

# Digital Interoperability of Foreign Languages Education

Rusudan Makhachashvili

Borys Grinchenko Kyiv University  
Kyiv, Ukraine  
r.makhachashvili@kubg.edu.ua

Yurii Zatsnyi

Zaporizhzhia National University  
Zaporizhzhia, Ukraine  
waizi@ukr.net

Ivan Semenist

Borys Grinchenko Kyiv University  
Kyiv, Ukraine  
i.semenist@kubg.edu.ua

Olga Klymenko

Zaporizhzhia National University  
Zaporizhzhia, Ukraine  
olga.klimenko.zp@gmail.com

## ABSTRACT

The focus of the inquiry is on the analysis of multipurpose, universal and interdisciplinary digitally enhances skillsets for stakeholders of European and Oriental Languages HEI programs in Ukraine in the timeframe of COVID-19 emergency digitization measures of March 2020 to October 2021. The study highlights a broad spectrum of issues, relevant for the global social and educational context: changes of the interdisciplinary avenues of development of digital education in the COVID-19 and post-pandemic paradigm; transformations of the network society and education in the digital age; the ratio of personal experiences and anticipations, challenges and technical advances that inform quality assessment of online and hybrid educational formats in emergency digitization context. The study introduces a computational framework of digital interoperability and interdisciplinarity of foreign languages education. The empirical data is collected through a survey that served to assess the digitally enhanced dimensions of interdisciplinarity, facilitated by the interoperable nature of correlation between digital communication skills and soft skills in Foreign Languages Education.

## CCS CONCEPTS

• **Human-centered computing** → **Empirical studies in collaborative and social computing**;

## KEYWORDS

digital interoperability, interdisciplinarity, digital education, digital competence, digital communication

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## 1 INTRODUCTION

Transformation of the knowledge economy, the general state of singularity [2] of technological development in the XXI century, elaboration of Industry 4.0 [15] (AI-operated production) and phases of Web technology evolution (Web 2.0 – interaction through social media, Web 3.0 – Internet of things [13], Web 4.0 – interaction informed by machine learning [27], Web 5.0 – intelligent personal agents [35]), establishment of networked society and new media ecology [16], emergency digitization due to quarantine measures has called for revision of job market demands for Arts and Humanities graduates' skillsets through interdisciplinary and cross-sectorial lens. Thus, a reevaluation of the interdisciplinary trends that drive the progress of digital education is in order.

The concept of meta-trends, transforming the world was introduced by Snyder [38] and is precipitated on universal connectivity as a permeating factor for development of technological trends. Across different predicative Global Trends frameworks [1, 2, 9], the following aspects of technological development are featured:

- evolutionary quality of technology (breakthroughs) (GT 2025);
- accessible quality of technologies (GT 2030);
- transformative nature of technology (GT 2040).

Accordingly, the intellectualization of worldwide culture presupposes a subjectively new way to deal with getting the cycles of equal advancement of human exercises and mental experiences. That is the strategic reasoning behind the idea of “noosphere”. Noosphere is the solidarity of “nature” and culture, particularly from the point in time when the intellectual culture, through the impact on the biosphere and geosphere, becomes the force of an unconventional “geological power” [42].

The noosphere is characterized as the current progressive phase of the biosphere, related with the development of mankind in it [20, 42], and is deciphered as a feature of the planetary environment with clues of human activities.

The necessary component of the Noosphere is distinguished as the Technosphere – a multitude of man-made items (innovations) created with assistance of technologies, and biological objects transformed because of technogenic development of humanity [29]. Likewise, the digital domain (digital reality, the internet) is seen as a multi-layered plane of blendings of the real world, human experience and activity informed with by the digital innovations; technogenic reality, a part of the technosphere of being [21, 30].

The Technospheric perspective change in the domain of Foreign Languages Education (FLE), initiated by iterative crisis digitalization measures, resulted in the need to make swift thorough moves [28, 31, 39] to accomplish the following efficient outcomes: a) to adjust the existent instructive contexts to digital, remote and hybrid designs; b) to update digital competence of all participants of the learning process; c) to actuate complex interdisciplinary ranges of abilities and competencies; d) to present practical digital solutions for the enhanced quality of formal and informal educational communication.

The study objectives span the following dimensions:

- (1) to unveil an extent of summed up hypothetical and applied issues and models, penetrating the social communication and digital learning setting worldwide through the range of online instructive activities in the time period of the pandemic emergency digitization measures of 2020–2021;
- (2) to overview the applied cases and best practices being developed for digitally assisted multipurpose direction, comprehensiveness, and interdisciplinarity of FLE (foreign languages education) through the range of learning activities the time period of the pandemic emergency digitization measures of 2020–2021.

The inquiry allows to diagnose in-depth the dimensions of interdisciplinarity, universality and transdisciplinarity, coordinated by the interoperability of global sustainable development goals [5, 24], soft skills [3, 16, 17, 34, 41, 43–45] and digital communication skills [4, 7, 8, 11, 18, 32] that ensure the success of digital education at different stages of emergency digitization measures of the pandemic.

The **mixed inquiry method** through **online survey analysis** is employed for the analysis of vocational competence and potential employability of HEI foreign languages majors. The empirical sample comprises of 618 respondents across 4 years (Freshman to Senior) of the Bachelor's projects in European (Spanish, Italian, French, English) and Oriental (Mandarin Chinese, Japanese) languages in capital city and regional HEI of Ukraine.

The survey design incorporates the qualitative and quantitative assessment of the a range of variable dimensions:

- profiling of interoperable digital and soft communicative competences, amplified by foreign languages education;
- estimation of the universality/ubiquity/versatility of FLE in the digital age;
- assessment of the linguistic training interdisciplinarity in the digital age;
- identification of social spheres that are amenable for a vocational skillset of foreign languages education;
- identification of necessity for upskilling by FLE majors in correspondence with the dynamic job market demands of the digital age.

The investigation of standards of universality and interdisciplinarity of digital learning in Arts and Humanities and in FLE specifically is an element of the overarching research project TRANSITION: Transformation, Network, Society and Education [31–33].

## 2 FINDINGS

### 2.1 Conceptual Grid of Digital Education

Digital foreign languages education is profiled across the following dimensions:

- INTERDISCIPLINARITY
- TREND
- UNIVERSALITY
- DIGITAL EDUCATION
- INTEROPERABILITY

INTERDISCIPLINARITY is synthetically perceived as an amalgamation of several knowledge domains into a uniform range of inquiry and activity [14, 19, 22, 26].

UNIVERSALITY is disclosed as a quality of an item or state to be ubiquitous, or to encompass everything [10]. The property of universality/ubiquity in this inquiry is attributed to digital communication activity.

DIGITAL INTEROPERABILITY is identified through different lenses [25, 37] as a feature of items and systems, that permits their structure to be understandable and compatible with digital items and systems.

Within the paradigm of digital education in Arts and Humanities, the concept of interoperability addresses the property of practical, unique interconnectivity between the source and target areas of expert substance, theoretical content, related areas of scientific and universal data, and spheres of expert and social application and communication, enhanced by the digital transformation paradigm [6]. Degrees of interoperability facilitated the assessment of interdisciplinarity and universality of activities and competencies of Arts and Humanities students and faculty.

The generalized construct of multiple disciplinarity [12, 40] is structured through an interconnected grid of concepts:

- Multi-disciplinarity;
- Interdisciplinarity;
- Transdisciplinarity.

Multi-disciplinarity is in this manner recognized as an assembly of fields of information, that contain the perception of a specific item, issue or sphere.

Interdisciplinarity in this regard is deciphered as the interconnectivity of various circles of information that contained the substance of an issue or area.

Trans-disciplinarity, in this manner, is seen as a transformative output of blending various interconnected information areas

Interdisciplinarity, as applied to digital learning is, henceforth, disclosed in this study as a computational grid of disciplinary dimensions (figure 1) interconnected within the framework of digital transformation:

- (1) Row 1 – variations of disciplinarity types;
- (2) Row 2 – components of digital education;
- (3) Row 3 – tools of digital education.

Multidisciplinarity is manifested in the form of education design and content input that spans different knowledge domains. Multidisciplinary *input* thus serves the following purpose:

- (1) to cover the thematic scope of foreign languages education;
- (2) to establish meaning and referents of the conceptual and terminological grid;

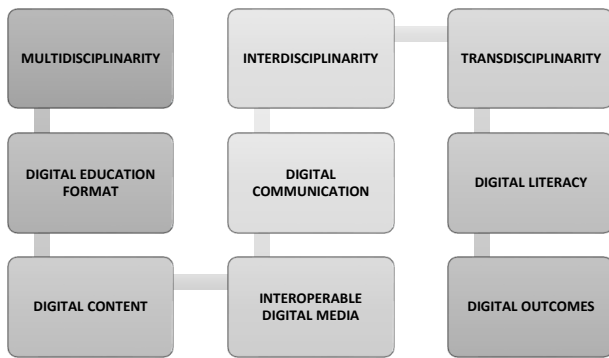


Figure 1: Multi-disciplinary framework in digital education.

(3) to cover the broad scope of cognitive presupposition for communication in professional contexts.

Interdisciplinarity of the digital education *content* is perceived as internal interrelation between theoretical and applied areas of knowledge, external interconnectivity of Arts and Humanities content with unrelated or semi-related knowledge spheres (computer science, digital humanities, physiology, anthropology, philosophy etc.).

Transdisciplinary dimension of FLE *output* is disclosed through the pervasive quality of target information areas and thorough ubiquity (or universal applicability) of skills and competences as well as the universal humanitarian outlook of FLE graduates.

Interdisciplinarity and transdisciplinarity of acquired skills enhance universal employability and both horizontal and vertical professional mobility of Arts and Humanities majors on the digital job market across different social domains.

Job market demands for graduates in Arts and Humanities (FLE) graduates in 2020–2021 incorporate a range of digital professional areas: ONLINE EDUCATION; COMPUTER ASSISTED TRANSLATION AND COPYEDITING; NATURAL LANGUAGE PROCESSING; SMM; DIGITAL CONTENT-CREATION; IT, GAMING INDUSTRY.

## 2.2 Interoperable Communicative Dimensions of Digital Education

Interoperable quality of vocational competencies, procured through advanced digital learning, is guaranteed by the communicativity of interdisciplinary skills and competencies. The center cross-sectorial space that is referential for essential skills (interactive abilities, emotional intellect, cooperation, collaboration, digital literacy/ICT competence), vital for instructive objectives accomplishment, is COMMUNICATION.

The digital component of communicative interoperability of e-learning originates from the design of Noosphere [42] and the composition of its elements:

- ANTHROSPHERE – a multitude of individuals, their exercises and accomplishments;
- SOCIOSPHERE – an assembly of social variables typical for this phase of social advancement;

- TECHNOSPHERE – a multitude of technogenic items made by man, and items of nature, modified because of technological activity.

Given the idea of progressively digitized setting of foreign languages education and open application (“the Technospheric shift” [32]), it is recommended to consider the various kinds of data source and data objective (human and machine/software) in the design of the basic Communication model (Cf. Shannon [36]), when communication is treated as the center variable of interoperability of source and target information and application areas (figure 2).

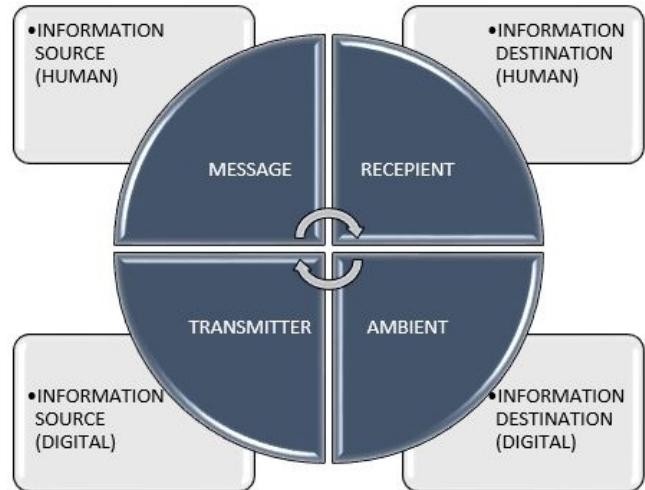


Figure 2: Communication model in digital education.

Consequently, an interdisciplinary elements model of online/digital learning, structured according to the communicative nature of interaction of its participants and elements, is devised (figure 3).

The proposed model reveals the idea of open communication in digital instruction across such focus aspects:

- (1) EXODISCIPLINARY DIMENSION revealed through the interoperable coordination of
  - (a) human subject of training and digital environment;
  - (b) human subject of instruction and digital artifacts;
- (2) ENDODISCIPLINARY DIMENSION revealed through the interoperable coordination of
  - (a) human subject of instruction and another human in the digital environment;
  - (b) a human stakeholder of instruction and computerized simulacra;
- (3) EXTRADISCIPLINARY DIMENSION revealed through the interoperable coordination of
  - (a) human subject of learning and the machine (AI) as a subject of instruction or as a wellspring of instructive information;
  - (b) human and post-human stakeholders of learning.

Hence, the major interdisciplinarity, that the pandemic induced digitized procedural changes forced on the instructive cycle in the area of Arts and Humanities, is checked by a unified structure of correspondence between the elements of a pivotal communicative



Figure 3: Interdisciplinary dimensions of digital education.

ability [23], including a different range of abilities, and different parts of digital literacy in Arts and Humanities [4, 8, 11, 18], used in the instructive interaction.

In view of the interdisciplinary informative and computerized interoperability matrix the accompanying turnpikes of digital changes in foreign languages education are recognized: DIGITAL HUMANITIES; NLP, DATA SCIENCE, MACHINE LEARNING; E-LEARNING.

Generally speaking, the communicative dimension in digital education is fulfilled through such aspects:

- (1) Data-driven, soft competencies dwelling (Web 3.0 sort);
- (2) Data-driven, hard competencies dwelling (Web 4.0 sort);
- (3) Emotional Intelligence (EQ)-driven, soft competencies dwelling (Web 2.0 sort);
- (4) Emotional Intelligence (EQ)-driven, hard competencies dwelling (Web 5.0 sort).

The open interdisciplinary organization in advanced education is expounded with the assistance of such computerized devices and instructive technologies as LMS; Web 2.0 training through online communication; formal, casual, and semi-formal computerized networks of information (research online communities, communities of knowledge).

In this manner, the communication designs in digital learning follow the overall patterns of Web communication (Web X.0 model), appropriated across two axes: X – content direction and Y – kinds of competencies necessary (figure 4).

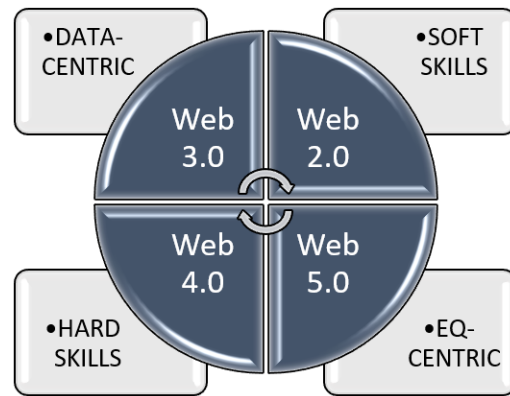


Figure 4: Network-type Communication Pattern in FLE.

### 2.3 Digital Interoperability of Foreign Languages Education: Survey Results

Foreign Languages Education, within the structure of this inquiry, this study is diagnosed based on the computational grid of the interdisciplinarity of curriculum: INPUT ⇒ CONTENT ⇒ OUTPUT.

Multidisciplinary INPUT analysis permitted to pinpoint the what informed the choice of career in foreign languages major programs:

- Freshmen (students of the 1st year of studies) scored such target spheres that define the choice of FLE programs as highest:
  - proficiency in a foreign language (27%);
  - private sector or business (26%);
  - education (different tiers) (25%).
- Freshmen (students of the 1st year of studies) scored such target spheres that define the choice of FLE programs as lowest:
  - translation, interpreting (2%);
  - IT career (23%);
  - becoming a public servant (24%).
- Seniors (students of the 4th year of studies) scored such target spheres that define the choice of FLE programs as highest:
  - becoming a public servant (31%);
  - IT career (24%);
  - private sector or business (24%).
- Seniors (students of the 4th year of studies) scored such target spheres that define the choice of FLE programs as lowest:
  - translation, interpretation (1,2%);
  - education (different tiers) (20%);
  - proficiency in a foreign language (24%).

Digital domains (Computer science, IT) have lowered the score of multi-disciplinary potential level of FLE INPUT but gained the transdisciplinary potential score of FLE OUTPUT as of 2020 (the start of worldwide emergency digitization measures).

The transdisciplinary potential of FLE across accommodating and amenable social spheres is distributed as follows (table 1).



**Table 1: Social spheres most accommodating or lucrative for a foreign languages education**

The social spheres that are amenable for a foreign languages education?	Mean
Private sector / business sector	77%
Civil service/education	69%
Foreign economic activity	59%
IT industry	50%
Social services	51%

The transdisciplinary potential of FLE across different social areas across contrasting periods of FLE is distributed in the following manner (social domains ranked by the highest score 5):

- Freshmen stakeholders ranked such social spheres as highest in FLE applicability:
  - Private sector/business sector – 80%
  - Manufacturing/Law/Social services – 68%
  - IT industry – 43%
- Senior stakeholders ranked such social spheres as highest in FLE applicability:
  - Agriculture – 67%
  - IT industry – 57%
  - Finance/Law – 56%

The top scoring areas of transdisciplinarity in FLE application are the Private business area (77%), Public assistance area (69%) and Foreign economy area (59%). IT area is assessed among top 5 socio-economic domains for FLE application (50%).

Evaluation of skills in FLE across tiers of training provided the eloquent outcomes, regarding the capability of foreign languages education to improve interoperability of soft and vocational competences. Crucial interoperable (soft) skills, across different competency models, were determined as amplified by FLE:

- Average scores of highest ranking interoperable skills, facilitated by FLE (1st year students – INPUT):
  - Digital literacy – 3,39
  - Problem solving – 3,31
  - Communication – 3,27
  - Creativity – 3,26
  - Critical thinking – 3,22
  - Innovativity – 3,24
  - Team-work – 3,25
- Average scores of highest ranking interoperable skills, facilitated by FLE (4th year students – OUTPUT):
  - Digital literacy – 4,41
  - Communication – 4,61
  - Creativity – 4,49
  - Critical thinking – 4,61
  - Innovativity – 4,51
  - Problem solving – 4,49

Digital literacy is highlighted as an interoperable skill, enhanced via FLE, over various tiers of learning, apparently, because digital literacy is considered a core literacy in the pandemic timespan, that

facilitates foreign languages education and facilitated utilization of other types of communicative soft skills.

Comparison of interoperable skills amplified by FLE is shown in figure 5.

Interdisciplinarity of FLE was assessed across several key dimensions (figure 6):

- Freshmen respondents ranked such dimensions of FLE interdisciplinarity as highest:
  - Proficiency in multiple foreign languages – 81%
  - Arts and humanities – 81,2%
  - Educational and teaching competencies – 60%
  - Geopolitics and history – 50%
  - Digital linguistics and language data processings – 43%
- Senior respondents ranked such dimensions of FLE interdisciplinarity as highest:
  - Proficiency in multiple foreign languages – 62,2%
  - Arts and humanities – 65%
  - Applied skills (programming, statistical analysis) – 36%
  - Geopolitics and current affairs – 33%

Digital domain is of steady interdisciplinary importance for perception of FLE content. However, respondents, that enrolled in the year 2021 evaluate digital language and data processing ranking higher than programming and computer science skills as an interdisciplinary feature of FLE.

The necessity for interdisciplinary upskilling or reskilling (figure 7), upon completion of a FLE program is estimated across different parameters.

Freshmen stakeholders determine necessity to reskill or upskill upon graduation in FLE across the following planes:

- Need to study an adjacent Arts and Humanities area – 58%
- Need to master an applied/technical specialty – 18,2%

For FLE INPUT timeframe (1st and 2nd year respondents) the necessity for interdisciplinary upskilling in adjacent Arts and Humanities areas is dominant.

Senior stakeholders determine necessity to reskill or upskill upon graduation in FLE across the following planes:

- Need to study an adjacent Arts and Humanities area – 45,3%
- Need to master an applied/technical specialty – 36%

For FLE OUTPUT timeframe (4th and 3rd year respondents) the necessity for interdisciplinary upskilling in adjacent Arts and Humanities areas and for cross-domain reskilling in a digital/computer science sphere, is dominant, in full correspondence with the concept of transdisciplinarity of foreign languages HEI programs in the digital age.

### 3 CONCLUSIONS

The exhaustive diagnostics of the components of interdisciplinarity, universality and transdisciplinarity of FLE unveiled the interoperability of soft skills and digital competencies across differentiating phases of foreign languages training by understudies of various tiers of the Bachelor's program and early vocation preparing.

Digital real, digital communication and digital competence are surveyed as interoperable dimensions that facilitate interdisciplinarity regarding FLE in the stretch of time of the most recent 5 years (2017–2021).

### 1st year vs 4th year

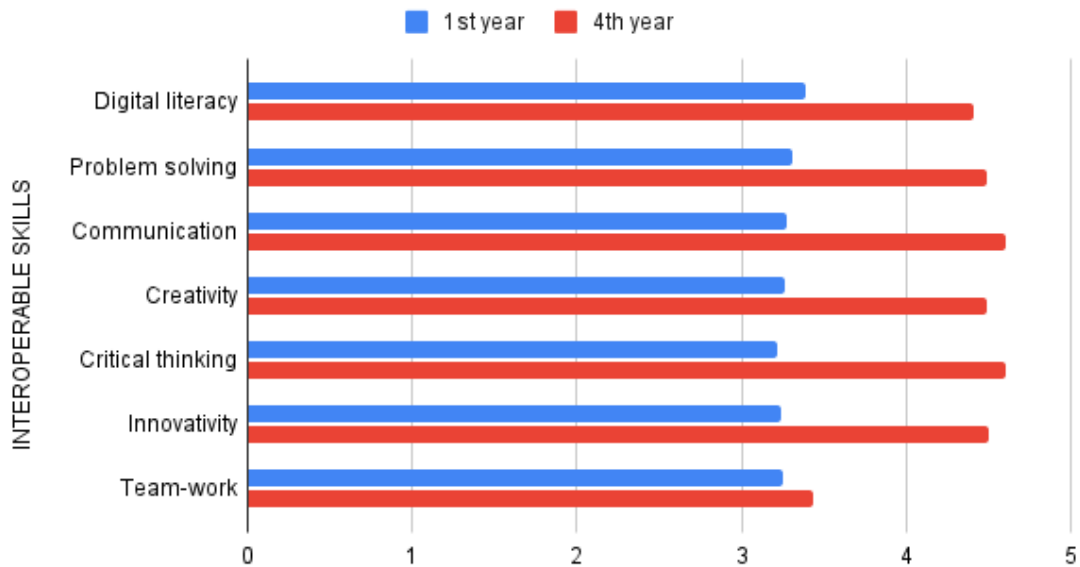


Figure 5: Comparison of interoperable skills enhanced by FLE.

### 1st year vs 4th year

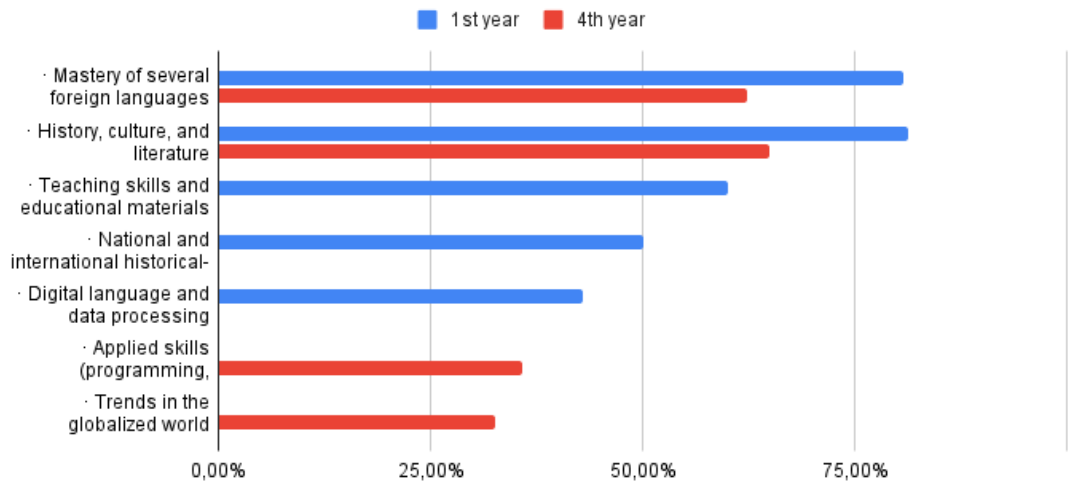


Figure 6: Interdisciplinarity of FLE assessment.

The computational system approach permits to dependably gauge the various disciplinarity proportions of the FLE work process (input – content – output).

Multidisciplinary input of FLE is overwhelmed by the linguistic proficiency, paying little heed to application space and tier of training. Interdisciplinarity of FLE is assessed as interconnectivity of such center spaces of information: history, culture, and discourse; geopolitics; programming, digital language processing.

The predominant interoperable abilities, obtained through FLE, are: correspondence, passionate keenness, imagination, critical

thinking and advancement. Computerized education highlights as a conspicuous interoperable ability, working with the use of different kinds of delicate abilities of the open nature in broad semantic preparation.

The necessity for interoperable competencies improvement and development of FLE comprehensiveness in proficient application incorporate tansdisciplinary re-skilling over cross-domains areas, not associated with language learning and communication (data processing, technology development, software engineering, design, finance). These discoveries are in a roundabout way certified by

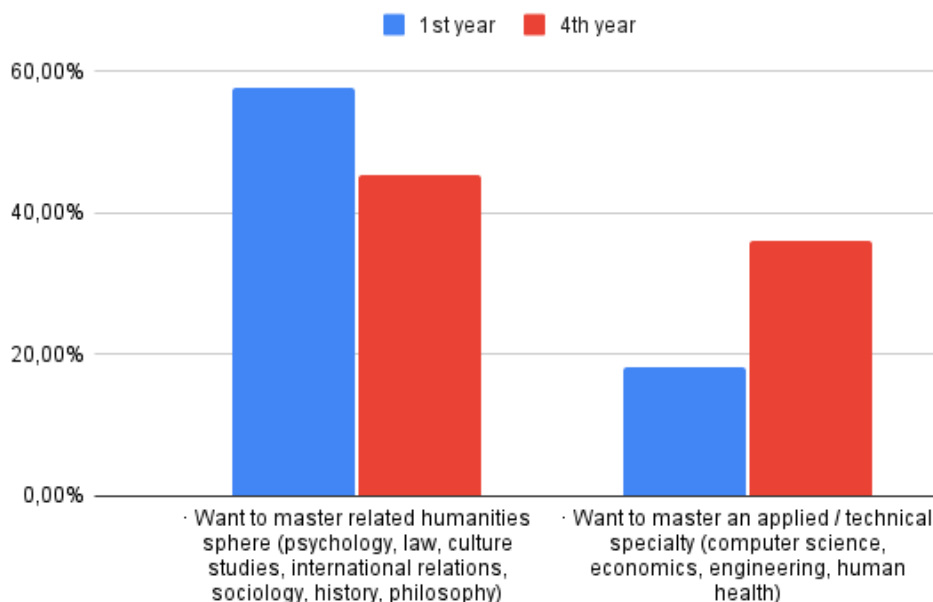


Figure 7: Interdisciplinary upskilling or reskilling in FLE assessment.

the transdisciplinary capability of FLE across various social areas (Knowledge economy, IT area, Public service area, Foreign economy area, Finance).

The inquiry results illuminate the induction regarding the accompanying proposals for FLE:

- Basic audit of the educational plan content to oblige the elements of multi-disciplinary digital humanities assumptions for the FLE students in the digital era;
- Audit and update of the FLE educational program content interconnectivity and learning results to oblige the interoperable connection point of competencies, modified to be compatible with language application in the digitized world;
- To devise an adaptable model of FLE content improvement to meet the dynamic transdisciplinary prerequisites of the digital job market in Industry 4.0.

The inquiry results will be further amended in the vein of evaluation of the interdisciplinary and interoperable digital competence flexibility for different groups of FLE students and faculty, as indicated by jobs and undertakings instrumental for the language acquisition process, as well as per age and section of digital education level.

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