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Embracing Transdisciplinary Communication: Redefining Digital Education Through Multimodality, Postdigital Humanism and Generative AI

Rusudan MAKHACHASHVILI
Germanic Philology Department
Borys Grinchenko Kyiv Metropolitan University, Bulvarno-Kudryavska-st., 18/2,
Kyiv, Ukraine

Ivan SEMENIST
Oriental Studies and Culture Department
Borys Grinchenko Kyiv Metropolitan University, Bulvarno-Kudryavska-st., 18/2,
Kyiv, Ukraine

ABSTRACT

In the study we explore the evolving landscape of digital multimodality and its implications for transdisciplinary communication in education. It is examined how digital literacy integrates multidisciplinary and multimodal approaches, fostering embodied transdisciplinarity that transcends traditional boundaries in the age of AI.

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 and AI models stand 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.

Transdisciplinary communication in digital education represents a transformative trend for humanity, reshaping the way disciplines interact and collaborate. The core concept of transdisciplinarity hinges on dialogue—bridging disciplinary divides to create new frameworks for knowledge transfer. This evolution moves beyond digital humanism and digital humanities, progressing toward post-humanity and post-disciplinarity, where rigid disciplinary boundaries dissolve in favor of interconnected knowledge systems.

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 Humanism, 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. 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.

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

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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].

This shift necessitates new comprehensive frameworks to interpret AI's role in digital education. AI, like the human mind, evolves, learns, and generates new content, contributing to a constantly expanding knowledge ecosystem. To navigate the implications of this, policymakers and researchers must develop adaptable governance models that integrate AI into digital education while ensuring its ethical and transparent use. That in turn spawns 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.

In the current global landscape, AI-driven digital communication is embedded within broader societal and geopolitical complexities. As transdisciplinarity becomes the new norm, we must reconsider traditional concepts of disciplinarity in a world where knowledge transcends specific academic boundaries. Ultimately, the emergence of post-digital humanism, post-humanity, and post-disciplinarity will define the next stage of digital education, where AI acts as a critical agent in shaping and disseminating interconnected disciplinary knowledge.

Taking into account the context of the erupted military intervention on Ukraine (2022-2025), 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 transdiciplinarity, 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 pandemic and wartime timeframes; 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 Modalities in Education

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

- INTERDISCIPLINARITY
- TREND
- UNIVERSALITY
- DIGITAL EDUCATION
- INTEROPERABILITY
- MULTIMODALITY
- 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 Generative AI. The integration of generative AI into education has introduced multimodality as a fundamental dimension of transdisciplinary communication. This evolution marks a significant step in understanding how digital education interacts with disciplinary boundaries, shaping new approaches to collaboration and knowledge creation (Fig. 1) within the digital transformation framework:

1) Different types of disicplinarities (MULTIDISCIPLINARITY, INTERDICIPLINARITY, TRANSDISCIPLINARITY);
2) Digital education components (DIGITAL EDUCATION FORMAT, DIGITAL COMMUNICATION, DIGITAL LITERACY);
3) Digital education tools and practices (DIGITAL CONTENT, INTEROPERABLE DIGITAL MEDIA, GEN AI, DIGITAL LEARNING OUTCOMES).

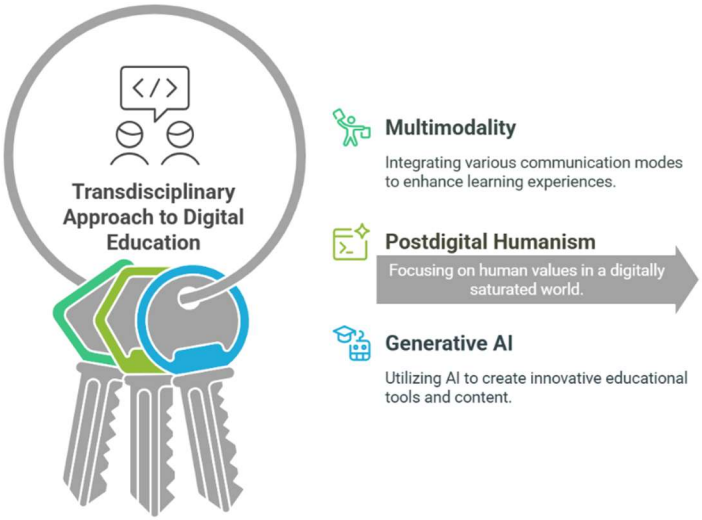

Figure 1: Transdisciplinary Dimensions of Digital Education

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 2020-2025 (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, prompt engineer, LLM – IT SECTOR, GAMING INDUSTRY.

Transdisciplinary multimodal 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.

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. Multimodality functions as both a building block and an outcome of transdisciplinary education. Applying a transdisciplinary approach to educational communication inherently results in multimodal outputs, expanding the ways in which learning materials are processed, created, and transmitted. Digital literacy plays a crucial role in enabling the comprehension and production of multimodal educational content, fostering a more interconnected and adaptable learning environment (Fig. 2).

Figure 2: Digital Multimodality in Education

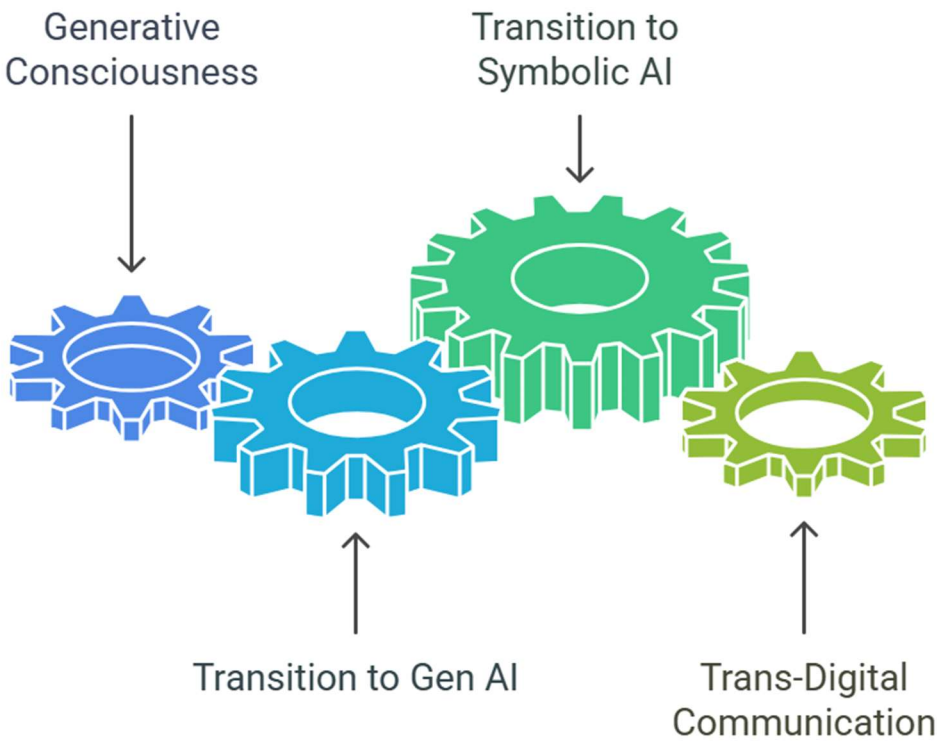

Figure :3 AI in Transdigital Communication

This phenomenon is reinforced by the presence of AI in the loop, wherein AI not only processes and transforms information but also participates as an agent of communication. Machine-readable data and AI-assisted learning materials enhance transdisciplinary collaboration, redefining educational models to accommodate dynamic, multimodal exchanges. The interaction of AI with disciplinary frameworks accelerates a broader paradigm shift - one that moves toward post-human and post-disciplinary educational landscapes (Fig.3).

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 INTERDISCILINARY PARADIGM; DH AS TRANSDISCIPLINARY KNOWLEDGE/EDUCATION; DH AS COMMUNICATION; DIGITAL POST-HUMANITIES, GENERATIVE AI AS A TRANSFORMATIVE AGENT (Fig. 4).

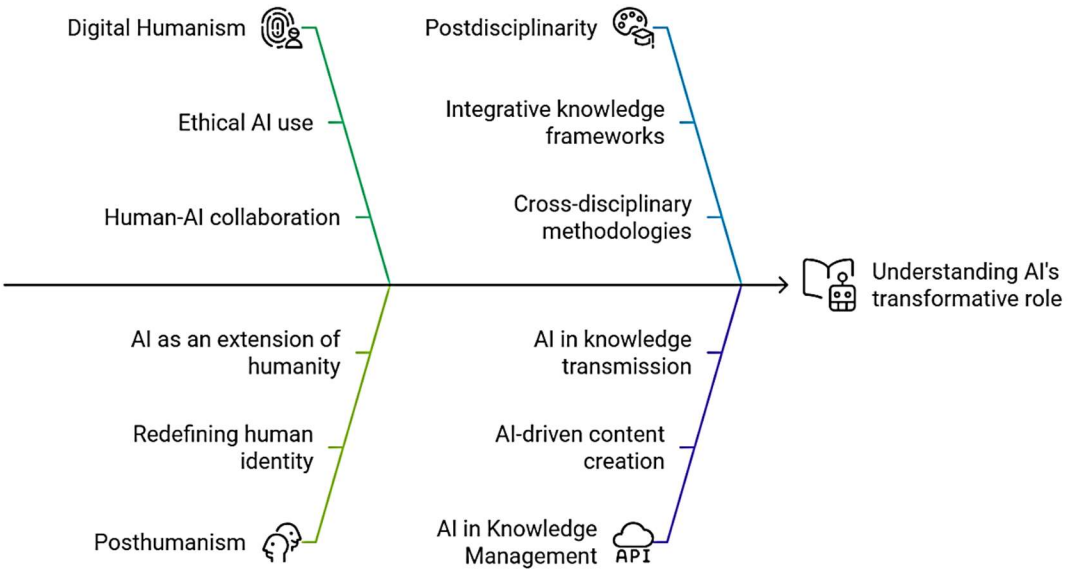

Figure 4: AI in the loop of transdisciplinary communication

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.

Beyond communication, AI integration is reshaping notions of consciousness and knowledge processing. The emergence of symbolic AI, capable of engaging with semiotic systems at higher levels of abstraction, signals a transformation in how knowledge is generated and understood. As multimodality and AI redefine digital education, they simultaneously challenge traditional disciplinary structures, promoting a more fluid, adaptable, and cross-disciplinary mode of learning.

Multidisciplinary input into the education design and content in the form of data, information and knowledge across different source domains of is 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 Arts and Humanities 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 and adaptive applicability.

This framework leads to the understanding of digital humanism and posthumanism as foundational to postdisciplinarity 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, GEN AI, XAI.

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, paving way to the notion of POST-disciplinarity in the Age of AI. Consequently, the AI-enhanced communicative dimension of education proper acquires meta-digital, trans-digital (transcendent digital), and post-digital properties. The trans-digital characteristics of educational communication are ensured through the interoperability of such framework parameters as: Interaction, Disciplinarity, Cognition, AI.

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 interdiciplinarity of trends and models in digital educational design and practice in the timespan of the last years (2020-2025).

GLOBAL CHALLENGES of digital education in the emergency digitization measures of 2020-2025 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 convergence of transdisciplinary frameworks, multimodal knowledge creation, and AI-driven processes underscores the need to develop comprehensive governance models that ensure ethical, scalable, and impactful educational innovations.

The evolution of transdisciplinarity in digital education has reshaped not only the structure of academic communication but also how we conceptualize human cognition in an increasingly AI-driven world. As digital tools become integral to educational paradigms, transdisciplinary learning is transforming into a cognitive framework, redefining both human and machine-mediated knowledge production.

This shift necessitates a reevaluation of post-humanism, an idea once linked to cyber-augmentations but now emerging as a broader conceptualization of intelligence and knowledge beyond human exclusivity. In an era where AI disrupts traditional educational hierarchies, post-humanism challenges long-held assumptions about human intellectual primacy, introducing non-human agents into collaborative learning models. This paradigm shift leads to the reinvention of post-disciplinarity, wherein disciplinary boundaries dissolve, fostering fluid, adaptive knowledge systems.

Post-disciplinarity is only fully realizable within digital communicative environments, particularly those incorporating AI as a dynamic agent in the learning process. AI not only facilitates transdisciplinary education but reshapes cognitive interaction, prompting a shift toward collaborative digital epistemology. As education integrates machine intelligence, it must also redefine the frameworks governing knowledge creation, dissemination, and validation.

Understanding post-humanism and post-disciplinarity in digital education requires rethinking the monopoly on knowledge, acknowledging AI's role as a participant in learning and communication. This transition demands new governance models, ensuring ethical, transparent, and scalable digital educational structures that accommodate both human and machine intelligence as co-creators of knowledge.

Generative AI capabilities, such as natural language processing and content generation, not only transform linguistic frameworks of cognition, but also facilitate new forms of interaction across disciplines. Through the lens of generative consciousness and the role of generative AI, we highlight how these technologies enhance transdigital communication as transdisciplinary at its core, by enabling seamless integration and transference of diverse knowledge domains and modalities.

This angle of modelling transdisciplinary communication situates digital humanism and posthumanism within the context of postdisciplinarity, advocating for a transformative approach to understanding and engaging with AI impact on knowledge creation, expression, transmission, and management.

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