

Cybernetics and Informatics of Generative AI for Transdisciplinary Communication in Education

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ABSTRACT

As a product of modern civilization, the digital reality has become an independent format of being. Accordingly, electronic media act not only as a means of transmitting information, but also reveal their own world-creating, meaning-making and, as a consequence, communicative potential. The global digital realm stands as an integral environment, demanding new cognition and perception ways via complex philosophic, cultural, social, linguistic approaches, providing unlimited opportunities for human intellect, communicative development and research.

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. As a product of modern civilization, digital reality has become an independent format of being. Accordingly, electronic media act not only as a means of transmitting information but also reveal their own world-creating, meaning-making, and, as a consequence, communicative potential. The global digital realm stands as an integral environment, demanding new cognition and perception ways via complex philosophic, cultural, social, and linguistic approaches, providing unlimited opportunities for human intellect, communicative development, and research.

Transformative shifts in the knowledge economy of the XXI century, Industry 4.0 (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, to Web 4.0 – machine learning powered interaction, LLMs, to Web 5.0 – intelligent personal agents, Web 6.0 – cognitive AI), development and elaboration of networked society and new media ecology, emergency digitization due to quarantine measures and the ongoing warfare have imposed pressing revisions onto interdisciplinary and cross-sectorial job market demands.

The context of the erupted military intervention in Ukraine and the ensuing information warfare in various digital ambients (social media, news coverage, digital communications), the specific value is allocated to the enhanced role of digital

humanism as a tool of the internationally broadcast strife for freedom and sovereignty.

Keywords: Transdisciplinary Communication, Generative AI, 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), to *technological danger* (GT2045) accordingly.

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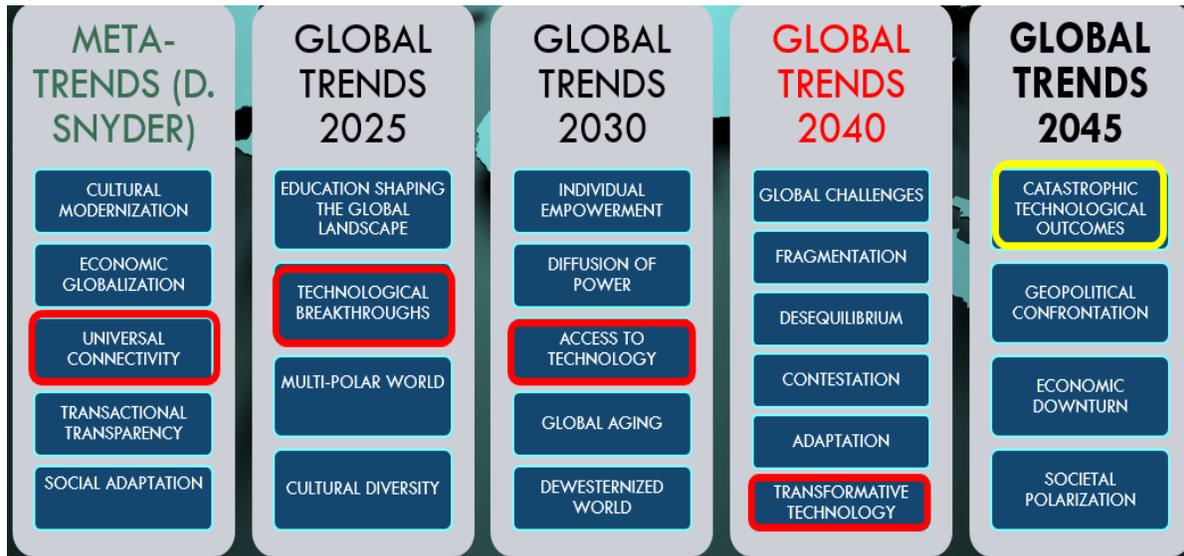


Figure 1: Transformative model of Global Trends

Through the span of these predictive Global Trends frameworks, provided is the lens through which technological growth and advances features in the global development trendsetting. The sub-trend of the technological society development is manifested through the elaboration of an interdisciplinary paradigm of *Digital Humanities* – a diverse, open for augmentation, transdisciplinary 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 education; Digital sociology; Digital music etc. Transformative shifts in the knowledge economy of the XXI century, Industry 4.0 (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, to Web 4.0 – machine learning powered interaction, LLMs, to Web 5.0 – intelligent personal agents, to Web 6.0 – cognitive AI) development and elaboration of networked society and new media ecology, emergency digitization due to quarantine measures and the ongoing warfare have imposed pressing revisions onto interdisciplinary and cross-sectorial job market demands. Interdisciplinarity and ubiquity (universality) of digital education in the 21st 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 pandemic development and enhanced by continuous 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.

Taking into account the context of the erupted military intervention on Ukraine (2022-2024), and the ensuing information warfare in various digital ambient (social media, news coverage, digital communications), the specific value is allocated to the enhanced role of digital humanism as a tool of the internationally broadcast strife for freedom and sovereignty. For the first time in modern history the full inventory of interconnected areas of digital humanities (from fact-checking

via digital archives, to AI-powered content distribution algorithms and fake-news detection, to viral blogging and SMM, to big data processing and sociological analysis, to corpus analysis and computer assisted translation, digitally enhanced logistics coordination etc.) are implemented to achieve maximum advantage in the information warfare waged both on the cyberfront and in actuality. This development clearly heralds the branching out of digital humanities into new, undercharted areas of AI-enhanced military digital humanities and digital peacekeeping, digital diplomacy.

The study **objective** is therefore to disclose a wide scope of generalized theoretical and applied issues and models, permeating the digital communication and digital education context through the lens of digital humanities paradigm.

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 interdisciplinary 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 digital humanities paradigm.

2. FINDINGS

Transdisciplinarity of Digital Humanities in 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
- CYBERNETICS AND INFORMATICS
- GENERATIVE AI

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.

Cybernetics of transdisciplinary communication is modeled through regulation and control in the education system, focusing on the flow of information and how it is used by the system to control and course-correct itself.

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 transcendent types of disciplinary dimensions, controlled, enhanced or powered by Gen AI (Fig. 2) within the digital transformation framework:

- 1) Silo 1 – different types of disciplinarity (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).

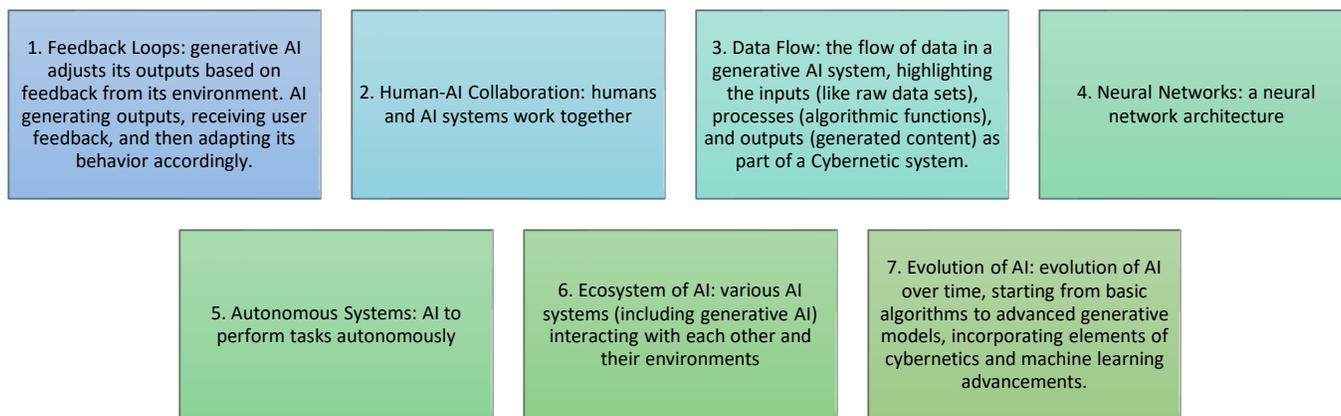


Figure 2: Cybernetics of Generative AI in digital education

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.

Transdisciplinary communicative dimensions of AI in Digital Education

Trans-disciplinary and cross-referential integration between the corresponding skillsets, henceforth, constitutes a meta-

framework of digital educational communication. The transdisciplinary integration of communication in digital education could be referred to the following key interdisciplinary domains: DIGITAL EDUCATION, DIGITAL CONTENT, INTEROPERABLE DIGITAL MEDIA, DIGITAL COMMUNICATION, DIGITAL SKILLS, DIGITAL OUTCOMES.

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:

- ANTHROPOSPHERE - 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.

Informatics of transdisciplinary communication is subsequently viewed in this study through the consecutive transformations of a general information system. Given the nature of increasingly AI-augmented context of education and communicative application [32], it is suggested to consider the different types of information source and information destination (human and machine(AI)/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 and generative AI, is elaborated (Fig. 4).

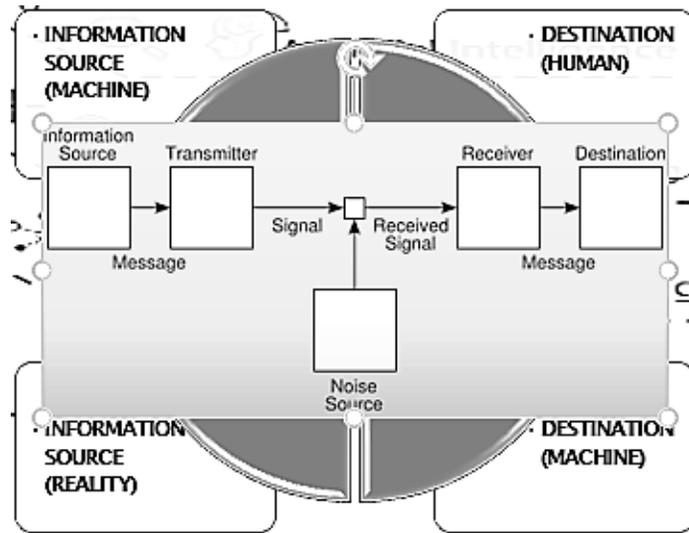


Figure 3: Adaptation of communication model to AI role in education

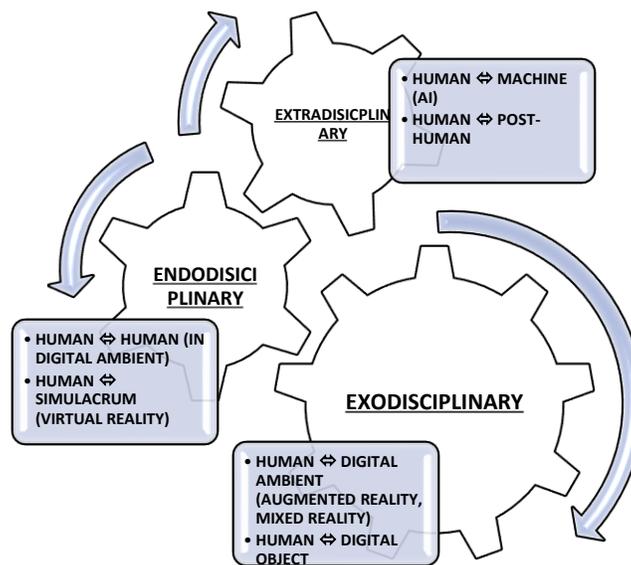


Figure 4: AI-enhanced dimensions of digital education

Communication is considered as a factor of interoperability of source and target knowledge as well as transdisciplinary domains of application of language and technologies. The proposed model reveals the nature of communicative interaction in the digital environment in the following main dimensions: 1) **EXODISCIPLINARY DIMENSION** - compatibility of a) a person and the digital environment (augmented reality, mixed reality); b) people and digital objects; 2) **ENDODISCIPLINARY DIMENSION** – compatibility of a) a person as a subject and another subject in the digital environment; b) human and digital simulacra (virtual reality); 3) **EXTRADISCIPLINARY DIMENSION** – compatibility of a) a person as a subject of communication and generative AI (e.g. ChatGPT, Bard or other large language models) as a subject of communication or a source of cross-domain data; b) human and post-human subjects of communication (Web 5.0 technologies). Thus, the fundamental interdisciplinarity, that digital procedural transformations

imposed on the educational process in the area of Arts and Humanities, 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 digital competence in Arts and Humanities [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 digital humanism, 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. Subsequently, the dynamic modelling of the digital humanities is identified within these parameters: DH AS

INTERDISCIPLINARY PARADIGM; DH AS TRANSDISCIPLINARY KNOWLEDGE/EDUCATION; DH AS COMMUNICATION WITH/VIA AI (Fig. 5).

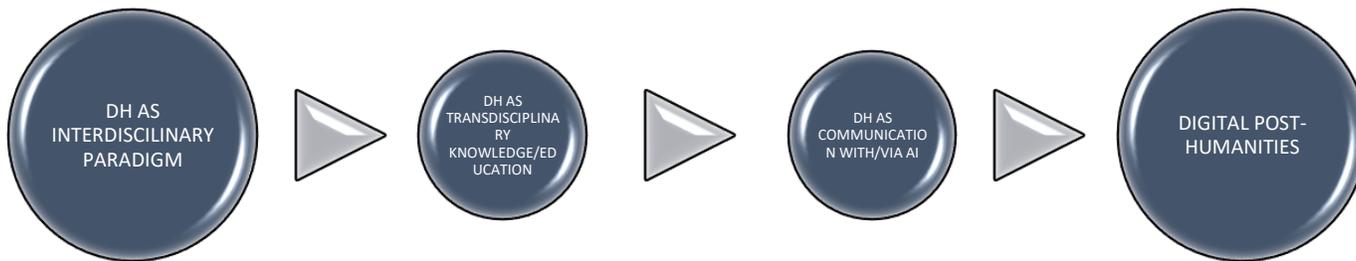


Figure 5: Communicative Dimensions of Digital Humanities

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. 6):

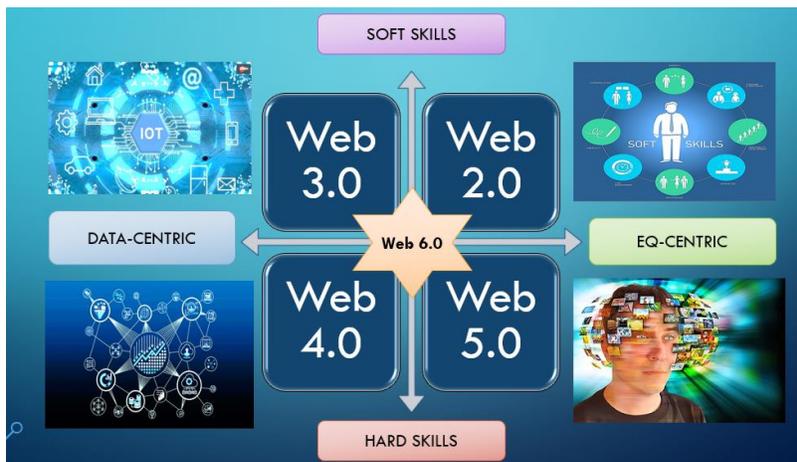


Figure 6: Network Communication Pattern in AI-informed Digital Education

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), 5) Artificial Intelligence (Web 6.0 type).

Transdisciplinary communication of stakeholders in digital education as a 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 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; AI teacher avatar; Educational robots.

Subsequently, based on the network communication dimensions presented above, the model of transcendent interdisciplinary dimensions of open-end rhizomatic digital humanities for AI in education is introduced (Fig. 7).

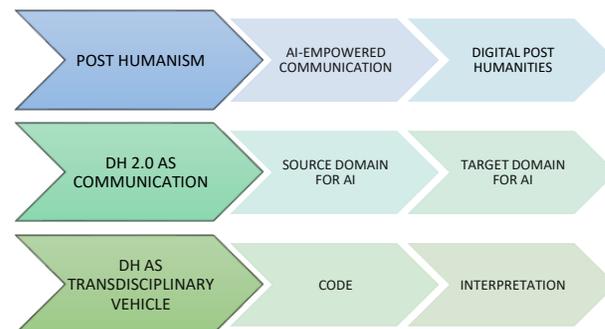


Figure 7: Transcendent Interdisciplinary Dimensions of Digital Humanities for AI in Education

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; META-REALITY; 3D PRINTING.

Taking into account the nature of the suggested modeling of educational communication across frameworks of complex skills, it is stipulated that META-disciplinarity has become the universal vehicle or framework of education in the digital realm, whereas TRANS-disciplinarity can be perceived as a universal output of educational communication in the digital realm. Consequently, the communicative dimension of education proper acquires meta-digital and trans-digital (transcendent digital) properties. The trans-digital characteristics of educational communication are ensured through the interoperability of such framework parameters as: Interaction, Disciplinarity, and Learning.

3. CONCLUSIONS

The comprehensive diagnostics of the interdisciplinary trends of digital humanities paradigm for AI-enhanced education disclosed the interoperability of soft skills and digital communication skills across contrasting timeframes and stages of Arts and Humanities 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/AI 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 Digital 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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