

# Interdisciplinary Trends of Digital Education in the COVID-19 Paradigm: Global Event Horizon

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## ABSTRACT

Transformative shifts in the knowledge economy of the XXI century, Industry 4.0 and Web 4.0 development and elaboration of networked society, emergency digitization of all social communicative spheres due to pandemic measures have imposed pressing revisions onto interdisciplinary and cross-sectorial job market demands of university level education, curriculum design and learning outcomes. The COVID-19 pandemic induced amplified digitalization measures in the higher education sphere, informed by the need to take quick comprehensive action in order to achieve the overarching result to transform educational and communicative scenarios into interdisciplinary digital, remote, and hybrid formats.

The consequent functional tasks to meet this challenge in the educational sphere worldwide are estimated as 1) to adapt the existent educational scenarios to digital, remote and hybrid formats; 2) to upgrade e-competence and digital literacy of all stakeholders of the educational process and industry; 3) to activate complex interdisciplinary skillsets, otherwise latent or underutilized in the professional interaction; 4) to introduce functional technical solutions for facilitation of formal and informal educational workflow and communication.

The findings of the comprehensive framework research project 'TRANSITION' disclose a wide scope of generalized theoretical and applied issues, permeating the social and educational context worldwide: global event horizon and paradigm shifts in the interdisciplinary trends of digital education in the Covid-19 timeframe and beyond; transformative changes and avenues of development of the network society and education as an interdisciplinary socio-cultural institution and industry in the digital age; global experiences, universal/generic challenges, technical advances and specific national gains in quality assurance of online and hybrid learning in the Covid-19 paradigm.

**Keywords:** Interdisciplinarity, Trends, Universality, Interoperability, Digital Education, Digital literacy, digital communication

## 1. INTRODUCTION

Transformative shifts in the knowledge economy of the XXI century, Industry 4.0 [7] (AI-powered technologies and production) and corresponding stages of Web technology development (from Web 2.0 – social media interaction, to Web 3.0 – Internet of things [6], to Web 4.0 – machine learning powered interaction, to Web 5.0 – intelligent personal agents [34]), development and elaboration of networked society and new media ecology [10], emergency digitization due to quarantine measures has imposed pressing revisions onto interdisciplinary and cross-sectorial job market demands of Liberal Arts university graduates' skillsets, upon entering the workforce. This, in turn, stipulates reevaluation of the interdisciplinary trends, permeating the development of digital education.

The theoretical problems of holistic, multidimensional modeling and prognostication of reality and its separate spheres development are informed by the dialectics of deterministic and fuzzy interaction of objects, signs of their reception and interpretation (in the field of individual and collective consciousness), embodiment, consolidation and retransmission of the results of interaction of these systems of features in an event horizon that is qualified as a 'singularity' [30] – the state-of-the-art of technology development that facilitates multiple unpredictable outcomes.

The seminal overview of meta-trends, changing the world by D. Snyder [39] identified *universal connectivity* as a transcendent premise of technological trends development. Through the span of the following predictive Global Trends frameworks [19; 20; 21], provide the hindsight in the lens through which technological growth and advances features in the global development trendsetting (Fig. 1). The paradigm of these aspects evolving from *technological breakthroughs* (GT 2025) to *accessibility of technology* (GT 2030) to *transformative technology* (GT 2040), accordingly.

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Figure 1: Retro-futuristic model of Global Trends

Interdisciplinarity and ubiquity (universality) of digital education in the 21<sup>st</sup> century, therefore, is informed, in crucial ways, by intellectualization and amplified information capacity of human social activities in general. Thus, the intellectualization of modern global culture determines a qualitatively new approach to understanding the processes of parallel development of human activities and cognitive (intellectual) experiences. That is the origin and methodological premise of the concept of "noosphere". Noosphere is the unity of "nature" and culture, especially from the moment when the intellectual culture reaches (by force of influence on the biosphere and geosphere) the power of a peculiar "geological force" [45].

The noosphere is defined as the current stage of development of the biosphere, associated with the emergence of humanity in it [18; 45], and is interpreted as part of the planet and planet ambient with traces of human activity.

The integral real component of the Noosphere is identified as the Technosphere - a set of artificial objects (technologies) created by the humankind, and natural objects changed as a result of technological activity of humankind [28]. In turn, Computer Being (computer reality, cyberspace) is a complex, multidimensional sphere of synthesis of reality, human experience and activity mediated by the latest digital and information technologies; technogenic reality, a component of the technosphere of existence [22; 30].

Therefore, it is stipulated in **the study design**, that the cognitive (Noosphere) premise of digital education is informed by the following **dimensions**: 1) the *interdisciplinary dimension*, disclosed through the mutual transformative potential of information and modern technology, as "knowledge in a scientific sense can lag only slightly behind this world transformation because knowledge becomes transformed in the process" [22]; 2) the *universal dimension*, disclosed through the pervasive, ubiquitous nature of humanitarian and linguistic (especially multi-cultural) knowledge applicability, as "science and technology revolutionize our lives, but memory, tradition and myth frame our response" [18]; 3) the *interoperable dimension*, informed by the underlying anthropocentrism of linguistic knowledge and skills, providing the interface for development and application of skills and activities across different domains, as "a human is a nexus of existential horizons" [27].

The result of a fundamental Technosphere shift in the sphere of Foreign Languages Education, induced by the COVID-19 pandemic development and enhanced by continuous iterative digitalization measures, was the need to take quick comprehensive action [31; 40] in order to achieve such desirable results: a) to adapt the existent educational scenarios to digital, remote and hybrid formats; b) to upgrade e-competence and digital literacy of all stakeholders of the educational process and industry; c) to activate complex interdisciplinary skillsets, otherwise latent or underutilized in the professional interaction; d) to introduce functional technical solutions for facilitation of formal and informal educational workflow and communication.

The study **objective** is to disclose a wide scope of generalized theoretical and applied issues and models, permeating the social communication and digital education context worldwide through the span of digitized educational activities in the time-frame of COVID-19 quarantine measures of 2020-2021.

The inquiry allows to diagnose in-depth the dimensions of interdisciplinarity, universality and transdisciplinarity, informed by the interoperability of global sustainable development goals [33; 29] soft skills [2; 10; 11; 14; 38; 47; 48] and digital communication skills [3; 12; 15; 16; 32; 44] for efficient and successful digital education across contrasting timeframes and stages of quarantine measures.

The study of groundwork principles of universality and interdisciplinarity of digital education in Liberal Arts and linguistic education in particular is a parcel of the framework project *TRANSITION: Transformation, Network, Society and Education* [31; 32]. The inquiry main findings disclose: global event horizon and paradigm shifts in the interdisciplinary trends of digital education in the Covid-19 timeframe and beyond; transformative changes and avenues of development of the network society and education as an interdisciplinary socio-cultural institution and industry in the digital age; global experiences, universal/generic challenges, technical advances and specific national gains in quality assurance of online and hybrid learning in the Covid-19 paradigm.

## 2. FINDINGS

### Interdisciplinarity of Digital Education in A Conceptual Grid

The following grid of groundwork concepts is applied to profile digital education in such dimensions:

- INTERDISCIPLINARITY
- TREND
- UNIVERSALITY
- DIGITAL EDUCATION
- INTEROPERABILITY

The meaning of INTERDISCIPLINARITY is synthesized for the purpose of this study as an agglomeration of two or more fields of knowledge into one scope/goal of study, inquiry or activity [8; 17; 23; 26].

UNIVERSALITY is generally understood as a property of object or state to **“exist everywhere (ubiquity), or involve everyone”** [9]. In the context of this study we suggest to attribute the property of universality/ubiquity to social activity, vocational activity and professional performance.

The concept of INTEROPERABILITY is disclosed across different approaches [25; 37] as a characteristic of an object, product or system, that allows its interface to be comprehensible, to work with other objects, products or systems.

As applied to digital education in Liberal Arts, the concept of interoperability represents the property of functional, dynamic interconnectivity between the source and target domains of professional content, professional theory content, related areas of scientific and universal knowledge, and domains of professional and social application and communication, informed and facilitated by the *digital transformation framework* [4]. Degrees of interoperability help define the measure of interdisciplinarity

and universality of activities, skills and competence applications of Liberal Arts stakeholders.

The generic concept of multiple disciplinarity [1; 42] comprises, in its turn, of a framework of interconnected concepts:

- Multi-disciplinarity;
- Interdisciplinarity;
- Transdisciplinarity.

Multi-disciplinarity, thus, is understood as a multitude of fields of knowledge, that comprise the scope of understanding a certain object, problem or area of inquiry.

Interdisciplinarity in this respect is interpreted as the interconnectivity of multiple spheres of knowledge that comprised the content of a problem or area of inquiry.

Trans-disciplinarity, subsequently, is perceived as a transcendent product of merging multiple interconnected knowledge domains.

*Interdisciplinarity in digital education in general* is, therefore, postulated in this study as a computational framework of interconnected types of disciplinary dimensions (Fig. 2) within the digital transformation framework:

- 1) Silo 1 – different types of disciplines (MULTIDISCIPLINARITY, INTERDISCIPLINARITY, TRANSDISCIPLINARITY);
- 2) Silo 2 – digital education components (DIGITAL EDUCATION FORMAT, DIGITAL COMMUNICATION, DIGITAL LITERACY);
- 3) Silo 3 – digital education tools and practices (DIGITAL CONTENT, INTEROPERABLE DIGITAL MEDIA, DIGITAL LEARNING OUTCOMES).

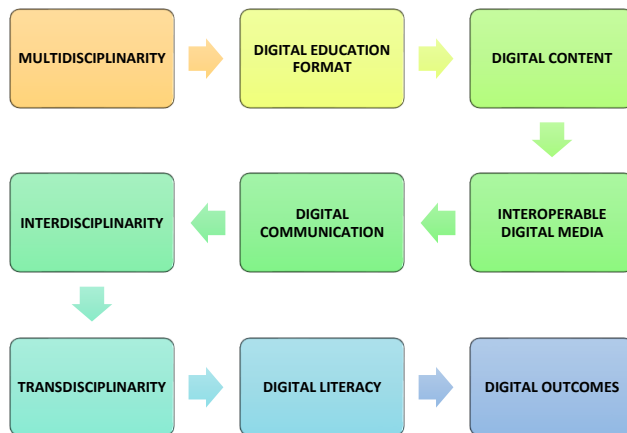


Figure 2: Computational framework of multiple disciplinarity in digital education

Multidisciplinary **input** into the education design and content in the form of data, information and facts across different source domains of human knowledge in order 1) to constitute the thematic content of education; 2) to constitute the semantic referents of key terms and concepts; 3) to constitute the vast framework of reference and contexts for professional communicative application.

Interdisciplinary connections of the educational **content** for digital education – internal interconnectivity of theoretical and applied disciplines, external interconnectivity of Liberal Arts content with non-related areas of human knowledge (computer science, physiology, anthropology, philosophy etc.).

Transdisciplinary **output** in the transcendent nature target knowledge domains and universal applicability of skills, training and outlook of the professionals upon graduation.

Interdisciplinary and transdisciplinary skills ensure *universal* applicability of Liberal Arts majors on the digital job market across various spheres of social activity.

Digital job market demands for Liberal Arts and FLE graduates in the years 2020-2021 (benchmarking conducted across national and international hiring platforms – LinkedIn, Indeed.com, Work.ua, Jooble.org, include the positions in the following professional areas, mediated by digital technologies:

- Teacher of language / literature, corporate coach / MOOC tutor / curriculum developer / teacher (negotiation) – EDUCATION

- Translator, proofreader, CAT editor – TRANSLATION, COPYEDITING;
- Researcher (scholar) - writing grants and grant applications, linguist-expert – RESEARCH AND DEVELOPMENT, NGO SECTOR; SOCIAL SERVICES; LEGAL SERVICES;
- PR manager, Copywriter, Content manager, SMM – MEDIA COMMUNICATIONS; ADVERTISING, CONTENT-CREATION;
- Computational linguist (NLP), lexicographer, applied terminologist, digital humanities – IT SECTOR, GAMING INDUSTRY.

**Interdisciplinary communicative dimensions of digital education**

Interoperability for professional skills, acquired through digital education, is ensured by the communicative nature of interdisciplinary skills. The core cross-sectorial domain that is referential for primary skills (social skills, emotional intellect, collaboration, communication, digital literacy), necessary for educational goals achievement, is COMMUNICATION. The digital dimension of communicative interoperability of digital education stems from the structure of Noosphere [40] and content of its components:

- ANTHROSPHERE - a set of people as living organisms, their activities and achievements;
- SOCIOSPHERE - a set of social factors characteristic of this stage of society development and its interaction with nature;
- TECHNOSPHERE - a set of artificial objects created by man, and natural objects, altered as a result of human activity.

Given the nature of increasingly digitalized context of foreign languages education and communicative application (“the Technospheric shift” [32]), it is suggested to consider the different types of information source and information destination (human and machine/computer/program, accordingly) in the structure of the groundwork Communication model (Cf. Claude Shannon [36]), when communication is approached as the core factor of interoperability of source and target knowledge and application domains (Fig. 3). Subsequently, a model of interdisciplinary dimensions of digital education, informed by the nature and subjects of communicative interaction of the stakeholders, is elaborated (Fig. 4).

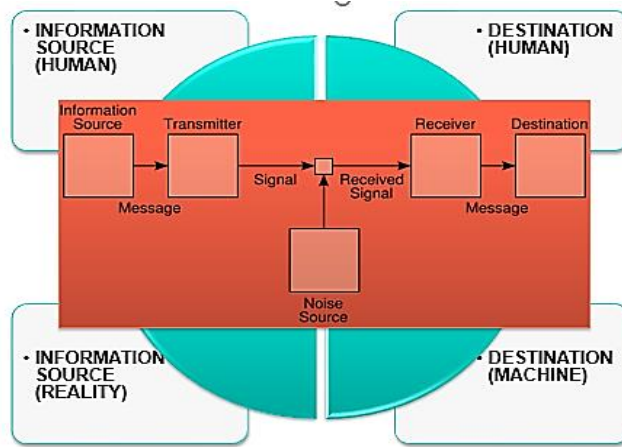


Figure 3: Adaptation of communication model to digitized context of education



Figure 4: Interdisciplinary dimensions of digital education

The suggested model discloses the nature of communicative interaction in digital education across such core dimensions: 1) EXODISCIPLINARY DIMENSION – the interoperability of a) human subject of education and digital ambient (Augmented reality, Mixed Reality); b) human subject of education and digital objects; 2) ENDODISCIPLINARY DIMENSION - the interoperability of a) human subject of education and another human subject in the digital ambient; b) human subject of education and digital simulacra (Virtual reality); 3) EXTRADISCIPLINARY DIMENSION - the interoperability of a) human subject of education and the machine (AI) as a subject of education or as a source of educational data; b) human and post-human subjects of education.

Thus, the fundamental interdisciplinarity, that COVID-19 digital procedural transformations imposed on the educational process in the area of Liberal Arts, is verified by a unified framework of correspondence between the components of a crucial communicative competence [24], comprising of a diverse skillset, and various aspects of ICT competence in Liberal Arts [3; 15; 16; 44], utilized in the educational process, elaborated for the purposes of this study.

Based on the interdisciplinary communicative and digital interoperability grid the following freeways of digital

transformations in education are identified: DIGITAL HUMANITIES; NLP, DATA SCIENCE, MACHINE LEARNING; E-LEARNING.

The framework of these developments is informed by the range of consecutive transformations in social media ecology and communicative patterns. Namely: NETWORKED SOCIETY transformations [lead to] ⇔ RHIZOMATIC education [open ended educational practices and lifelong credentials accumulation] that [leads to] ⇔ the configuration of an INTERDISCIPLINARY NETWORK of knowledge.

The open-ended interdisciplinary network in digital education is elaborated with the help of such digital tools as and educational technologies as: learning management systems; Web 2.0 education through social media; formal, informal and semi-formal digital communities of knowledge (academic social media).

Subsequently, the network communication patterns in digital education follow the general typology of Web communication (Web X.0 scheme), distributed across two axes – X-content orientation and axes Y – types of skills involved (Fig. 5):

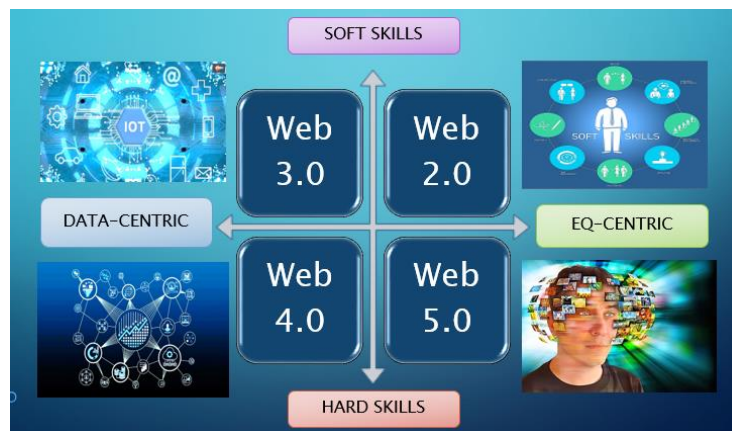


Figure 5: Network Communication Pattern in Education

Overall, the network communication in digital education is actualized through such dimensions: 1) Data-centric, soft-skills oriented (Web 3.0 type); 2) Data-centric, hard skills oriented (Web 4.0 type); 3) Emotional Intelligence (EQ)-centric, soft-skills oriented (Web. 2.0 type); 4) Emotional Intelligence (EQ)-centric, hard skills oriented (Web. 5.0 type).

Subsequently, based on the network communication dimensions presented above, the model of interdisciplinary dimensions of open-end rhizomatic digital education is introduced.

Such sliding-scale axes are identified: 1) Informal rhizomatic education; 2) Formal rhizomatic education. The key formats are, accordingly – Micro credentials accumulation (for professional upskilling and reskilling purposes); Edutainment (education + entertainment) (for leisure and/or self-actualization, self-transcendence).

### Interdisciplinary Trends in Digital Education

The identified interdisciplinary communicative dimensions of the digital education allowed to single out integrated trends in digital education development in the Covid-19 timeframe.

*Trend 1: TRANSFORMATION OF COMMUNICATION FORMATS IN DIGITAL EDUCATION.*

Types of digital education formats, on the rise globally through the emergency digitization measures are determined as follows: E-LEARNING 1.0 - direct synchronous computer-assisted distant instruction; E-LEARNING 2.0 [43] - mostly asynchronous computer-supported collaborative learning; E-LEARNING 3.0 [35] - AI-assisted digital or hybrid learning; BLENDED LEARNING [46; 5; 11] - in-person teaching with asynchronous ICT assisted learning methods; HYBRID LEARNING [13] - synchronous instruction of in-presence and remote students via ICT tools.

Modelling of the comprehensive framework of educational activities and experiences in Liberal Arts transformation into digitally enhanced format [32] is, therefore, possible through an interoperable set of parameters: Time; Space; Communicative distance; Dependence on ICT tools and infrastructure. The level of communicative complexity of digital education format is proportionately dependent on the technological enhancement involved and counter-proportionally dependent on the communicative distance of the digital learning format.

The sub-trend 1.1 includes replication of *non-digital components* or creating *simulacra* in educational communication: learning space digital recreation; learning ritual/scenarios recreation;

measurable learning outcomes recreation; learning interaction recreation.

The sub-trend 1.2 elaboration of authentic or self-aware components of digital communication, such as Flipped digital classroom; Inquiry-based digital learning; Digitally enhanced peer-assessment; Collaborative (networked) learning.

Transformative communicative model of digital education facilitates the identification evolution directions of e-learning formats, informed by the space-time constrains of the global quarantine measures.

This way, the mobile learning (m-learning) acquires features of ubiquitous learning in the lockdown perimeters. Ubiquitous learning adjusts from a space-centric model to a time-centric model due to time-zone discrepancies in digital educational communication and becomes w-learning (whenever-learning).

**Trend 2: TRANSFORMATION OF CONTENT IN DIGITAL EDUCATION.** This trend heralds the observable shift from human-originated to digital content in education.

The sub-trend 2.1 is manifested through the development of an interdisciplinary paradigm of digital humanities – a diverse, open for augmentation, range of areas of knowledge, applied activities and education in Arts and Humanities, centered on *digital adaptation, production, processing, manipulation and dissemination of relevant thematic content*: Digital history; Digital philology; Digital art; Digital pedagogy; Digital sociology; Digital music etc.

The sub-trend 2.2 is manifested through the emergence and implementation of the “born digital” formats in education (Fig. 6).

Born digital dimensions in digital education include: Born digital LEARNING OBJECTS; Born digital LEARNING SCENARIOS; Born digital LEARNING OUTCOMES; Born digital ASSESSMENT.

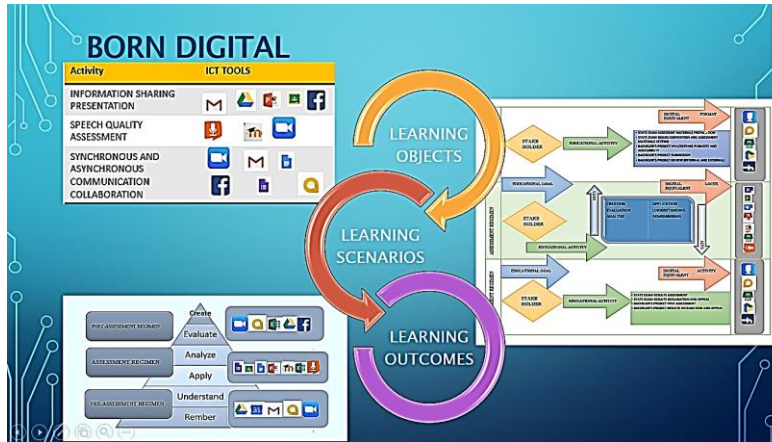


Figure 6: “Born digital” dimensions in digital education include

The primary result of these transformations in the nature of the educational content is interdisciplinarity as a fundamental endgame of digital education.

Interdisciplinary social domains most accommodating or lucrative for liberal arts education are estimated as follows: Private sector (business); Public sector (civil service, public education, state social sector, etc.); Foreign economic activity; Industry; IT sector; Law/ legislature; Agriculture; Volunteering; Finance. According to the data of the online survey, conducted as a parcel of the project ‘TRANSITION’, led by the authorial team, the highest average scoring transdisciplinary domains of education in the Liberal Arts application are the Private business sector (77%), Public service sector (68.65%) and Foreign

economy sector (58.62%). IT sector is estimated among top 5 domains (48.5%).

**Trend 3: TRANSFORMATION OF STAKEHOLDERS IN DIGITAL EDUCATION.** This trend is manifested, primarily, through the ambidirectional shifts in human to machine interaction in education. The subsequent result is the introduction of Artificial Intelligence solutions in education (Fig. 7) as an alternative form of educational communication subjects – from limited in scope and complexity to sophisticated and communicatively independent: Chat-bots; Gamification of educational tasks; AI Teacher Assistant (LMS); AI learning companion; Educational robots.



Figure 7: AI solutions in education

AI enhancement of the learning stakeholders and communicative components informs transformations in other components of educational communication, namely the elaboration of machine learning powered mixed reality [28] learning environments and content, such as: AUGMENTED REALITY; VIRTUAL REALITY; ANNOTATED REALITY; 3D PRINTING.

For the multidisciplinary OUTPUT of Liberal Arts digital education dominant is the identified need to both interdisciplinary **upskill** in related humanities/Liberal Arts disciplines and cross-sectorially **reskill** in a technical/computer science field, which is consistent with the identified trend content and interaction transformation in the pandemic timespan and with the transdisciplinary understanding of Arts and Humanities education in general.

### 3. CONCLUSIONS

The comprehensive diagnostics of the interdisciplinary trends of digital education in the pandemic paradigm disclosed the interoperability of soft skills and digital communication skills across contrasting timeframes and stages of Liberal Arts education.

Digital environment, digital industry, digital communication, digital stakeholders and digital literacy are estimated as the interoperable parameters that inform interdisciplinarity of trends and models in digital educational design and practice in the timespan of the last 2 years (2020-2021).

GLOBAL CHALLENGES of digital education in the emergency digitization measures of 2020-2021 include the following types: SOCIAL AND PSYCHOLOGICAL: Emotional burnout; Stress; Fatigue; Health; Domestic difficulties / limitations; Time restrictions in connection with the introduction of quarantine restrictions; TECHNICAL CHALLENGES AND DIGITAL LITERACY: Technical difficulties (lack of stable Internet connection, lack of necessary equipment, capacity of household computer equipment); Lack of digital literacy skills; Lack of experience in transforming the curriculum and training materials into an online format; Lack of digital communication experience; Lack of experience with electronic learning management systems (Moodle, Google Class, etc.); Lack of experience with auxiliary

ICT tools for organizing the learning process (video conferencing, testing, surveys, online boards, etc.); SOFT SKILLS: Lack of skills of adaptation and self-organization; Lack of situational learning and training skills; Lack of communication and cooperation skills.

The inquiry results inform the derivation of the following recommendations for UNIVERSAL AND LOCALLY CUSTOMIZED SOLUTIONS for *interdisciplinary digital education going forward*: 1) To critically review of the curriculum content to accommodate the dynamics of digital society input; 2) To update the curriculum content interconnectivity and learning outcomes to accommodate the interoperable interface of skills, customized to facilitate professional activity and communicative application in the intensely digitized world; 3) To devise a flexible model of educational content upgrade to meet the dynamic transdisciplinary requirements of the job market in the digital economy of the post-pandemic timespan; 4) To enhance the universality of professional application for university graduates in the digital age.

The study overview results provide a springboard for the assessment of interdisciplinary and interoperable digital skills adaptability for separate groups digital education stakeholders, according to roles and tasks performed in the communication

workflow, as well as according to age and entry digital literacy level (digital immigrants and digital natives). The perspective of the study is in scaling the inquiry into the digital education trends and models to estimate the parameters Liberal Arts education interdisciplinarity and universality for separate areas of knowledge, as well as to diagnose interdisciplinary trends of digital education in Arts and Humanities across different countries and regions of the world.

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