industry 4.0 and Logistics 4.0. Furthermore, organizations constantly seek innovative practices, where the latter are dependent on innovative process and digital competencies degree of each individual workforce (Abdul Rahman et al., 2019).

Individual suggestions and solutions depend on the results and naturally vary and are limited to the requirements and needs of individual education institutions, educators, and their customers (students). The solutions also depend on the immediate environments' needs in which the education institution is located, and on the facilitation and encouragement (be it financial or general investments) they can receive from the immediate environment.

Many different models and frameworks have been presented in the past that specify, analyse, or interpret digital competencies in education systems: a) UNESCO ICT Competency Framework for Teachers, where the target groups are teachers in primary and secondary schools (UNESCO, 2011); b) ISTE Standards for Educators: A Guide for Teachers and Other Professionals represent an informative map for educators in different spheres of action (Crompton, 2017); c) beforementioned DigCompEdu framework, which defines key competency areas in a differentiated way, through competencies at different performance levels (Redecker, 2017); d) DigComp 2.1. Framework, which describes digital competencies as key competency for lifelong learning (Carretero et al., 2017); and many other national and international frameworks or models (Godaert et al., 2022).

In the future, this conceptual model could be applied to and implemented at all education levels (such as primary and secondary education), as it also includes parental involvement due to the integration of DigCompEdu framework, which is designed to be used at all stages of education. However, the focus of this research is on the higher education systems, which is why the (importance of) parental involvement was not emphasized, due to all students being adult citizens.

It is crucial to be aware, that the importance of the quality of acquired digital competencies and the quality of provided education is significant in order to acquire professional personnel in every field and sphere, even in supply chain management and logistics.

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