Interdisciplinary, AI-interoperable, and Universal Skills for Foreign Languages Education in Emergency Digitization

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

Ganna PRIHODKO
English Philology Department, Zaporizhzhya National University,
Universytets'ka-st., 66a, Zaporizhzhya, Ukraine

Olexandra PRYKHODCHENKO
English Philology Department, Zaporizhzhya National University,
Universytets'ka -st., 66a, Zaporizhzhya, Ukraine

Iryna RUDIK
Foreign Languages for Specific Purposes Department, Odessa I.I. Mechnikov National University,
Dvoryans'ka St, 2, Odesa, Ukraine

Maryna TER-GRYGORYAN
Foreign Languages for Specific Purposes Department, Odessa I.I. Mechnikov National University,
Dvoryans'ka St, 2, Odesa, Ukraine

Mariia BRUS
Ukrainian Language Department, Vasyl Stefanyk Precarpathian National University,
Shevchenka St., 57, Ivano-Frankivsk, Ukraine

ABSTRACT

Transformative potential of the knowledge economy of the XXI century, establishment of networked society, emergency digitization due to the pandemic and wartime measures have imposed elaborate interdisciplinary and transdisciplinary demands on the marketability of Liberal Arts university graduates' skills and competences, upon entering the workforce. The study is focused on the in-depth diagnostics of the development of multipurpose orientation, universality and interdisciplinarity of skillsets for students of European (English, Spanish, French, Italian, German) and Oriental (Mandarin Chinese, Japanese) Languages major programs through the span of educational activities in the time-frame of sustainable and emergency digitization measures of 2020-2024 in Ukraine. A computational framework of foreign languages education interdisciplinarity is introduced in the study. The survey analysis is used to evaluate the dimensions of interdisciplinarity, universality and transdiciplinarity, informed by the interoperability of soft skills and digital communication skills for Foreign Languages Education across contrasting timeframes and stages of foreign languages acquisition and early career training.

Keywords: Interdisciplinarity, Universality, Interoperability, Foreign Languages Education (FLE), digital literacy, digital communication

1. INTRODUCTION

Transformative shifts in the knowledge economy of the XXI century, Industry 4.0 development and elaboration of networked society, 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 approaches to comprehensive professional competences in foreign languages acquisition, education, and application.

Theoretical problems of holistic, multidimensional modeling of reality and its separate spheres are directed by the deterministic 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.

Conditions for the development of modern globalization civilization determine the expansion and refinement of the paradigm of views on the theoretical principles of determining the groundwork and characteristics of the consolidation of the world order, its perception in culture, collective social consciousness and natural language.

The universality of language in this respect is accessed through is the concept of the **logosphere**, synthetically perceived as 1) the plurality of language units, which are conditionally exhaustive phenomenological realizations of abstract and empirical elements of different spheres of life [4; 23]; 2) the zone of

---

integration of thought, speech, and experience continuums of cultures [5; 16; 26]; 3) the plurality of culturally relevant universal meanings and signs - **semiosphere** [27]; 4) a plurality of transcendent spiritual meanings – **pneumatosphere** [14].

Foreign Languages Acquisition on university-level major programs is a rigorous process that involves different stages and a regimen of activities, communication types and competences across interconnected domains [24; 25]. Interdisciplinarity and ubiquity (universality) of Foreign Languages Education (FLE) in the 21st century, therefore, is informed, in crucial ways, by intellectualization and amplified information capacity of human 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" [40].

The noosphere is defined as the current stage of development of the biosphere, associated with the emergence of humanity in it [16; 40], 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 [17; 28].

Therefore, it is stipulated in **the study design**, that the cognitive (Noosphere) premise of Foreign Languages Education is informed by the following **dimensions**: 1) the *interdisciplinary dimension* of FLE, 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" [17]; 2) *the universal dimension* of FLE, 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" [32]; 3) *the interoperable dimension* of FLE, 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" [22].

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 through the wartime, was the need to take quick comprehensive action [29; 36] in order to achieve such desirable results:

a) To activate comprehensive interdisciplinary skillsets, otherwise latent or underutilized in the Foreign languages educational process;
b) To enhance the scope foreign language communication skills beyond the domains traditionally reserved for Liberal Arts education;
c) To boost ICT competence and digital literacy of FLE stakeholders, to meet the requirements of

post COVID-19 and active warzone job market and workplace.

The study **objective** is to critically review the applied cases and best practices in development of multipurpose orientation, universality and interdisciplinarity of skillsets for students of European (English, Spanish, French, Italian, German) and Oriental (Mandarin Chinese, Japanese) Languages major programs through the span of educational activities in the time-frame of pandemic quarantine measures of March 2020 to January 2022 and emergency wartime digitization of February 2022 to May 2024 in different regions of Ukraine.

The survey analysis method is used to diagnose the dimensions of interdisciplinarity, universality and transdiciplinarity, informed by the interoperability of soft skills [2; 8; 9; 11; 31; 41] and digital communication skills [3; 10; 12; 13; 27; 29; 39] for Foreign Languages Education across contrasting timeframes and stages of foreign languages acquisition and early career training. The study of groundwork principles of universality and interdisciplinary of Foreign languages professional training and linguistic education in general is a parcel of the framework project *TRANSITION: Transformation, Network, Society and Education* [29; 30]. The inquiry main findings disclose: assessment of interdisciplinary and universal skills, crucial for successful professional development overall; systematization and assessment of interdisciplinary and custom professional skills, enhanced by higher linguistic education; evaluation of a linguistic training universality/versatility by stakeholders; estimation of a linguistic training interdisciplinarity by stakeholders; core professional values a linguistic education can help actualize; cross-sectorial and interdisciplinary social spheres estimated most accommodating or lucrative for a foreign languages education skillset; estimated needs and avenues of interdisciplinary upskilling or retraining by Foreign Languages majors to meet dynamic job market requirements in the XXI century.

2. FINDINGS

Interdisciplinarity in A Conceptual Grid

The following grid of groundwork concepts is applied to profile the Foreign Languages Education (FLE) in such disciplinary dimensions (Fig. 1):

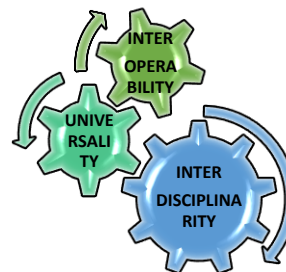- INTERDISCIPLINARITY
- UNIVERSALITY
- INTEROPERABILITY

Figure 1: Conceptual Grid of the Inquiry

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 [6; 15; 18; 21].

UNIVERSALITY is generally understood as a property of object or state **to "exist** everywhere **(ubiquity), or involve everyone"** [7]. 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 [20; 34; 35] 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 Foreign Languages Education, the concept of interoperability represents the property of functional, dynamic interconnectivity between the source and target domains of linguistic content, linguistic theory content, related areas of scientific and universal knowledge, and domains of professional and social application. Degrees of interoperability help define the measure of interdisciplinarity and universality of activities, skills and competence applications of FLE stakeholders (Fig. 2):
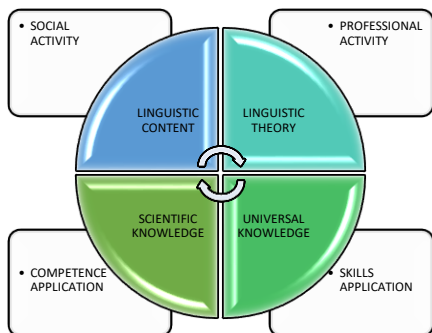

Figure 2: Interoperablity model for FLE

The generic concept of multiple disciplinarity [1; 38] comprises, in its turn, of a framework of interconnected concepts:

- Multi-disciplinarity;
- Interdisciplinarity;
- Transdiciplinarity.

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 FLE in general* is, therefore, postulated in this study as a computational framework of interconnected types of disciplinarities.

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 language acquisition; 2) to constitute the semantic referents of linguistic units; 3) to constitute the vast framework of reference and contexts for communicative application.

Interdisciplinary connections of the educational **content** for FLE – internal interconnectivity of theoretical and applied disciplines, external interconnectivity of FLE 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 FLE professionals upon graduation.

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

Actual job market demands for FLE graduates in the year 2020 (benchmarking conducted across national and international hiring platforms – LinkedIn, Indeed.com, Work.ua, Jooble.org, include the positions in the following areas:

- 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.

Interdisciplinarity of skills in FLE

The study premise is based on identification of various competency principles, derivative of 21st century skills [2; 8; 9; 11; 31; 41] for foreign languages education stakeholders and projected digital literacy requirements.

A *complex skill* is generally understood *as a skill requiring to process lots of information and make lots of decisions simultaneously* [30; 42]. That way, a comprehensive correspondence between 21st century skills framework, Competences 2020 framework [29] and the newly introduced Global Skills 2025 framework [41] has been devised and upgraded.

The interdisciplinary integration between the corresponding skillsets across various frameworks could be referred to the following key interdisciplinary domains of human activity [30]:

- COMMUNICATION;
- COGNITIVE ACTIVITY;
- PERSONAL INTERACTION;
- SOCIAL ACTIVITY;
- HEURISTICS.

Interoperability of Soft Skills and Digital Communication in FLE

Interoperability for FLE skills 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, ICT-literacy), necessary for educational goals achievement, is COMMUNICATION.

The digital dimension of communicative interoperability of FLE 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 digitalized context of foreign languages education and communicative application ("the Technospheric shift" [30]), 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 [33]), when communication is approached as the core

factor of interoperability of source and target knowledge and application domains in FLE

Subsequently, a grid of interoperable soft skills paradigms and digital literacy frameworks interoperability in FLE is suggested:
1) UNESCO ICT and AI Competence Framework [39], customized for in-training and in-service teachers accommodates the following types of soft skills in terms of digital competence requirements: collaboration, team-work, problem-solving, reasoning and ideation.
2) European e-competence framework guideline [13], customized according to European professional competence framework, accommodates the following soft skills in terms of digital competence requirements for vocational activity: service orientation; attention to detail, learning strategies, leadership and social influence, cognitive creativity and flexibility, coordination and time-management; human resources management;
3) Digital Competence 2.0 framework [12] for general public, accommodates the following soft skills in terms of digital competence requirements for efficient digital citizenship: Communication and collaboration, creativity and adaptability, learning and innovation, trustworthiness, emotional intelligence, complex problem solving.

Thus, the fundamental interdisciplinarity, that digital procedural transformations imposed on the educational process in the area of Foreign languages acquisition, is verified by a unified framework of correspondence between the components of a crucial communicative competence [19], comprising of a diverse skillset, and various aspects of digital competence in Liberal Arts [3; 12; 13; 39;], utilized in the educational process, elaborated for the purposes of this study).

Interdisciplinary, Universal and Interoperable Skills for FLE: Iterative Survey results (2020-2024)

The survey analysis is applied for in-depth diagnostics of professional competence and projected employability of in-training linguistic specialists. The inquiry seeks to identify various groups of applied skills, digital skills, and interdisciplinary soft skills, customized for up to date Foreign language university programs. The benchmarking survey samples consist of 724 respondents across 4 study years (Freshman to Senior) of the Bachelor's programs in European (Spanish, Italian, French, English) and Oriental (Mandarin Chinese, Japanese) languages, in different regions of Ukraine (capital city of Kyiv, frontline regions, rear regions).

The design of the online survey included the diagnostics of the following parameters:
- assessment of skills, crucial for successful professional development overall;
- systematization and assessment of skills, enhanced by higher philological education;
- evaluation of a philologist training universality/versatility by stakeholders; estimation of a philologist training interdisciplinarity by stakeholders;
- core professional values a FLE education can help actualize;
- social spheres estimated most accommodating or lucrative for a foreign languages education skillset;
- employment options and projected career paths for a foreign languages major in Ukraine;
- estimated needs and avenues of upskilling or retraining by Foreign Languages majors to meet dynamic job market requirements.

The diagnostics is structured according the computational framework of the interdiscilplinarity of INPUT=>CONTENT=>OUTPUT of FLE curriculum.

The following types of questions were used for the diagnostics: multiple-choice; Likert scale score; short answer.

Diagnostics of multidisciplinary INPUT, that allowed to identify informed choice of career paths in FLE, yielded the following results across the board:

1st year students **highest** scoring target domain that informed the choice of FLE:
1) **mastering a foreign language of preference (29%);**
2) a career in business sector (26%);
3) a career in education (21%).

1st year students **lowest** scoring target domain that informed the choice of FLE:
1) to be a translator (2%);
2) **a career in IT sector (28%);**
3) **a career in public service (22%)**

4th year students **highest** scoring target domain that informed the choice of FLE:
1) **a career in public service (35%);**
2) **a career in IT sector (24%);**
3) a career in business sector (24%);

4th year students **lowest** scoring target domain that informed the choice of FLE:
1) to be a translator (1,2%)
2) a career in education (18%)
3) **mastering a foreign language of preference (26%)**

Consequently, it is evident that mastery of a foreign language, regardless of application domain and sphere of education have gained the multi-disciplinary significance with the FLE majors through the span of recent 5 years (2019-2024). Computer science and IT domains have dropped in multy-disciplinary potential level of FLE INPUT by the year 2020.

Projected transdisciplinarity of FLE career avenues according to content analysis of responses is shaped around target domains of FLE applicability (estimated according to verbal predicates used) for INPUT timeframe (1st and 2nd year students) yielded the following results:
- translation services;
- AI services;
- working abroad (forced displacement);
- education

Comparison and contrast with multidisciplinary INPUT is mostly consistent with the original choices for the career path (due to a limited time span of the FLE education).

Projected transdisciplinarity of FLE career avenues according to content analysis of responses is shaped around target domains of FLE applicability (estimated according to verbal predicates used) for OUTPUT timeframe (3rd and 4th year students) yielded the following results:
- translation services;
- working abroad (no specific focus);
- business/corporate sector;
- language as a work tool
- AI.

Comparison and contrast with multidisciplinary INPUT indicates that respondents didn't originally plan for career options in translation, but changed their mind due to interdisciplinary potential of the FLE content.

Social domains most accommodating or lucrative for foreign languages education are estimated as follows:
- Private sector (business)
- Public sector (civil service, public education, state social sector, etc.)

- Foreign economic activity
- Industry
- IT sector and AI
- Law/ legislature
- Volunteering
- Finance

The distribution of transdiscilplinary potential of FLE across different social spheres across different years of study is estimated as follows (social domains ranked by the highest score 5):

1st year respondents' highest ranking social spheres of FLE applicability are:

- Private sector (business)   -   75%
- Industry/Law/Social services   -   65 %
- Finance   -   46,50%

4th respondents' highest ranking social spheres of FLE applicability are:

- Agriculture   -   60,10%
- IT sector and AI   -   51,10%
- Finance/Law   -   34,80%
-            -

The highest average scoring transdisciplinary domains of FLE application are the Private business sector (75%), Public service sector (65%) and Foreign economy sector (58,62%). IT secto and AIr is estimated among top 5 domains (51%). However, the score range of Foreign economy sector demonstrates the highest standard deviation (8,65), indicative of an assessment gap as this domain as reliably transdisciplinary, informed by FLE content.

Assessment of skills in FLE across different levels of study yielded the evocative results, as to the potential of foreign languages education for enhancing interoperability of different types of soft and professional skills). Key interoperable (soft) skills, across different skills frameworks, identified as enhanced by FLE are as follows:

- New knowledge creation
- Innovative and adaptive thinking
- Interdisciplinary connections
- Social intellect
- Emotional intellect
- Digital literacy
- Cognitive management
- Makering outlook
- Cross-cultural communication
- Collaboration
- Communication
- Enterpreneurship
- Creativity
- Critical thinking
- Innovativity
- Leadership
- Problem solving
- Team-work
- Facilitation/mediation
- Coordination

1st year respondents – score means of top ranking interoperable skills enhanced by FLE (INPUT):

- Emotional intellect	4,239263804
- Cross-cultural communication	3,222891566
- Communication	**3,272727273**
- Creativity	3,159259259
- Critical thinking	**4,217391304**

- Innovativity	3,234567901
- Problem solving	**3,306748466**
- Team-work	**3,253012048**
- Digital literacy	**3,251533742**

4th year respondents – score means of top ranking interoperable skills enhanced by FLE (OUTUT):

- Innovative and adaptive thinking	**4,533333333**
- Social intellect	4,378378378
- Emotional intellect	4,386666667
- Digital literacy	**4,605405405**
- Collaboration	4,306666667
- Communication	**4,608108108**
- Creativity	**4,493333333**
- Critical thinking	**4,608108108**
- Resilience	**4,506666667**
- Problem solving	**4,493333333**

The consistent interoperable skills, acquired through FLE, regardless of multi-disciplinary input or transdisciplinary output estimate are: communication, emotional intellect, creativity, problem solving and innovation. Digital literacy proper features as a prominent interoperable skill, acquired through FLE, with respondents of the 1st and 4th years, presumably, because digital literacy is perceived in the timeframe of 2020-2024 as a core literacy, instrumental to foreign languages education and instrumental to application of other types of soft skills of the communicative nature.

Groundwork understanding of FLE interdisciplinarity was estimated across such core parameters:

- Mastery of several foreign languages
- History, culture, and literature
- Philosophy, psychology, sociology of law
- Applied skills (programming, statistical analysis, mathematical modeling)
- Digital language data processing
- Teaching skills and educational materials development
- National and international historical-political and economic context
- Trends of the globalized world

For 1st year students such parameters of FLE interdisciplinarity rank highest:

- **Mastery of several foreign languages**   -   **90,20%**
- **History, culture, and literature**   -   **71,20%**
- **Teaching skills and educational materials development**   -   **62%**
- National and international historical-political and economic context   -   50%
- *Digital language and data processing*   -   43%

For 4th year students such parameters of FLE interdisciplinarity rank highest:

- **Mastery of several foreign languages**   -   **72,20%**
- **History, culture, and literature**   -   **34,90%**
- *Applied skills (programming, statistical analysis)*   -   **65,71%**

- Trends in the globalized world - 32,60%

Polyglocy, domains of history, culture and literature, as well as digital sphere and IT are a consistent average interdisciplinary priority of FLE content. However, students of the 2023 of enrollment estimate National and international historical-political and economic context of FLE and education domain studies over globalization studies as an interdisciplinary priority. Groundwork understanding of FLE universality was estimated across such core parameters:

- Multitasking
- Ability to work under any conditions, resilience
- Ability to work in any field
- Ability to hold any position

For 1st year students such parameters of FLE interdisciplinarity rank highest:

- Multitasking - 43%
- Ability to work under any conditions, resilience - 42%
- **Ability to work in any field** - **75%**
- Ability to hold any position - 33,1%

For 4th year students such parameters of FLE interdisciplinarity rank highest:

- Multitasking - 28,8%
- Ability to work under any conditions - 23,3%
- **Ability to work in any field** - **74%**
- Ability to hold any position - 43,80%

Respondents of both INPUT and OUTPUT timeframes overwhelmingly estimate universal applicability of foreign languages education as ability to work in any professional field or domain (75% and 74% of respondents respectively).

The estimation of the need for interdisciplinary upskilling or reskilling, having completed a higher educational program in FLE is determined across such parameters:

- FLE is universal and quite sufficient
- Want to master related humanities sphere (psychology, law, culture-studies, international relations, sociology, history, philosophy)
- Want to master an applied / technical specialty (computer science, economics, engineering, human health)
- Believe that FLE alone is not enough for a successful life

1st year respondents identify the need to reskill or upskill after completion of the Bachelor's program in FLE as follows:

- Want to **master related humanities sphere** (psychology, law, culture studies, international relations, sociology, history, philosophy) - **47,60%**
- FLE is universal and quite sufficient - 30%
- Want to master an **applied / technical specialty** (computer science, economics, engineering, human health) - 28,20%

For FLE INPUT timeframe (1st and 2nd year students) dominant is the identified need to interdisciplinary **upskill** in related humanities/Liberal Arts disciplines, which is consistent with multi-disciplinary understanding of FLE.

4th year respondents identify the need to reskill or upskill after completion of the Bachelor's program in FLE as follows:

- Want to **master related humanities sphere** (psychology, law, culturology, international relations, sociology, history, philosophy) - **44,10%**
- Want to master **an applied / technical specialty** (computer science, economics, engineering, human health) - 38%
- Believe that FLE alone is **not enough** for a successful life - 46%

For FLE INPUT timeframe (4th and 3rd year students) 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 transdisciplinary understanding of FLE.

3. CONCLUSIONS

The comprehensive diagnostics of the dimensions of interdisciplinarity, universality and transdiciplinarity of foreign languages education disclosed the interoperability of soft skills and digital communication skills across contrasting timeframes and stages of foreign languages acquisition by students of different years of the Bachelor's program and early career training.

Digital domain, digital communication and digital literacy are assessed as interoperable parameters that inform interdiciplinarity of foreign languages education in the timespan of the last 5 years (2020-2024).

The computational framework approach allows to reliably estimate the multiple disciplinarity ratio of the foreign languages education workflow (input – content – output).

Multidisciplinary **input** of FLE is dominated by the mastery of a foreign language, regardless of application domain and sphere of education. Inter-disciplinarity of FLE is estimated as interconnectivity of such core domains of knowledge: history, culture, and literature; national and international historical-political and economic context; programming, digital language data processing.

The dominant interoperable skills, acquired through FLE, are: communication, emotional intellect, creativity, problem solving and innovation. Digital literacy features as a prominent interoperable skill, facilitating the application of other types of soft skills of the communicative nature.

The priority avenues of interoperable skills development and expansion of FLE universality in professional application include inter-disciplinary up-skilling across adjacent Liberal Arts and Social sciences domains, and tansdiciplinary re-skilling across cross-sectorial domains, not immediately connected to language acquisition and communication (hard sciences, computer science, engineering, economics). These findings are indirectly corroborated by the diagnostic of transdisciplinary potential of FLE applicability across different social domains (Private business sector, Public service sector, Foreign economy sector, Finance, IT sector).

The survey results inform the derivation of the following recommendations for FLE:

- Critical review of the curriculum content to accommodate the dynamics of multi-disciplinary input expectations of the FLE stakeholders;

- Review and update of the FLE curriculum content interconnectivity and learning outcomes to accommodate the interoperable interface of skills, customized to facilitate professional activity and language application in the intensely digitized world;
- To devise a flexible model of FLE content upgrade to meet the dynamic transdisciplinary requirements of the job market and enhance universality of professional application for foreign languages majors.

The survey results will be furthered and elaborated in assessment of interdisciplinary and interoperable digital skills adaptability for separate groups FLE stakeholders, according to roles and tasks performed in the language acquisition workflow, as well as according to age and entry digital literacy level. The perspective of the study is in scaling the inquiry to estimate the parameters FLE interdisciplinarity and universality for separate groups of source and target languages acquired, as well as to diagnose interdisciplinary trends of FLE across countries of Asia and countries of Europe.

4. ACKNOWLEDGEMENT

5. REFERENCES

[1] Alvargonzález D. "Multidisciplinarity, "Interdisciplinarity, Transdisciplinarity, and the Science', **International Studies in the Philosophy of Science,** Vol. 25(4), 2011, pp. 387-403.

[2] Abbott S., **The Glossary of Education Reform**. Retrieved from: http://edglossary.org/hidden-curriculum (accessed July 2020), 2013.

[3] American Library Association, **Digital Literacy**. Retrieved from: https://literacy.ala.org/digital-literacy, 2020.

[4] Bakhtin M. **Aesthetics of verbal creativity**, M.: Art, 1979.

[5] Barthes R. **Elements of Semiology**, Hill and Wang, 1968.

[6] Callaos N., Marlowe T., "Inter-Disciplinary Communication Rigor". **Rigor and Inter-Disciplinary Communication: Intellectual Perspectives from Different Disciplinary and Inter-Disciplinary Fields**. TIDC, LLC, 2020, pp. 4-29.

[7] **Cambridge Dictionary,** CUP, Retrieved from: https://dictionary.cambridge.org, 2020.

[8] Davies A., Fidler D. et al, **Future Work Skills 2020**, Institute for the Future for University of Phoenix Research Institute. Retrieved from: https://www.iftf.org/uploads/media/SR-1382A_UPRI_future_work_skills_sm.pdf, 2011.

[9] Dos Reis A., "To Be a (Blended) Teacher in the 21st Century - Some Reflections", **International Journal of Research in E-learning**, 1(1), 2015, pp. 11-24.

[10] DQ Global Standards Report, **World's first global standard for digital literacy, skills and readiness launched by the Coalition for Digital Intelligence.** Retrieved from: https://www.dqinstitute.org/, 2019.

[11] Eduventures, **TechLandscape.** Retrieved from:https://encoura.org/2020-eduventures-tech-landscape-heres-what-to-expect/, 2020.

[12] European Commission, **Digital Competence 2020**. Retrieved from: https://ec.europa.eu/jrc/en/digcomp/digital-competence-framework, 2020.

[13] European Commission, **European E-Competence Framework Guideline.** Retrieved from: https://www.ecompetences.eu/, 2020.

[14] Florensky P. "Namehail as a philosophical proposition. On the name of God", **Studia Slavica Hung,** Budapest**,** Vol. 34/1–4, 1988. pp. 40–75.

[15] Frodeman R. (ed). **The Oxford Handbook of Interdisciplinarity (2 ed.)**, OUP, 2017.

[16] Gachev G. "Humanistic commentary to natural science", **Issues of Literature**, Issue 11, 1993, pp. 71–78.

[17] Heim M., **The Metaphysics of Virtual Reality.** LA: Westport Publishers, 1993. 278 p.

[18] **Holbrook, J. Britt (2013).** "What is interdisciplinary communication. Reflections on the very idea of disciplinary integration", **Synthese,** Vol. 190 (11), 2013, pp. 1865–1879.

[19] Hymes, Dell H., "Communicative competence", **Sociolinguistics: selected readings**, Harmondsworth: Penguin., 1972, pp. 269–293.

[20] Interoperability Working Group, **Definition of Interoperability**. Retrieved from: http://interoperability-definition.info/en/, 2020.

[21] Jacobs, J.A. & S. Frickel, "Interdisciplinarity: a critical assessment", **Annual Review of Sociology,** Vol. 35, 2009, pp. 43–65.

[22] Khoryzhy S. "Notes on Ontology of Virtuality". **Issues of Philosophy**, Vol. 6, 1997, pp. 53–58.

[23] Kranz W. (ed.), **Die Fragmente der Vorsokratiker**, Zürich: Weidmann,1996.

[24] Legal Act of Ukraine, **On Higher Education.** Retrieved from: https://zakon.rada.gov.ua/laws/show/1556-18#Text, 2019.

[25] Legal Act of Ukraine, **On Standard of Higher Education in Specialization Field 035 "Philology".** Retrieved from: https://mon.gov.ua/storage/app/media/vishchaosvita/zatver dzeni%20standarty/2019/06/25/035-filologiyabakalavr.pdf, 2019.

[26] Losev A. "Philosophy of the Name", **Being. Name. Cosmos**. M: Thought, 1993, pp. 613–801.

[27] Lotman, Yu. **Semiophere**. SPb: Art, 2000.

[28] Makhachashvili R., et al. "Digital Humanities Event Horizon", **Digital Hunaminities Workshop Proceedings**, ACM, 2021, pp. 1-28.

[29] Makhachashvili, R., Semenist, I., "Interdisciplinary Trends of Digital Education in the Covid-19 Paradigm: Global Event Horizon", **Proceedings of the 25th World Multi-Conference on Systemics, Cybernetics and Informatics**, 2021, pp. 164–171.

[30] Makhachashvili, R., Semenist, I., "Systemic Paradigm of innovative Educational Communication in the Digital Realm", **Proceedings of the 16th International Multi-Conference on Society, Cybernetics and Informatics**, IIIS, 2022, pp.11-16**.**

[31] Morze N., Makhachashvili R., Smyrnova-Trybulska E., "Communication in education: ICT tools assessment".

Proceedings from DIVAI, Sturovo: University of Nitra, 2016, pp. 351-354.

[32] Schlesinger, A.M. Jr. **Papers**. Manuscripts and Archives Division, The New York Public Library. Retrieved from: http://archives.nypl.org/mss/17775#overview, 2020.

[33] Shannon, C. E., "A Mathematical Theory of Communication", **Bell System Technical Journal**, Vol. 27 (3), 1948, pp. 379–423.

[34] Slater, T. "Cross-Domain Interoperability", **Network Centric Operations Industry Consortium - NCOIC**. Retrieved from: https:// www.ncoic.org, 2013.

[35] Slater, T. "What is Interoperability?", **Network Centric Operations Industry Consortium – NCOIC**. Retrieved from: https:// www.ncoic.org, 2012.

[36] Taleb, N. **The Black Swan: The Impact Of The Highly Improbable** (2nd ed.). London: Penguin, 2010.

[37] The Digital Divide, **Project Overview**. Retrieved from: https://cs.stanford.edu/people/eroberts/cs181/projects/digital-divide/start.html (accessed October 2020), 2020.

[38] Torre, I., Łucznik, K., Francis, K. B., Maranan, D. S. et al. "Openness across disciplines: Reflecting on a multiple disciplinary summer school", **Open(ing) Education: Theory and Practice**, Brill, 2020, pp. 300–328.

[39] UNESCO, **ICT Competency Framework for Teachers.** Retrieved from: https://unesdoc.unesco.org/ark:/48223/pf0000265721, 2018.

[40] Vernadsky V. **Scientific thought as a planetary phenomenon.** M.: Academia, 1991.

[41] World Economic Forum, **The Future of Jobs Report 2023.** Retrieved from: https://www.weforum.org/publications/the-future-of-jobs-report-2023/in-full/, 2024.

[42] Wulf G., Shea, G. "Principles derived from the study of simple skills do not generalize to complex skill learning", **Psychonomic Bulletin & Review**, Vol. 9, 2002, pp. 185–211.