Online and Face-to-Face Learning Effectiveness in Ukrainian Higher Education: A Multidimensional Comparison

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Abstract: The rapid digital transformation of higher education has intensified scholarly interest in the effectiveness of online learning. This study provides a multidimensional comparison of online and face-to-face learning effectiveness in Ukrainian higher education. Drawing on a mixed-methods research design, the study integrates a systematic review of recent empirical literature (2019-2025) with quantitative survey data collected from 140 university students. Learning effectiveness is conceptualized as a multidimensional construct encompassing academic outcomes, student engagement and motivation, interaction quality, technological and organizational conditions, and psychological perceptions of the educational process. The findings indicate that online learning demonstrates clear advantages in technological accessibility, organizational efficiency, and perceived psychological safety, while face-to-face learning shows stronger outcomes in fostering social interaction and the development of transferable skills. Differences in academic outcomes and motivation are comparatively moderate, suggesting that effectiveness is shaped less by learning modality per se and more by instructional design and institutional support. The results support a complementary interpretation of online and face-to-face formats rather than a dichotomous opposition between them. The study contributes empirical evidence from an underrepresented Eastern European context and offers practical implications for the balanced integration of digital learning formats in contemporary higher education systems.

1 INTRODUCTION

In the twenty-first century, digitalization has permeated all spheres of social life, triggering profound transformations in educational practices, particularly within higher education systems. One of the most significant consequences of this process has been the expansion of online education as an independent mode of organizing the educational process and an integral component of contemporary university curricula. Online education has become a key element of modern higher education, offering flexibility, accessibility, and cost efficiency. Across Europe, Ukraine, and globally, universities increasingly integrate online learning formats into their academic programs, reflecting broader trends toward digitalization and lifelong learning initiatives. In academic literature, online education is understood as a set of distance learning formats that involve the use of digital platforms, multimedia resources, and networked communication to ensure access to educational content regardless of learners' location or time constraints. The considerable scholarly interest in the effectiveness of this mode of learning is driven not only by its large-scale implementation during the COVID-19 pandemic but also by ongoing structural transformations in higher education systems in the post-pandemic period [1].

The effectiveness of online education in higher education institutions is conceptualized as a multidimensional construct encompassing students' academic outcomes (achievement and academic

performance), levels of engagement and learning motivation, as well as the capacity of digital environments to support communication among participants in the educational process. Findings from systematic reviews and meta-analyses indicate that the success of online learning largely depends on a complex set of factors, including course design quality, instructional structure, students' digital literacy, instructors' professional competence, and the availability of appropriate technological and organizational support at the institutional level. Moreover, some studies emphasize that the positive impact of online education on academic outcomes can be realized only when high-quality interactive elements, active participant interaction, and adaptive instructional design are incorporated [2].

Alongside its advantages related to flexibility, accessibility, and individualized learning pathways, online education faces significant challenges. These include sustaining student motivation, ensuring meaningful social interaction, mitigating feelings of isolation among participants, as well as overcoming technical and infrastructural barriers that limit equitable access to digital resources. Without adequate institutional support and proper instructor training, these factors can substantially undermine the effectiveness of online courses.

Despite the growing body of research on online learning, several limitations remain. Comparative analyses that integrate academic, motivational, interactional, technological, and psychological dimensions within a single analytical framework are still relatively limited. Furthermore, empirical evidence from Eastern European contexts, particularly Ukraine, remains underrepresented in the international scholarly discourse. Post-pandemic evaluations also tend to insufficiently address psychological and regulatory aspects of the educational experience, including perceptions of safety, stress, and well-being.

These limitations point to the need for a more integrative approach to assessing learning effectiveness, one that captures not only academic outcomes but also the behavioural, relational, technological, and psychological conditions under which learning occurs. In this regard, investigating online and face-to-face learning effectiveness in higher education constitutes not only a relevant academic issue but also an important societal task.

Accordingly, this study adopts a multidimensional analytical framework that incorporates academic, motivational, interactional, technological, and psychological perspectives as interrelated domains of educational effectiveness. The study aims to provide a systematic comparison of online and face-to-face learning in Ukrainian higher education. By doing so, it contributes empirical evidence to the ongoing discussion on the role of digital learning formats in contemporary university education.

2 LITERATURE REVIEW

In contemporary international research, the effectiveness of online education in higher education institutions examined as a multidimensional phenomenon encompassing academic, socio-psychological, technological, and organizational dimensions. Scholars emphasize that online learning provides learners with flexibility, opportunities for self-paced study, and access to interactive digital resources, thereby fostering higher engagement and deeper comprehension of learning materials. According to the literature, these characteristics can positively affect students' academic performance and overall achievement [3].

Research by Mohammadi et al. (2025) and Younas (2025) demonstrates that online learning environments can significantly enhance student motivation, increase opportunities for interaction, and create favorable conditions for developing digital competence. The authors highlight the necessity of standardized platforms, pedagogically supported student services, and continuous professional development for instructors as key elements for the successful implementation of such educational models [3], [4].

At the same time, the effectiveness of online learning depends not only on technological infrastructure but also on meaningful course design, participants' digital readiness, and students' psychological motivation. In particular, the development of interactive content, adaptive learning pathways, and tools supporting student self-regulation plays a decisive role in determining engagement levels and the ability to achieve intended learning outcomes. These findings align with the results of Yuan et al. (2024), who emphasize the importance of comprehensive analyses of learners' behavioral patterns for improving the predictability of online learning outcomes [5].

Studies on the effectiveness of online education indicate that digital platforms have a positive impact on student motivation to learn and self-regulation, as well as on student engagement and autonomy in the learning process. In turn, these factors correlate with improved academic performance, provided that

instructional content and pedagogical strategies are carefully designed and effectively implemented [6].

Instructors benefit from centralized content delivery systems, streamlined administrative processes, and improved capacity to monitor and assess student progress. For higher education institutions, online learning enhances cost efficiency, supports scalability, and expands access to a broader and more diverse student population, including international learners [7].

However, alongside these advantages, most reviews draw attention to substantial limitations and challenges associated with the implementation of online education. Some relate to limited social interaction, which may lead to feelings of isolation and decreased engagement, particularly in fully distance learning formats. Other studies highlight technical inequalities in access to high-quality digital resources, insufficient digital competence among some students, and difficulties in delivering laboratory-based and practice-oriented courses in virtual environments. These challenges underscore the importance of pedagogically grounded instructional design and comprehensive support for participants in online learning contexts [8].

Analytical reviews also emphasize the role of psychological factors in online education, such as autonomy, self-esteem, and self-regulation capacity, which function as critical determinants of learning success in digital environments. This perspective is reinforced by recent research asserting that motivation is not only a key predictor of success but also a compensatory factor capable of mitigating the absence of direct instructor-student interaction [9].

The study by Pashchenko et al. (2025) demonstrates that online learning environments incorporating interactive digital elements and structured content can contribute to higher student satisfaction and improved academic performance. Evaluations of such approaches also reveal positive dynamics in the development of critical thinking, analytical, and communicative skills, which are essential competencies for the contemporary labor market [10].

Overall, literature published over the past five years converges on a consistent conclusion: online education represents a significant component of contemporary educational practice capable of enhancing academic performance, motivation, and digital competence among students; however, its effectiveness largely depends on the integration of technology, pedagogically sound course design, and comprehensive support for participants in the educational process.

3 RESEARCH METHODOLOGY

To assess the effectiveness of online education in higher education, this study employed a mixed-methods research design combining quantitative and qualitative analytical approaches. This study adopts this design based on the premise that educational processes - particularly those mediated by digital technologies - are inherently multidimensional and cannot be adequately captured through a single methodological paradigm.

3.1 Research Design

The study adopts a descriptive-analytical and explanatory design based on the integration of secondary data analysis (scholarly literature) and primary empirical data collected through surveys. The application of methodological triangulation enhances the validity and reliability of the findings by minimizing the limitations inherent in individual methods.

3.2 Literature Review

At the first stage, a systematic review of scholarly literature was conducted, encompassing peer-reviewed journal articles, meta-analyses, and analytical reports published between 2019 and 2025. The selected timeframe reflects the period of accelerated digital transformation in higher education, particularly following the global expansion of online learning. The literature review enabled the identification of key indicators of online education effectiveness, as well as its principal advantages, challenges, and research gaps.

3.3 Sample and Data Collection

The empirical phase involved a quantitative survey administered to 140 students from the Faculty of Information and Computer Technologies at a higher education institution in the Zhytomyr region of Ukraine. Respondents represented different academic years and levels of experience with online and blended learning formats.

Data collected using a structured online questionnaire consisting of closed-ended and semi-open questions designed to measure:

- perceptions of online learning effectiveness;
- levels of student engagement and motivation;
- quality of student-instructor interaction;

- technological and organizational challenges associated with the digital learning environment;
- psychological perceptions of the educational process.

The online administration mode ensured methodological consistency with the digital context under investigation.

3.4 Research Instruments, Validity and Reliability

Survey items were developed in alignment with regulatory frameworks defined by strategic European Union policy documents in digital education, particularly the Digital Education Action Plan 2021-2027, as well as the core principles of the European Higher Education Area. Within these frameworks, online learning effectiveness is conceptualized as a multidimensional phenomenon encompassing not only academic outcomes but also student engagement and motivation, learning autonomy, and the quality of interaction in digital educational environments [11], [12]. This ensures comparability with European empirical practices and enables interpretation of the results as indicators of alignment between national educational contexts and European standards for digital higher education.

Likert-type scales were used for quantitative measures, facilitating subsequent statistical analysis. Content validity was ensured by aligning questionnaire items with theoretical models of online learning presented in contemporary academic literature.

3.5 Data Analysis Methods

Quantitative data were analyzed using descriptive statistics to identify general trends in perceptions of online education among students and instructors. Qualitative responses to open-ended questions were processed through thematic analysis involving coding and categorization of recurring themes, including advantages, challenges, and recommendations for improving online learning.

3.6 Ethical Considerations

The study was conducted in accordance with established ethical principles of academic research. Participation was voluntary, and all collected data were anonymized. Participants were informed about the purpose of the study and the exclusive use of the results for scientific research purposes.

3.7 Methodological Limitations

Key limitations of the study include reliance on self-reported data, which may affect response subjectivity, as well as the limited geographical representativeness of the sample. Nevertheless, the combination of quantitative and qualitative methods partially compensates for these limitations and provides a more holistic understanding of the phenomenon under investigation.

4 RESULTS AND DISCUSSION

This dimension reflects students' generalized perceptions of the effectiveness of the learning process in online and face-to-face learning in terms of achieving educational outcomes and the overall quality of the learning experience (Fig. 1).

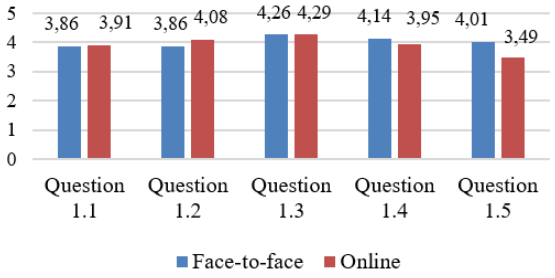

Figure 1: Perceived learning effectiveness across online and face-to-face formats.

In Figure 1:

- Question 1.1 - The learning process supports the achievement of programme learning outcomes and the development of required competencies.
- Question 1.2 - Learning materials and information are presented clearly and are easy to understand during classes
- Question 1.3 - I receive timely, meaningful, and constructive feedback from academic staff.
- Question 1.4 - Interaction with academic staff and fellow students helps me to better understand the learning material.
- Question 1.5 - The learning process effectively supports the development of my transferable skills (e.g. communication, critical thinking, teamwork).

The highest values in both formats are associated with receiving timely and substantive feedback from instructors (4.26 and 4.29 for face-to-face and online formats, respectively), confirming the consistently high importance of instructor support regardless of the mode of delivery.

The most pronounced gap in favor of face-to-face learning is observed in the development of soft skills (-0.52), which may indicate the limited capacity of the online environment to foster communicative, collaborative, and social competencies. A similar, though less pronounced, tendency is evident in the domain of interaction with instructors and peers (- 0.19). This underscores the need for targeted pedagogical and organizational reinforcement of social and communicative components within the digital learning environment.

Overall, the findings suggest that online learning is perceived as effective in terms of academic outcomes, accessibility of materials, and the quality of feedback. However, it lags behind the face-to-face format in fostering soft skills and social interaction. These results allow online and face-to-face learning formats to be interpreted as relatively holistic educational models in students' perceptions, each demonstrating distinct strengths and limitations.

Engagement and motivation (Fig. 2) represent the lowest-rated dimension across both formats, suggesting that the motivational-behavioral component constitutes the most vulnerable layer of the educational process. While mean differences between formats are small, the consistently moderate scores indicate that engagement is not format-specific but structurally constrained within both delivery modes.

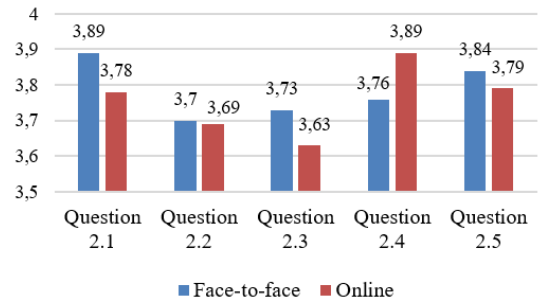

Figure 2: Student engagement and motivation across online and face-to-face formats.

In Figure 2:

- Question 2.1 - The learning format encouraged my active engagement in the educational process (e.g. completing tasks, participating in discussions, independent study).
- Question 2.2 - The learning format had a positive impact on my motivation to engage in regular study.
- Question 2.3 - The learning format contributed to the development of my self-discipline.
- Question 2.4 - I am interested in continuing my studies in this format in the future.
- Question 2.5 - Interaction with academic staff within this format supported my motivation to learn.

Online learning demonstrates relatively higher future-oriented acceptance (3.89), reflecting its perceived sustainability. However, lower ratings in self-discipline (3.63) and active participation (3.78) point to increased demands for autonomous regulation in digital environments.

Importantly, the absence of large format effects suggests that motivational dynamics are shaped less by modality and more by instructional design and regulatory demands. Theoretically, these findings support models of self-determination and academic engagement that emphasize structural and pedagogical scaffolding over delivery format per se. Thus, engagement appears to function as a cross-format systemic challenge rather than a modality-dependent deficit.

Interaction quality is evaluated positively across both formats, reinforcing the instructor's central role as a stabilizing agent within the educational system (Fig. 3). However, effect magnitudes reveal differentiated interaction logics.

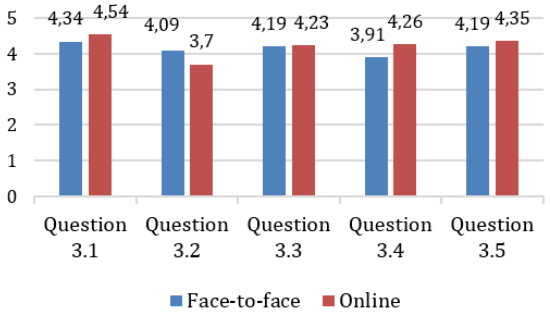

Figure 3: Student-instructor interaction quality across formats.

In Figure 3:

- Question 3.1 - During the educational process, academic staff adhere to the principles of academic integrity and demonstrate respect towards students.
- Question 3.2 - During classes, I experience a sense of presence and engagement from academic staff.

- Question 3.3 - I feel that I am an equal and valued participant in the educational process.
- Question 3.4- The system for organising and submitting assessed work is convenient and efficient.
- Question 3.5 - The assessment of my academic performance is fair and objective.

The most substantial face-to-face advantage is observed in perceived instructor presence (-0.39), indicating that embodied co-presence continues to shape relational and affective dimensions of teaching. This gap likely reflects the reduced transmission of nonverbal immediacy cues and spontaneous interaction in digital settings.

Conversely, online learning demonstrates moderate advantages in assignment organization and timeliness (+0.35), objectivity of assessment (+0.16), and academic integrity adherence (+0.20). These effects suggest that digital environments enhance procedural transparency and institutional clarity.

Taken together, these findings support a dual-process interpretation of interaction quality: face-to-face learning privilege relational immediacy, whereas online formats reinforce procedural structure. This distinction contributes to the growing literature on digital pedagogy by differentiating affective presence from organizational efficiency as parallel, format-contingent dimensions of instructional interaction.

Technological and organizational conditions constitute the strongest domain of online learning advantage (Fig. 4). Effect sizes are substantively larger here than in previous dimensions, indicating a structurally embedded digital benefit.

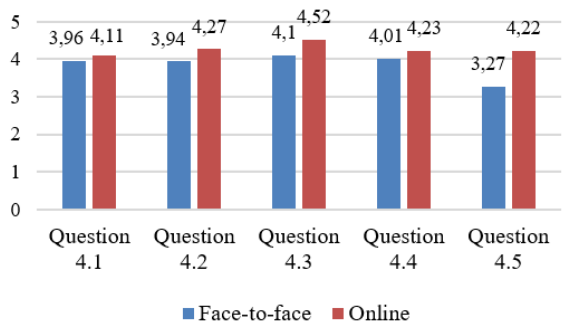

Figure 4: Technological and organizational conditions across formats.

In Figure 4:

- Question 4.1 - The institution provides timely technical support when difficulties arise.
- Question 4.2 - Learning materials are well structured and readily accessible.
- Question 4.3 - Academic staff make effective use of digital tools in the teaching and learning process.
- Question 4.4 - Overall, the technological and organisational conditions support the achievement of learning outcomes.
- Question 4.5 - During my studies, I am able to maintain a satisfactory balance between academic responsibilities and personal life.

The most pronounced effect concerns study-life balance (+0.95), representing the largest cross-format difference observed across all dimensions. This substantial magnitude underscores flexibility and temporal autonomy as defining affordances of digital learning. Additional moderate advantages are found in effective use of digital tools (+0.42) and accessibility of learning materials (+0.33), confirming structural optimization within the online environment.

In contrast, differences in technical support are minimal (+0.15), suggesting institutional parity across formats.

Theoretically, these results align with affordance-based models of digital learning, wherein technology-mediated environments reconfigure spatial-temporal constraints and resource accessibility. However, variability within online ratings indicates that digital effectiveness is contingent upon institutional implementation quality rather than inherent technological superiority.

Psychological perceptions display the most context-sensitive pattern (Fig. 5).

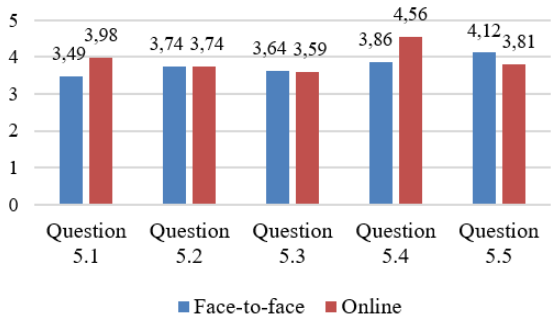

Figure 5: Psychological perceptions across online and face-to-face formats.

In Figure 5:

- Question 5.1 - The level of stress associated with my studies is manageable.
- Question 5.2 - During classes, I am able to concentrate and sustain my attention.

- Question 5.3 - I feel that I receive adequate psychological and emotional support from academic staff and fellow students.
- Question 5.4 - I feel safe within the educational environment.
- Question 5.5 - The level of social interaction available to me during my studies is sufficient.

Online learning shows clear advantages in perceived safety (+0.70) and acceptable stress levels (+0.49), both representing moderate-to-large effects relative to other dimensions. These magnitudes suggest that psychological regulation may be more strongly influenced by learning format than academic outcomes.

Conversely, face-to-face learning retains an advantage in social interaction (-0.31), indicating the enduring importance of direct interpersonal contact for socio-emotional integration.

Given the Ukrainian national context of the sample, elevated sensitivity to safety and stress indicators may reflect broader environmental instability. Thus, format effects should be interpreted within macro-contextual conditions influencing psychological security.

Conceptually, these findings extend the discourse on digital learning by introducing a regulatory perspective: online environments may function as psychological buffers by reducing situational stressors, while face-to-face learning sustain social belonging and relational depth. The complementarity of these effects supports hybrid models that integrate digital psychological safety with face-to-face social capital.

The analysis of students' open-ended responses regarding the effectiveness of online learning and its potential improvement identified a set of interrelated organizational, pedagogical, and technological factors shaping perceptions of educational quality.

Primarily, students associate the effectiveness of the online format with a clearly structured course design, including a logical division of content into topics, transparent requirements, explicit assessment criteria, and well-defined deadlines. Such structural clarity reduces uncertainty and facilitates more effective planning of learning activities.

A major advantage of online learning is perceived as temporal and spatial flexibility. The elimination of commuting, the opportunity to study in a comfortable environment, and the possibility of combining studies with employment are considered factors enhancing productivity. Comfortable conditions are seen as supporting concentration and reducing psychological strain. At the same time, some respondents report decreased motivation and limited social interaction, reflecting an ambivalent perception of distance education.

Instructional design quality emerges as another critical component of effectiveness. Students highlight the importance of clear explanations, real-time demonstrations during practical sessions, access to recorded lectures, and supplementary video materials. There is also a strong demand for greater interactivity, including quizzes, polls, short in-class tasks, and brief feedback activities. Interactivity is interpreted as a mechanism for sustaining attention and cognitive engagement.

Many responses emphasize the need to strengthen the practical and applied orientation of courses by increasing the number of practice-based activities, incorporating real-life cases, and reconsidering the balance between theory and practice. The effectiveness of online learning is further linked to the development of learner autonomy, self-discipline, and intrinsic motivation, indicating the growing importance of self-regulation in digital learning environments.

The technological dimension is regarded as a foundational condition for quality education, including stable internet access, user-friendly platforms, digital automation tools, and the integration of innovative solutions. Additionally, some responses extend beyond organizational improvements and raise broader concerns about the impact of artificial intelligence on academic integrity, motivation, and future professional prospects.

Overall, enhancing the effectiveness of online learning, from the students' perspective, requires a comprehensive approach integrating structured course organization, interactive teaching methods, accessible learning materials, practical orientation, technological optimization, and consideration of long-term digital transformations in education.

5 CONCLUSIONS

The present study provides a multidimensional comparison of online and face-to-face learning effectiveness in Ukrainian higher education, integrating academic, motivational, interactional, technological, and psychological dimensions. The findings demonstrate that learning effectiveness cannot be reduced to a single modality-based hierarchy; rather, both formats exhibit distinct strengths and limitations across different dimensions of the educational process.

In terms of academic outcomes and feedback quality, differences between formats are relatively moderate. Both online and face-to-face learning demonstrate comparable levels of perceived support for learning outcomes and constructive instructor feedback. However, face-to-face learning shows a

stronger contribution to the development of transferable skills and social interaction, underscoring the importance of embodied co-presence for communicative and collaborative competencies.

Online learning demonstrates its most pronounced advantages in technological and organizational conditions. Students report higher levels of material accessibility, effective use of digital tools, structured assessment procedures, and improved study-life balance, with flexibility and temporal autonomy emerging as defining affordances of digital environments.

Psychological perceptions reveal a differentiated pattern: online learning is associated with higher perceived safety and lower stress, whereas face-to-face learning maintains an advantage in social integration and interpersonal interaction. These findings suggest that digital environments may enhance psychological stability, while face-to-face formats strengthen relational depth and social belonging.

Engagement and motivation appear only moderately influenced by modality. The relatively small differences across formats indicate that student engagement is shaped more by instructional design and institutional support than by delivery mode itself.

Overall, the results support a complementary rather than oppositional understanding of online and face-to-face learning formats. Each modality demonstrates specific affordances that contribute to different aspects of educational effectiveness. Therefore, strategic integration of digital and face-to-face elements may enhance institutional resilience and educational quality.

The study is limited by its reliance on self-reported data and a sample drawn from a single faculty, which may influence generalizability. Future research should incorporate cross-disciplinary samples, multi-institutional comparisons, and longitudinal designs to further examine the evolving relationship between digital and face-to-face learning environments.

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