The impact of digital transformation on the dynamics of the skills ecosystem in the education sector

1 INTRODUCTION

1.1 RATIONALE AND PROBLEM-STATEMENT

Digital Transformation (DT) is a prime topic in different industries but the concept lacks formal categorization and clear boundaries in the literature (Reis, Amorim, Melão, & Matos, 2018). DT *'is not a simple phenomenon but a complex range of continually unfolding, interrelated, and often unpredictable developments'* (OECD, 2019e, p. 29), a process through which organisations embed new, ubiquitous digital technologies in order to sustain their competitive advantage by transforming multiple aspects of their operation (e.g. business model, customer experience, administration) and having an impact on people (skills, organizational culture) and networks, including the entire value system (Ismail, Khater, & Zaki, 2017, p. 6). Skog, Wimelius and Sandberg (2018, p. 432) propose a similar definition for digital disruption as *'the rapidly unfolding processes through which digital innovation comes to fundamentally alter historically sustainable logics for value creation and capture by unbundling and recombining linkages among resources or generating new ones'*.

The problem can be approached from a (digital) innovation perspective (Hinings, Gegenhuber, & Greenwood, 2018) following the guidelines of the OECD's Oslo Manual considering innovation as *'a new or improved product or process (or combination thereof) that differs significantly from the unit's previous products or processes and that has been made available to potential users (product) or brought into use by the unit (process).'* (OECD/Eurostat, 2018, p. 20), distinguishing between product and process innovation and a subject- and object-based approach when measuring the phenomenon. The innovation perspective considers digital disruption from the Schumpeterian notion of creative destruction, putting the dynamics of disruptive innovation (Christensen, 1997) into our focus.

DT is identified as one of the key megatrends besides globalization, demographic trends and migration having considerable implications for skills utilization (OECD, 2019d). Skills utilization focuses on the effective application of skills in the workplace considering the complex interplay of learning providers and employers and a range of human resource management practices, matching the supply of and demand for skills (Scottish Government Social Research, 2008). As DT involves multiple and diverse areas (societies, industries, organizations, individuals etc.) (Ismail et al., 2017), we are applying a systems-thinking approach, considering a specific skill ecosystem (the teaching profession) – *'a self-sustaining network of workforce skills and knowledge in an industry or a region'* (Windsor, 2008, p. 5) –, to investigate the impact and challenges of DT.

The education sector is particularly interesting from this regard as it is assaulted on many fronts: Schools has to deal with 'digital native' incoming students (whose social environment are affected by DT) and 'digital native' new entrants from initial teacher education. On the other side, there is a constant socio-economical pressure from the labour market for schools to prepare children to be successful in a digital world requiring not only specific or vocation-related skills but new, transversal, general skills as well. These pressures can be felt in initial teacher education and continuous professional development courses, as well as schools, are expecting teachers to be able to cope with these challenges. As these changes unfolding rapidly, numerous new entrants to the wider education sector emerged providing solutions to these needs (e.g. summer schools providing programming skills to students, Massive Open Online Courses (MOOC) that are frequented by teachers, alternative pedagogical solutions that are focusing on the development of entrepreneurial competencies, online professional learning communities for teachers on a specific topic etc.). Taking this complexity into consideration it clear that in our investigation we need to cover besides initial teacher education and continuous professional development the area of non-formal and informal learning, especially workplace learning as well to have an overview of the skill ecosystem of the teaching profession and its socio-economic context.

Therefore this research project will contribute to the broad research question: **What characterizes the dynamics of skills formation and skills utilization in the education sector considering the challenges posed by DT (RQ1)?** In this regard, the first, explorative phase (P1) of the project will focus on the analysis of the system-environment of the education sector utilizing a mixed-method design. After having a broad understanding of the main issues, the research will set out in an interpretative approach (P2) to answer a narrower research question: **How does institutions and individuals adapt to the changing world of work and learning in the context of the skills ecosystem of the teaching profession (RQ2)?** Utilizing a quantitative approach, the research project will focus on teachers/schools and teacher educators/universities to explore their perceptions of DT, their digital readiness and other individual and organizational characteristics. Switching to an explorative approach again (P3), the research will focus on specific cases that were identified in the previous phase in a qualitative design. Finally, the research project will be closed in an interpretative approach (P4), summarizing the results of the previous phases in a multiple embedded case study design. The research process with the specific phases, approaches and research questions is illustrated in Figure 1 and will be detailed in the next chapter.
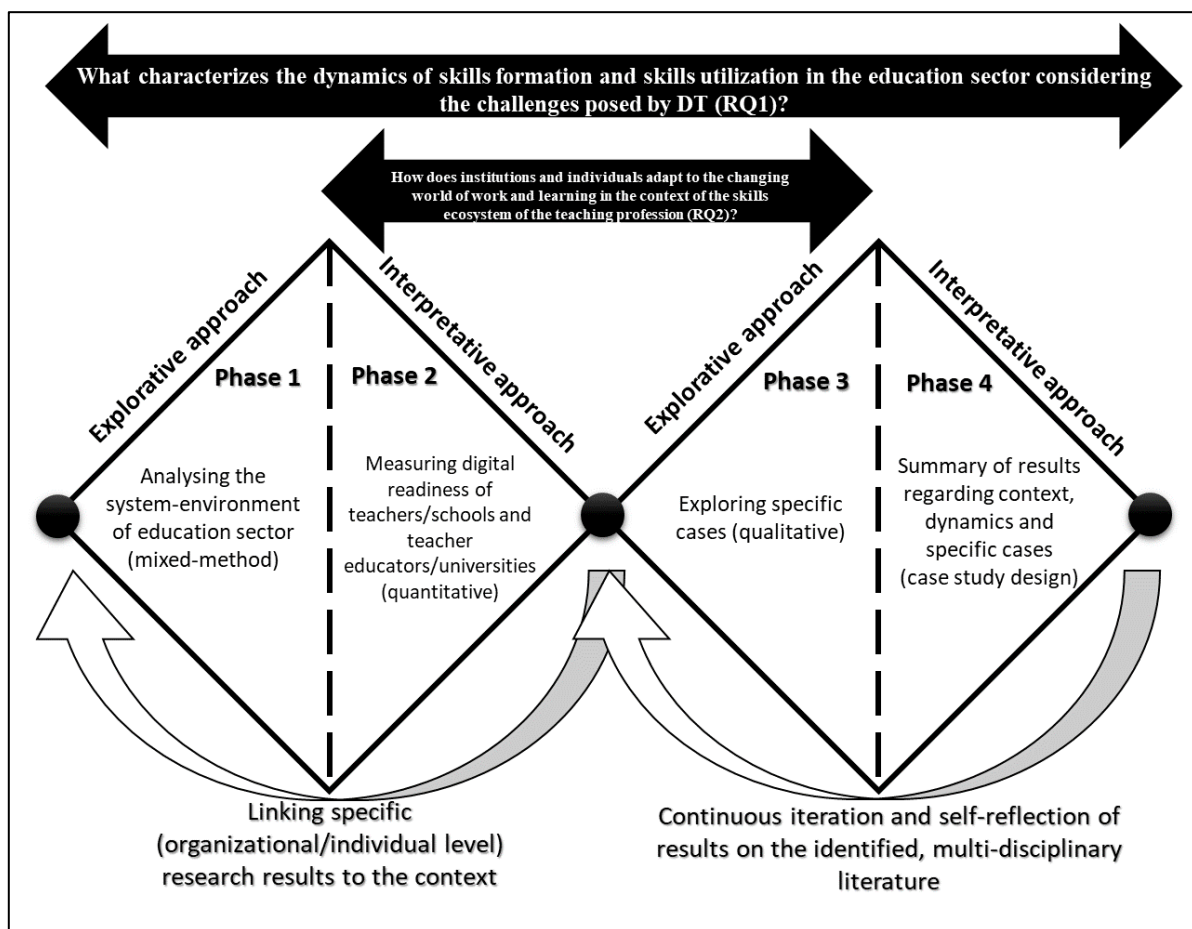

Figure 1. The research framework.

1.2 INDIVIDUAL ANTECEDENTS OF THE PROJECT

The proposed project is not without its antecedents. The principal investigator (PI) was involved in "The Emergence and Diffusion of Local Innovations and their Systemic Impact in the Education Sector" (**Innova**) research project (OTKA 115857) where they explored the characteristics of service-based innovations, public sector innovation and especially hidden, employee-driven innovation in the context of schools and higher education institutions as well. The project provides a sound theoretical background and a rich database for secondary analysis

that can be utilized by this project as well. A natural continuation of the Innova project was for the involved researchers to contribute to the realization of the Hungarian Digital Education Strategy by drafting the educational technology pillar of the Hungarian Educational Sector Innovation Strategy (NOIR) as a separate policy document (**DigiNOIR**). The DigiNOIR explored various (inter)national case studies on how to support the implementation of digital innovations in the educational sector which could be used as a starting point for the proposed research project.

As a main focus of the proposed research project is the organizational and individual level adaptation of stakeholders, the PI dealt with these issues from the perspective of organizational learning and learning organizations in both school and university settings. During the Mentorháló 2.0 project the operation of schools as learning organizations were explored from an organizational development perspective, while the same issue was covered in the PI's doctoral dissertation focusing on higher education institutions. These projects provide databases for secondary analysis as well, and questionnaires developed, translated and validated during these projects are also an important input for the proposed research project as well (e.g. the Hungarian-version of the Dimensions of the Learning Organization Questionnaire (DLOQ) developed by Marsick and Watkins (2003)).

Cooperating with the ICT Research Group of the Károli Gáspár University of the Reformed Church in Hungary the PI was involved in a research project to explore the digital competences of teacher educators in Hungary, adapting the Digital Competence Framework for Educators (DigCompEdu) (Redecker & Punie, 2017) into Hungarian higher education which will also serve as a basis for the proposed research project.

2 PURPOSE

The purpose of this project is to explore how the education sector responds to the challenges posed by Digital Transformation. When considering the education sector our focus is on the skills ecosystem of the teaching profession, thus dealing with schools as workplaces and teachers as employees and learners (considering formal learning like continuous professional development and non-formal and informal learning like workplace learning) and higher education institutions as learning providers for the teaching profession and as an entity also affected by DT. In this project, we propose a broad and a narrow research question that will be detailed in the following sub-chapters:

- RQ1: What characterizes the dynamics of skills formation and skills utilization in the education sector considering the challenges posed by DT?
- RQ2: How does institutions and individuals adapt to the changing world of work and learning in the context of the skills ecosystem of the teaching profession?

2.1 WHAT CHARACTERIZES THE DYNAMICS OF SKILLS FORMATION AND SKILLS UTILIZATION IN THE EDUCATION SECTOR CONSIDERING THE CHALLENGES POSED BY DT?

2.1.1 Changing world of work

The fast and radical changes from DT can be felt in all aspects of human society (Bounfour, 2016; Reis et al., 2018) as the ubiquitous penetration of digital technologies not only transforms professions and education but also affects everyday life (Dessewffy, Gurály, & Mezei, 2018; North, Maier, & Haas, 2018). DT brings about the automatization of jobs and routine tasks in which process jobs and profession will disappear, others will fundamentally transform and new ones will appear. In addition, governments are going digital as well, which would require citizens to develop their digital skills to be able to access basic public services (OECD, 2019d). Parallel to this, customers of different organizations also need to

acquire digital competences to be able to cooperate with digital organizations (Reis et al., 2018). Effects of DT can be viewed from an equity-perspective, considering the increased divergence between workers, organizations and regions (OECD, 2019c) which brings about new topics to discuss: access, trust, openness, privacy, inequalities, cross-national data flows etc. (OECD, 2019a). It is evident that the scope of DT is wide, therefore we will focus on the changing world of work, education and higher education.

DT has a definitive impact on work processes and work environments (Reis et al., 2018) through flexibilization and polarization of work which requires new skills from employees, e.g. collaboration with cyber-systems, ability to adapt to working independent of location and time, work in diverse working groups etc. (Mittelmann, 2018). New and transforming jobs will require a polarization of work tasks: human-only activities, machine-only activities and hybrid activities where humans can complement machines (e.g. train, explain, sustain) or where machines boost human capabilities (e.g. amplify, interact, embody) as proposed by the framework of Daugherty and Wilson (2018). In accordance with these changes, a variety of statistics is available to support the development perspectives proposed by these changes: the Digital Economy and Society Statistics projects a large increase in the time that employees will spend on acquiring new skills due to the effects of digital technologies while repetitive tasks will decrease. On the other hand, approximately 80% of workers in different European countries now use e-mail on a daily basis, while around 30% of them received their tasks via apps (OECD, 2019b).

Focusing on Hungary, according to the Digital Economy and Society Index (DESI), it only provides a moderate enabling environment for DT as there is a lack of progress regarding digital infrastructure and e-leadership. Hungary performs relatively well in terms of digital skills (mis)match at work, having only approximately 10-10% of workers who have the skills to cope with more demanding tasks and workers who need further training to cope with their current tasks. It also indicates the importance of the topic that the number of internet users aged 16-24 who can programme rose from 5% to 10% in Hungary from 2015 to 2017. (Probst et al., 2018). Regarding skills formation, Hungary scores at the bottom 25% for providing the necessary skills for the next generation and effective ICT integration in schools (OECD, 2019c). Although it can be stated that the different policy initiatives suggest that Hungary realized that DT is not a matter of choice (e.g. Digital Education Strategy, Digital Export Development Strategy, Digital Start-up Strategy etc.) (Egner, Koch, Steindler, Newrly, & Levačić, 2017).

2.1.2   Changing world of education

These changes also have a profound effect on education as a demand-side regarding the demand for skills. Having a closer look at the education sector we can identify numerous changes and opportunities (e.g. 3D printing, robotics, artificial intelligence, mobile learning, e-learning etc.) regarding digital technologies. These challenges if left unchecked could weaken the legitimacy of schooling (Radó, 2020). Education can be considered as an important cross-cutting component which influences the ability of individuals to participate in a digital society (OECD, 2019a), therefore investing in skills is imperative if economies, societies, organizations and individuals want to make the most of DT (OECD, 2019c). Education can be considered as a medium-low sector regarding digital-intensity (OECD, 2019b) and at the bottom of sectors having clear digital strategies (Kane, Palmer, Phillips, Kiron, & Buckley, 2015). Increased attention from educational policy is evident from the gradual improvement of the focus in different educational policy documents. Before 2002 the main focus was on infrastructure, between 2002 and 2011 policies focused more on educational innovations and after 2011 there is a clear trend that focusing on building teaching capacity (combined with infrastructure development) (Conrads et al., 2017). Parallel to this development, large-scale studies on the implementation of digital technologies in education also strengthens the need for focusing on teaching capacities. While there is significant progress in ICT integration, improvements in infrastructure do not necessarily translate into better student outcomes as the integration of these technologies into the everyday routine of schools is not evident (Conrads et al., 2017).

As the integration of digital technologies in education disrupts existing routines it is expected that the process will leave teachers drained and tired, as they need to relearn on-task behaviour (e.g. students being engaged looks and sounds different) and redefine their role in the classroom which could lead to feelings of fear and insecurity (Blundell, Lee, & Nykvist, 2016). From these aspects the importance of

the role of pedagogy in implementing digital technologies in education is evident. This claim is supported by PISA results as it is shown that *'technology can amplify great teaching but great technology cannot replace poor teaching'* (OECD, 2015, p. 4). Analysing key ingredients required for schools to embed technological innovations teachers' confidence in using these technologies in a pedagogically meaningful way, the willingness to innovate through these technologies and strong, supportive school leaders are essential (Kampylis, Punie, & Devine, 2015; Schleicher, 2015).

Teachers would need professional development opportunities that would highlight technology use from a pedagogical perspective to embed digital technologies in their teaching practice. Several research emphasis that teachers prefer informal methods of ICT training and those who are participating in online learning communities are more likely to apply digital technologies (Arjomand et al., 2012; European Commission/EACEA/Eurydice, 2019). These findings open the door for non-formal and informal learning, especially workplace learning. Considering the teaching profession, an emerging trend would be teachers participation in MOOCs. Teachers can be considered important target group for these providers also in courses that are not specially designed for them which in return would have an indirect impact on the competences of the teaching labour force (Castaño Muñoz, Punie, & Inamorato dos Santos, 2016). The emergence of MOOCs provides a possible disruption for traditional learning providers for teachers, e.g. higher education institutions.

2.1.3   Changing world of higher education

The Higher education sector itself is also undergoing changes attributed to DT as these institutions are looking for ways to better serve their students and reach new target groups. However, these changes are greatly influenced by government policies and institutional strategies (Orr, Weller, & Farrow, 2019; Xiao, 2019). DT is a strategic issue in higher education systems. For example, the HEInnovate[1] self-diagnostic tool considers digital technologies as key enablers of innovation and entrepreneurship, therefore fostering a digital culture serves the missions of these institutions.

Regarding the missions of higher education, Stiegler insists on a tighter collaboration between universities and the political-civil society. Stiegler, as a leading philosopher of technics, proposes that technology transforms learning ad teaching for students and for academics as well because technical systems are able to substitute mnemotechnical systems (e.g. students' memory is automated through Google-searches) which undermines reasoning power and critical thinking, deteriorating attentional processes (Mui & Murphy, 2020). This tension would require a new approach to teaching and learning, one which would move from a content-centred approach to a learning-centred approach.

Besides strategic aspects, digital technologies are altering how higher education is being delivered as most universities are considering opportunities for providing online learning and how these approaches changes teaching and learning in the institutions (Jensen, Price, & Roxå, 2019). As higher education institutions are adapting to these changes, faculty members need support in this regard. For example, many universities experimented with the implementation of Virtual Learning Environments but they are more focused on administrative tasks therefore successfully replicating behaviourist, content-centred models of learning (Blin & Munro, 2008). These findings again emphasize the role of conscious pedagogical decisions regarding the adaptation of digital technologies in teaching and learning. From a learning theory point of view, constructivist and connectivist learning approaches are more aligned to the envisioned needs of future learning (network-oriented, diverse, focusing on meta-cognitive competency and algorithmic thinking, semantically enhanced, individualized and adaptive) (Henning, 2018). As it was the case in secondary education, using digital technologies are not automatically translated into student outcomes in higher education either. Several studies highlighted a higher frequency of more teacher-centred use of technology in higher education (Bond, Marín, Dolch, Bedenlier, & Zawacki-Richter, 2018).

Higher education institutions are starting to adopt blended learning approaches by offering MOOCs, but their recognition in terms of ECTS are rare. Despite the growing tendency in MOOC offerings, one of the main reasons for universities not engaging in Open Education practices is the lack of competences of academics (Castaño Muñoz, Punie, Inamorato dos Santos, Mitic, & Morais, 2016). Besides Open

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[1] https://heinnovate.eu/en

Education tendencies, Open Science is also a rising trend in higher education also affecting the everyday work of academics. Open Science is a disruptive process itself as it has a profound effect on how researchers design, perform, capture and assess research (Mancini, Lardo, & De Angelis, 2020; OECD, 2020).

In the context of the changing world of work, education and higher education we propose to explore the dynamics identified in the teaching profession. In order to deepen our understanding of the phenomena, we will focus on how institutions and individuals adapt to these changes.

2.2 HOW DOES INSTITUTIONS AND INDIVIDUALS ADAPT TO THE CHANGING WORLD OF WORK AND LEARNING IN THE CONTEXT OF THE SKILLS ECOSYSTEM OF THE TEACHING PROFESSION?

As it emerged from reviewing the context of DT, it is not really about technology, but rather the ability of organizations to change and adapt. Organizations in the digital age must operate in a constantly evolving, fluid environment and shift their structures from a traditional functional model to more interconnected and flexible solutions. A digital-fit operating would require cultural openness, dynamic and flexible structures and mutual trust between members (Sommerfeld & Moise-Cheung, 2016). Illustrating the necessary risk-taking attitude and flexibility that would be required, organisations must be willing to 'cannibalize' their existing business and disrupt themselves (e.g. Amazon sacrificing their physical book sales when they introduced e-book solutions) (WEF, 2016).

This kind of operation could be best described through ambidexterity-theory which means that ambidextrous organizations are capable of managing contradictory processes at the same time like exploitation and exploration (Brix, 2019; Levitt & March, 2005; March, 1991). This approach can also be found in the literature regarding learning organisations. These requirements are not necessarily aligned with the nature of higher education institutions (HEIs) as they are very old establishments but their longevity poses the question whether or not they are having some inbuilt capacity to change and be resilient in a volatile environment? (Pinheiro & Young, 2017).

According to neo-institutionalism, we can consider HEIs as unique organisations that strive for legitimacy which is determined by their embeddedness in the socio-economic context (Hüther & Krücken, 2016). The three pressures (DiMaggio & Powell, 1983) to describe organisational behaviour are very useful terms of reference in higher education regarding DT as well: coercive pressures (e.g. the introduction of the Bologna-system), mimetic pressures (e.g. international rankings) and normative pressures (e.g. accreditation processes) are all identifiable. Reacting to changes and pressures, HEIs response is not often adaptive, merely a pretence action in order to demonstrate conformity (e.g. setting up a quality assurance office as it shows the image of a responsible HEI, but in reality, quality assurance processes are rarely implemented and the HEI rarely acts on the results of these processes) (Berghaeuser & Hoelscher, 2019).

The previously mentioned changes and requirements can be interpreted through the model of the learning organization (LO). Senge (2000) suggested that HEIs should change and become LOs in order to adapt to the needs of the knowledge economy. Kools and Stoll (2016, p. 10) adopted the concept of learning organisation in educational context, defining schools as learning organisations that *'has the capacity to change and adapt routinely to new environments and circumstances as its members, individually and together, learn their way to realising their vision'.* For HEIs as learning organisations, Örtenblad and Koris (2014) provide a literature review stating that the research field is neither cumulative nor integrative. Örtenblad (2015) proposes to consider context-adapted model for learning organizations in different settings effectively modifying the general model (learning at work, organizational learning, climate for learning and learning structure) in higher education setting to a less organic and flexible solution replacing learning structure with learning bureaucracy and the concept of the listening organization (that is able to hear the voices of employees and students and act upon those). Considering these aspects a versatile measurement tool would be the Dimensions of the Learning Organization Questionnaire developed by Marsick and Watkins (2003). The tool considers the level of the individual, the group and the organisation as well, and consists of 7 dimensions: continuous

opportunities for learning (CL), promoting inquiry and dialogue (ID), encouraging collaboration and team learning (CTL), empowering people toward a collective vision (EP), establishing systems to capture and share learning (SCL), connecting the organisation to its environment (CO) and providing strategic leadership for learning (SLL). The DLOQ had been tested in various industries and countries and its reliability and validity were proved in educational and higher education settings in Hungary as well.

Considering the challenges of DT and the unique characteristics of the education sector (especially higher education institutions) the proposed research project would like to explore the hypothesis that higher levels of learning organizational behaviour correspond to higher levels of digital readiness. More specifically we propose a moderated mediation model where we suggest that the perception of the disruptive effects of digital transformation directly relates to digital readiness but is also mediated by learning organizational characteristic and this mediation is moderated by cultural factors (e.g. organizational culture, disciplinary culture). The schematic of the model can be seen in Figure 2.
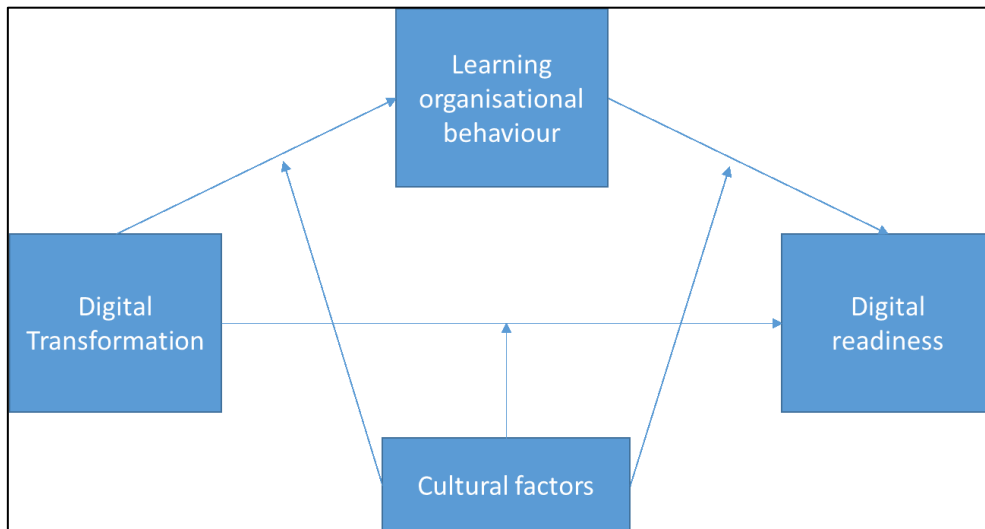

Figure 2. The proposed moderated mediation model.

In the next section, we will detail how certain elements in this model will be measured and how it is related to the overall aim and research questions of the proposed project.

3   RESEARCH DESIGN

The proposed research project consists of 4 distinct phases that iterate between explorative and interpretative approaches. Overall, the main output of the research would be a multiple embedded case study where the different elements will be explored through different phases of the project. To summarize the main research questions, focus, design and units of analysis regarding the project the following figure was created (Figure 3).
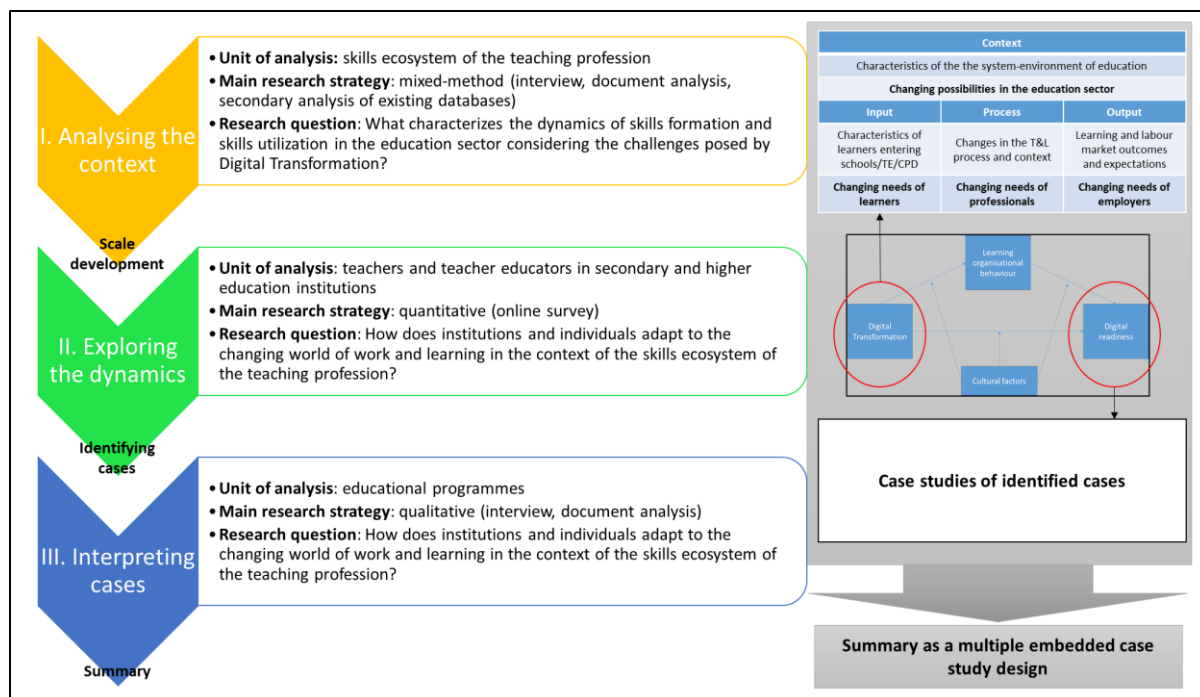
Figure 3. Main aspects of the research project.

3.1 PRELIMINARY PHASE (M1-2)

As a preparatory phase for the research, an initial consolidation of the research plan has to be conducted and also, the necessary research ethics permission must be obtained. In this phase, we will finalize our measurement tools and prepare the logistics for data gathering for the following phases. Besides these tasks, consolidation and expansion of the literature review regarding the topic will also be a main task in this period.

3.2 1ST PHASE: ANALYSING THE CONTEXT (M3-12)

The first phase aim is to analyse the context of the skills ecosystem of the teaching profession in relation to DT. A mixed-method design will be applied here utilizing existing databases (secondary-analysis of Innova database regarding digital innovations), exploring relevant labour market and socio-economic statistical data (KSH, Eurostat etc.) and conducting document analysis (on relevant strategic and policy documents, institutional strategies) and semi-structured interview with stakeholders (e.g. experienced teachers, novice teachers, student-teachers, teacher educators, representatives of professional organizations and the world of work etc.).

During the project, we propose to conduct a workshop (as a focus group, M7) with relevant stakeholders using innovative research methods (like Customer Journey Mapping and creating Personas) to uncover the dynamics of the context.

An important output of this phase will be a scale-development for the second phase regarding the possible dimensions on how individuals could perceive the impacts and challenges of DT regarding their work and organization.

Summarizing the results of the first phase an English language publication is planned in a Q1 journal and the preliminary results will also be presented in international educational conferences (e.g. ATEE, ECER, EARLI, EAIR).

3.3   2ND PHASE: EXPLORING THE DYNAMICS (M13-M18)

The second phase will be designed as quantitative research, creating an online questionnaire with the following modules:

- General, demographic questions
- Self-developed scale for the perception of DT (results of the 1st phase)
- Dimensions of the Learning Organization Questionnaire (DLOQ) (Marsick & Watkins, 2003)
- Digital Competence Framework for Educators (DigCompEdu) (Redecker & Punie, 2017)
- Digitally Competent Educational Organisations (DigCompOrg) (Kampylis et al., 2015)
- Organizational culture derived from the Competing Values Framework (Cameron & Quinn, 2011)

The online questionnaire (via Qualtrics) will be administered to a representative sample of schools in Hungary and for higher education institutions as well involved in teacher education. The questionnaire is focusing on the organization and on the individual as well. The school questionnaires could serve as contextual input for the higher education part.

The main aim of this phase is to test the proposed moderated mediation model in educational and higher education setting as well.

An important output of the second phase will be the identification of special cases that would serve the bases is case studies in the third phase.

Summarizing the results of the second phase an English language publication is planned in a Q1 journal and the preliminary results will also be presented in (inter)national educational conferences (e.g. ATEE, ECER, EARLI, EAIR and ONK).

3.4   3RD PHASE: INTERPRETING CASES (M19-28)

The third phase will focus on discovering specific cases (as case studies) identified in the previous phase. A qualitative approach will be used to explore the adaptation strategies and dynamics of different educational programmes via semi-structured interviews (with academics and leaders responsible for educational programmes) and document analysis (e.g. educational documents, students evaluation of teaching, labour market outcomes of education etc.).

Summarizing the results of the third phase, preliminary results will be presented in (inter)national educational conferences (e.g. ATEE, ECER, EARLI, EAIR and ONK).

3.5   4TH PHASE: SYNTHESIS OF THE RESULTS (M29-35)

The final phase of the research project is the synthesis of the results. In this process we treat the whole research project as a multiple embedded case study design where we gathered information regarding the context, we have a broad overview of the dynamics that we are focusing on and we have several case studies illustrating our points from which conclusions can be drawn.

A summary book will be compiled based on the results and the results will be disseminated in international educational conferences. Closing the research project we try to identify possible opportunities to further explore questions and dilemmas uncovered by the research.

4   EXPECTED RESULTS

The project envisions several theoretical and practical results that could further our understanding of this complex and dynamic topic. The following outputs are suggested:

- 3 conference presentation in international educational conferences
- 2 conference presentation in the national educational conference (ONK)

- 2 English-language articles in Q1 journals
- A summary book of the results
- Scale development and validation regarding the perception of DT
- Validating the proposed moderated mediation model
- Case studies on specific cases related to the research topic

The results of the project can be used in higher education in different educational programmes and courses as it could serve as a basis for course-development. Also, the results could have practical implication for schools and universities on how to develop their digital readiness in relation to learning organizational characteristics.

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