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Oksana Mkrtichian
Doctor of Science (Pedagogy), Associate Professor, Associate Professor of Theory, Technologies and Methods of Pre-school Education
H.S. Skovoroda Kharkiv National Pedagogical University, Kharkiv, Ukraine
oksana.mkrtichan@gmail.com
ORCID: 0000-0003-4962-3631

DIDACTIC DESIGN OF PEDAGOGICAL TECHNOLOGIES IN BLENDED LEARNING: THEORETICAL AND METHODOLOGICAL PRINCIPLES AND IMPLEMENTATION MODEL IN HIGHER EDUCATION INSTITUTIONS

Abstract. The article is devoted to the justification of the didactic design of pedagogical technologies in blended learning as a condition for the transition from situational “digitalization” to a controlled, reproducible and diagnostic organization of the educational process in higher education institutions. The purpose of the publication is to provide a theoretical and methodological justification of the didactic design of pedagogical technologies in blended learning and to develop a model for their implementation at the level of the educational component with the definition of quality criteria and performance indicators. The methodological basis is a synthesis of competency-based, activity-based and constructivist approaches, operationalized through the logic of instructional design: designing from expected results and evidence of their achievement to educational activities and resources. The distinction between the levels “methodology - pedagogical technology - digital tool” is clarified, which prevents instrumental reductionism and fixes the priority of pedagogical logic over the choice of platform. The author's implementation model is proposed as a five-stage cycle (context analysis → design → implementation → evaluation and correction → scaling and QA cycle) with feedback loops that provide redesign based on evaluation data. The "core" of the model is defined: quality criteria (consistency of results, activities and evaluation; quality of learning events and interactions; validity of integration of digital tools) and performance indicators (achievement of results by rubrics, dynamics of progress, involvement and repeatability of results in different groups). It is shown that neural networks and generative tools are a new stage in the development of pedagogical technologies in blended learning, however, their educational value is realized under conditions of transparent evaluation, academic integrity and digital pedagogical competence of the teacher. Practical implications include the use of the design matrix “results → evidence → activities → tools” and a regular cycle of course revision based on data.

Keywords: didactic design; pedagogical technology; blended learning; internal quality assurance; quality criteria; digital pedagogical competence; neural networks; higher education institutions

INTRODUCTION

Modern higher education is in a phase where blended learning is gradually moving from a forced decision mode to the status of a sustainable organizational and didactic model that combines classroom and online components into a single logic for achieving learning outcomes (Kharchenko et al., 2024). It is fundamentally important to distinguish between emergency distance learning as a crisis response of the system and designed online/blended learning as a pedagogically sound model with predictable outcomes, quality criteria and reproducible procedures (Hodges et al., 2020; Nalyvaiko, Vakulenko, & Zemlin, 2020). That is why the focus is not on the “availability of digital tools”, but on the didactic design of pedagogical technologies that ensures course integrity, manageability of the learning process and validity of assessment.

In international academic discourse, blended learning is interpreted as a combination of face-to-face learning with computer-mediated learning (Graham, 2006) or as a “balanced integration” of face-to-face and online learning experiences (Garrison & Kanuka, 2004). Both definitions emphasize that the key feature is not the mechanical “adding” of online activities, but the thoughtful construction of a learning environment in which different modalities work towards common goals and mutually reinforce each other (Garrison & Kanuka, 2004; Graham, 2006). For higher education institutions (HEIs), this means the need to rethink traditional teaching scenarios - from planning outcomes and structuring content to selecting activities and assessment procedures.

Empirical generalizations confirm the potential of blended formats, provided they are properly designed. Meta-analyses of online and blended learning research demonstrate that blended approaches are often as effective as traditional learning and, in some configurations, may outperform purely classroom models (Bernard et al., 2014; Means et al., 2010; Kalyniuk et al., 2024). More recent generalizations also emphasize that the benefits are primarily due to pedagogical decisions (type of activities, nature of interaction, organization of practice and feedback) rather than the use of technology itself (Schmid et al., 2023). Thus, the effectiveness of blended learning is derived from the quality of the didactic design and the coherence of its components.

At the same time, in the practice of higher education institutions, a methodologically risky trend is observed: pedagogical technology is identified with a digital service or platform, and "implementation" is reduced to the instrumental equipment of the course. Such a reduction shifts the emphasis from pedagogical goals to technical means and complicates quality control, comparability of results and reproducibility of educational solutions. The scientific and practical problem lies in the lack of sufficiently operationalized criteria that allow: (a) to distinguish between methodology, pedagogical technology and digital tools; (b) to ensure the technologicality of the educational process (controllability, reproducibility, diagnosticity); (c) to design blended courses as systems where results, learning activities and assessment are coordinated. In this context, constructive alignment and reverse engineering approaches are methodologically productive, requiring a fundamental correspondence between expected outcomes, learning activities, and assessment tools (Biggs & Tang, 2011; Wiggins & McTighe, 2005). Additionally, generalized principles of instructional design are important for didactic design, focused on activating previous experience, problem-solving, demonstration, application, and integration of knowledge into meaningful tasks (Merrill, 2002).

In light of the above, the need for theoretical and methodological substantiation of the didactic design of pedagogical technologies in blended learning and the creation of an implementation model that can be used as a "framework" for designing courses in higher education and for internal quality assurance is becoming more urgent.

The purpose of the article is to theoretically and methodologically substantiate the didactic design of pedagogical technologies in blended learning and to propose a model for their implementation in higher education with the definition of quality criteria and performance indicators.

The objectives of the article:

− to clarify the conceptual boundaries of the category of "pedagogical technology" in relation to the methodology and digital tool;

− to outline the principles of technological feasibility of the educational process in the context of blended learning;

− to determine the methodological framework for designing pedagogical technologies (competence-based, activity-based, constructivist approaches) and their connection with the logic of instructional design;

− to develop a conceptual model of implementation (context analysis → design → implementation → evaluation → scaling);

− to propose quality criteria and performance indicators for application at the course/educational component level.

RESEARCH RESULTS

Heoretical approaches to the concept of "pedagogical technology". In the modern scientific tradition, the concept of pedagogical technology is formed at the intersection of two complementary lines: (a) the international (Anglo-American) discussion of educational / instructional technology as a systematic design of learning; (b) the continental (in particular, post-Soviet) line of technologization of the educational process as the design and reproducible deployment of the pedagogical system. It is important that in both approaches the key idea is systematicity, manageability and result orientation, and not only the use of technical means.

Early interpretations of educational technologies often reduced them to the use of technical means of learning. Instead, already in the 1980s, international glossaries emphasized a broader interpretation: educational technology is understood as a systematic way of designing, applying and evaluating a holistic learning and teaching process, taking into account resources and the interaction of system components.

In the further development of the field (in particular within the framework of AECT), the concept of "educational technology" was clarified as an ethical and research-based practice focused on facilitating learning and improving performance through the creation, use and management of appropriate processes and resources. Important for our topic is that here "technology" is primarily the logic of designing and managing educational processes, and not a list of digital tools.

It is significant that professional associations continue to update the definition, expanding it to the strategic design, implementation and evaluation of educational environments and learning experiences. This captures the dynamic nature of the concept and the need to "tie" it to the context of higher education and blended learning each time.

For correct didactic design in blended learning, it is fundamentally important to distinguish three levels of description:

Methodology is a set of methods, techniques and methods for organizing educational interaction that specify how to act within a certain didactic logic (for example, the methodology for conducting a seminar, organizing a discussion, debate, case analysis). The methodology usually allows for high variability in implementation and significant dependence on the individual style of the teacher.

Pedagogical technology is a systematically designed and reproducible way of organizing the educational process, in which the goals, logic of actions, means, control procedures and result criteria are predetermined. In the classical technological paradigm, pedagogical technology is thought of as a project of a pedagogical system implemented in practice. Its "technological" does not mean mechanistic, but a scientifically substantiated reduction of the share of randomness and pedagogical "impromptu" due to preliminary design, phased implementation and verifiable result.

A digital tool (platform, service, application, LMS, interactive module, etc.) is a resource that can be built into a methodology or technology, but in itself is not equal to pedagogical technology. A digital tool acquires pedagogical meaning only when it is subordinated to a didactic goal, a scenario of educational activity and an assessment procedure. This division is especially important for blended learning, where the risk of "instrumentalism" (replacing the design of learning with a set of services) is methodologically and practically high.

Therefore, within the framework of our article, it is appropriate to interpret pedagogical technology as an integrative construct that includes: (a) a conceptual basis (approaches, principles), (b) a content-target block (results/competences), (c) a procedural-operational block (activities, interaction, resources), (d) an evaluation-diagnostic block (indicators, criteria, assessment tools).

The technological approach in didactics is traditionally described through a set of properties that ensure the controlled achievement of results.

Firstly, conceptuality and systematicity: the technology must be based on clear theoretical provisions and demonstrate the internal consistency of the components (goals ↔ content ↔ activities ↔ evaluation). In this sense, pedagogical technology is directly related to the systemic approach and depends on the structuring of the pedagogical system.

Secondly, controllability: the ability to set goals, plan, design, stage-by-stage diagnostics and correction of the educational process. It is controllability that transfers technology from the level of "intentions" to the level of procedures that can be checked, compared and improved.

Third, algorithmicity and reproducibility: the presence of a logically consistent scenario (stages and actions) that can be reproduced by other teachers in other groups under similar conditions with a predicted pedagogical effect. The idea of preliminary design with subsequent "accurate reproduction in the classroom" is explicitly stated in the technological tradition as a way to guarantee the success of pedagogical processes.

Fourth, effectiveness and diagnosticity: technology should be oriented towards an objectively fixed result (learning outcomes) and contain procedures for measuring the degree of its achievement. In technological logic, the problem of goals and control is not auxiliary - it is central; this determines the requirement for diagnostic formulation of goals and transparent assessment criteria.

In modern Ukrainian research, technologicality is also operationalized through similar characteristics (conceptuality, systematicity, manageability, algorithmicity, reproducibility, efficiency, diagnosticity), which confirms the convergence of the domestic and international logic of understanding "technology" as a managed design of the educational process. Thus, in the context of blended learning in higher education, pedagogical technology should be considered not as "digitalization of classes", but as a didactically designed, managed and evaluated system of organizing educational activities, where digital tools are resources for implementation, but do not replace the methodology and instructional design logic.

Methodological framework for designing pedagogical technologies in blended learning. The methodological correctness of didactic design in blended learning lies in the fact that the "technology" is designed not from the tool, but from the pedagogical meaning: learning goals/outcomes, the logic of the learner's activity, methods of interaction and valid assessment procedures. This section substantiates three complementary frameworks competency-based, activity-based and constructivist, that set requirements for structuring the course, selecting learning activities and setting up assessment in a blended format.

Competency-based approach: design from outcomes and evidence of their achievement

The competency-based approach in higher education focuses on describing learning outcomes as integrated entities (knowledge, skills, attitudes, ability to act in a situation) that should be observed and assessed. That is why it methodologically "pushes" course design towards a clear formulation of outcomes and the construction of a transparent system of criteria/indicators, rather than "covering topics". As European competence policies show, digital competence and the ability to learn throughout life are considered key educational outcomes that should be integrated throughout programmes and courses (Council of the EU, 2018).

For blended learning, the competence framework has two specific consequences. First, learning outcomes should be broken down at the course level: what exactly the learner demonstrates in classroom interaction, what in online activities, and how this "evidence" is collected into a holistic profile of achievements. Second, the role of the teacher's digital competence as a condition for effective design is increasing: it is not about technical skills in using services, but about the ability to select digital resources for pedagogical purposes, organize interaction, differentiation and assessment. This is systematically described in the DigCompEdu framework (Redecker, 2017).

It is significant that scientific analyses of competency-based higher education emphasize that competency as a category becomes productive only when it is not reduced to overly detailed lists, but is embedded in real educational practices through tasks, contexts, and assessment procedures (Mulder et al., 2009).

Activity-based approach: designing from learning action and situation

The activity-based approach (in the broad tradition of cultural-historical psychology) assumes that learning is a socially mediated activity, where tools (including digital ones) have meaning only as means of organizing action and interaction. In this logic, the key design question is: what activity must the learner perform in order to form the desired way of thinking/acting? (Vygotsky, 1978).

For blended learning, the activity perspective is methodologically particularly productive, as it allows for the distribution and coordination of activities between environments:

− audience – for dialogical interaction, modeling, joint problem solving, rapid formative feedback;

− online – for individual practice, working with resources, asynchronous discussions, collecting “digital traces” of learning (progress, contribution, errors), which can serve as a basis for design correction.

Within the framework of activity theory, it is also important to analyze the activity system as a whole: object (learning task), subject (learner), tools (resources/platforms), rules (academic integrity, criteria), community and distribution of roles. This optics helps to see not only the “motivation deficit”, but also structural contradictions (e.g., the discrepancy between stated outcomes and actual tasks/assessments) that inhibit performance (Engeström, 1987).

Constructivist approach: knowledge as the result of active construction

The constructivist framework argues that learning is a process of active construction of knowledge in tasks that have a meaningful context, problematization and cognitive challenge. In design, this means prioritizing: authentic tasks, explanation of one’s own thinking, reflection, collaboration and transfer. The classic formulation of the “objectivism vs. constructivism” debate emphasizes that constructivist designs require different assessment procedures ones that capture not just reproduction but also understanding, application, and argumentation (Jonassen, 1991).

For blended learning, constructivism provides a fundamental guideline: the online component cannot be simply “content to view” but must include activities (tasks, discussions, projects, micro-inquiries), otherwise the technology loses its pedagogical nature. This framework therefore logically fits in with models that describe educational interaction as a community of knowledge in online/blended courses.

4) Instructional design logic: alignment of goals, activities, and assessment

The methodological approaches above become operational only when they are “translated” into the language of instructional design. Here, it is appropriate to rely on four complementary pillars.

(a) Backward design: designing “backwards” from desired outcomes to assessment evidence and then to learning activities (Wiggins & McTighe, 2005).

(b) Constructive alignment: constructive alignment of outcomes, learning objectives, and assessment as a condition for the quality of university education (Biggs & Tang, 2011).

(c) Process design models (ADDIE): as a management framework for the sequence “analysis → design → development → implementation → evaluation”, convenient for institutional standardization of course design (Branch, 2009).

(d) Principles of effective learning: for example, “First Principles of Instruction” (problem, activation of prior experience, demonstration, application, integration) as criteria for the quality of learning events regardless of the environment (Merrill, 2002).

Separately, for the blended/online component, the Community of Inquiry (CoI) framework is methodologically productive, describing the quality of the learning experience as the interaction of cognitive presence, social presence, and teaching presence (Garrison et al., 2000). It allows translating "soft" categories of interaction into design solutions: which forms of communication support social presence, which tasks support cognitive presence, and which tools/strategies ensure teaching presence in a blended course.

Finally, to ensure professional correctness of the integration of digital resources, it is advisable to take into account the TPACK framework (see Fig. 1.), which emphasizes that effective use of technology does not arise from "service ownership", but from a combination of technological, pedagogical and subject knowledge (Mishra & Koehler, 2006).

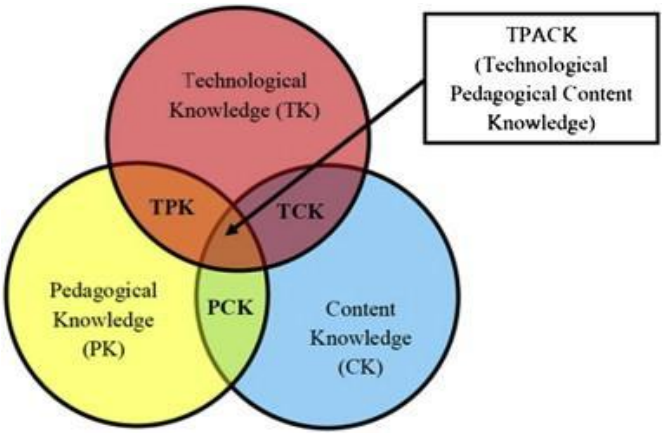

Fig. 1. The development, validity and reliability of TPACK-deep:
A technological pedagogical content knowledge scale
(Source: Yurdakul et al., 2012)

Thus, the competency framework answers the question "what exactly should be formed"; the activity framework – "through what action and interaction is it formed"; the constructivist framework – "what tasks should be in order for meaningful construction of knowledge to occur"; and instructional design translates these answers into a guided course design algorithm (backward design + constructive alignment + ADDIE) with verifiable principles of the quality of learning events (Merrill, 2002) and parameters of online/blended interaction (CoI).

Author's model for implementing didactic design of pedagogical technologies in blended learning (in higher education). The proposed author's model for implementing didactic design of pedagogical technologies in blended learning is based on a combination of the design logic of instructional design and the requirements of internal quality assurance in higher education. At the heart of the model is the principle according to which pedagogical technology in a blended course should be managed, reproduced and diagnostic, and therefore described as a sequence of stages with clear solutions and evidence of implementation. Methodologically, the model integrates the ADDIE (Analyze–Design–Develop–Implement–Evaluate) process framework as a management structure for design (Branch, 2009), the idea of "backward" design, which sets the movement from expected results to evidence of their achievement and only then to learning events (Wiggins & McTighe, 2005), as well as the constructive alignment of results, activities and evaluation (Biggs, 1996; Biggs & Tang, 2011). At the institutional level, the model correlates with the European Standards and Guidelines for Quality Assurance (ESG), which emphasize the cyclical nature of planning, implementation, review and improvement of the educational process (ENQA, 2015).

Stage 1. Context analysis.

The first stage fixes the principled position: in blended learning, technology does not begin with the selection of a platform, but with the analysis of the learning context as a system of conditions and constraints. First of all, the expected learning outcomes and competences that the educational component should provide, as well as the level of preparedness and learning needs of the target group, are specified. Institutional factors require separate analysis: available digital environments (LMS, etc.), teacher support resources, assessment rules and academic integrity policies. It is important that in modern European approaches, digital competence is conceived as a key competence for lifelong learning (Council of the EU, 2018), and the DigCompEdu framework sets guidelines specifically for the digital pedagogical competence of the teacher (Redecker, 2017). The result of this stage should be a “course passport”: a short contextual profile with defined goals, risks, resources and an initial map of competences.

Stage 2. Design (Didactic design).

The second stage is the core of the model, since it is here that the logic of the course as a pedagogical technology is set. Within the framework of backward design, the learning outcomes and criteria for their achievement are clarified, after which valid evidence (assessment evidence) is constructed, and only then - learning activities and resources (Wiggins & McTighe, 2005). Constructive coordination requires that the designed activities really “provoke” those actions of thinking and practice that correspond to the declared results, and the assessment checks these results, and not peripheral skills (Biggs, 1996; Biggs & Tang, 2011). At the level of quality of learning events, it is advisable to rely on principles that are considered universal for effective learning (problems, activation of experience, demonstration, application, integration) (Merrill, 2002).

In a blended course, design also includes designing interactions in the online component not as an “add-on” to classroom work, but as a full-fledged learning environment. Here, the Community of Inquiry framework is methodologically productive, describing the quality of the educational experience through the interaction of teaching, social, and cognitive presences (Garrison, Anderson, & Archer, 2000; Garrison, 2007). Finally, the choice of digital tools within the design phase should be subordinated to pedagogical decisions; the TPACK framework emphasizes that effective integration of technologies occurs only when subject, pedagogical, and technological knowledge are combined (Mishra & Koehler, 2006). The result of the phase is a course design matrix (outcomes → evidence → activities → tools/environments) and an assessment blueprint with rubrics and criteria.

Stage 3. Implementation.

The third stage in the model is interpreted as the reproduction of the designed technology in the real educational process. Here it is critically important to ensure the “visibility” of the technology for learners: transparent rules, clear criteria, the rhythm of communication and feedback, as well as the organization of the learning environment in the LMS in accordance with the design matrix . In terms of CoI, it is at the implementation stage that the practical deployment of the teaching presence as an organization, facilitation and direction of the educational discourse takes place (Garrison et al., 2000; Garrison, 2007). At the same time, implementation involves launching formative assessment procedures and collecting intermediate evidence of progress - as a basis for further correction of the design (Branch, 2009). The result of this stage is a functional “implementation package”: training modules, instructions, criteria, tasks, rubrics, feedback protocols and rules for honest work with digital resources.

Stage 4. Evaluation & improvement.

The fourth stage ensures the diagnosticity and controllability of the technology. Evaluation in the model has two contours: formative (operational indicators of progress) and summative (the degree of achievement of learning outcomes, confirmed by criterion-based assessment). In blended learning, learning analytics data acquire special importance as an additional source of “signals” about the quality of the course; SoLAR emphasizes that learning analytics is associated with the collection and analysis of data about learning in order to understand and optimize it. Fundamentally, correction should concern not only the content, but also the structure of activities and assessment procedures: if a gap is detected between the declared results and what is actually measured, this means a violation of constructive coordination (Biggs, 1996). The result of the stage is an analytical report on the achievement of results and a plan for point changes for the next cycle.

Stage 5. Scaling and standardization of quality (Scaling & QA cycle).

The fifth stage transfers the technology from the level of "author's course" to the level of institutional practice. If the technology claims to be reproducible, it should be described as a standard (or at least as an instructional and methodological package) indicating the stages, resource requirements, quality criteria and review procedures. ESG sees quality as a continuous cycle that includes planning, implementation, monitoring, review and public accountability for the results of the educational process (ENQA, 2015). At this stage, it is also advisable to provide support for the professional development of teachers, in particular in terms of digital pedagogical competencies (Redecker, 2017). The result is a "technology passport" of the course and an internal audit/expertise mechanism suitable for scaling within the educational program or HEI.

Quality criteria and performance indicators as the "core" of the model.

To ensure expert suitability, the model distinguishes between: (a) quality criteria for instructional design, which are tested at the course design level, and (b) performance indicators, which are recorded based on the results of implementation. The key quality criterion is alignment between outcomes, activities, and assessment, which reflects both the logic of backward design and constructive alignment (Wiggins & McTighe, 2005; Biggs, 1996). The second group of criteria is the quality of learning events (compliance with the principles of problem-based, applied, and integrated learning) (Merrill, 2002) and the quality of interaction in the online component, which can be operationalized through indicators of teaching, social, and cognitive presence (Garrison et al., 2000; Garrison, 2007). Another important quality criterion is the soundness of the integration of digital tools, which is conceptually consistent with TPACK (Mishra & Koehler, 2006).

Performance indicators should be grouped at the level of learning outcomes (degree of achievement of ILOs by rubric and quality of work performed), at the level of learning dynamics (engagement at critical points of the course, timeliness, sustainability of progress), and at the level of institutional effects (repeatability of results across groups and teachers as an empirical indicator of the reproducibility of the technology). In blended learning, these indicators can be strengthened by learning analytics data if they are used as a basis for pedagogically meaningful improvement, rather than as formal "digital reporting"

Stages of the model in the form of a conceptual scheme: how it works at the course level. At the level of a specific educational component, the proposed model functions as a guided cycle of didactic design, in which decisions regarding content, activities and digital resources are subordinated to the logic of achieving the planned results. The operational basis of the cycle is the ADDIE process framework (analysis → design → development/preparation → implementation → evaluation), which ensures the consistency of decisions and the possibility of repeated reproduction of the technology in different groups (Branch, 2009).

The internal "axis" of the model is set by the principle of backward design: first, the expected learning outcomes (ILOs) are specified, then acceptable evidence of their achievement (assessment evidence) is determined, and only then are learning events and resources constructed (Wiggins & McTighe, 2005). This sequence reduces the risk of course fragmentation and allows us to distinguish where digital tools are truly pedagogically necessary and where they merely instrumentally "decorate" the process without contributing to the results.

A key condition for the scheme's operability is constructive alignment, i.e., systemic correspondence between outcomes, learning activities, and assessment (Biggs & Tang, 2011).

In practical terms, this means: (1) activities should provoke precisely those actions of thinking and practice that are “sewn” into ILOs; (2) assessment should check not peripheral signs of activity, but essential indicators of result achievement; (3) digital tools are selected not according to the principle of popularity, but as means of implementing specific learning events and feedback procedures (Mishra & Koehler, 2006).

Within the framework of blended learning, the scheme additionally provides for the design of online interaction as a full-fledged segment of learning activity. Here, the quality parameters are the components of Community of Inquiry teaching, social, and cognitive presence, which together describe the conditions for a productive learning experience in a computer-mediated environment (Garrison et al., 2000). As a result, the model sets not only the implementation phase for the course, but also the criteria by which the quality of the design can be expertly assessed and reasonably adjusted in the next cycle.

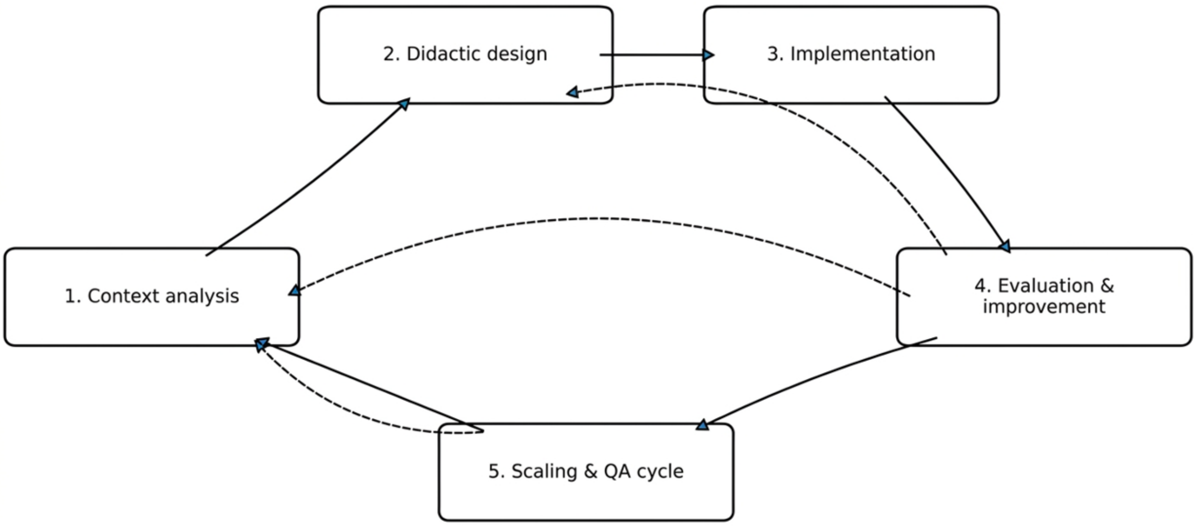

Fig. 2. Conceptual scheme for implementing the didactic design of pedagogical technologies in blended learning
(Source: Developed by the author)

Note. Solid arrows indicate the primary implementation sequence (1→2→3→4→5). Feedback arrows from stage 4 to stages 1–2 indicate redesign based on evaluation data (learning evidence, rubrics-based results, engagement signals, and identified misalignments). The feedback from stage 5 to stage 1 indicates re-analysis when the technology is institutionalized or scaled to new contexts.

Discussion. The most typical risk of implementing pedagogical technologies in blended learning is the instrumental reduction of design, when the technology is mistakenly identified with a platform or a set of digital services. In this case, the course acquires signs of “mosaicness”: activities exist next to each other, but do not support a single logic of achieving results, and assessment mainly records activity/presence, not educational achievements. That is why constructive coordination and backward design in the model act as a methodological fuse (Biggs & Tang, 2011; Wiggins & McTighe, 2005).

The second group of conditions for effectiveness is the readiness of the teacher, and not only technical, but also digital-pedagogical: the ability to select digital resources for didactic tasks, design interaction, organize formative assessment and ensure academic integrity through the design of assessment practices. This competence plane is systematically described by DigCompEdu (Redecker, 2017). In practice, this means that even a high-quality design-“framework” needs to be reinforced by professional development and methodological support from the HEI.

Infrastructural and organizational constraints should be taken into account separately: the availability of LMS and digital resources, the stability of communication, student support, as well as the realistic workload (for the teacher and applicants) (Shumeiko, 2024). In the European ESG logic, quality is conceived as a systemic responsibility of the institution, which includes support for the implementation of courses, transparency of procedures, regular review and improvement (ENQA, 2015).

Neural networks and generative AI systems can be considered as a qualitatively new stage in the evolution of pedagogical technologies in blended learning, as they shift the emphasis from simple “digitalization” of material delivery to AI-supported design and management of the educational process: personalization of trajectories, adaptive reinforcement (scaffolding), accelerated feedback, and analytically substantiated course improvement. At the same time, the educational potential of neural networks is revealed only if they are methodically well-consideredly embedded in didactic logic and subordinated to quality criteria; otherwise, AI recreates the risk of instrumental reduction, when technology is identified with a service, and pedagogical design is replaced by a technical solution (Nalyvaiko et al, 2024). In this sense, the integration of neural networks into blended courses should be considered as a design solution within the framework of constructive coordination of outcomes, learning activities, and assessment, supported by the digital pedagogical competence of the teacher and the internal quality assurance procedures of the HEI.

Finally, in the context of blended learning, the issues of integrity, privacy and trust are exacerbated, especially when institutions lean towards technocratic solutions such as online proctoring. Research indicates that privacy and “contextual integrity” of data collection are one of the key barriers to the acceptance of such systems in higher education, so assessment design must balance the validity of control and student rights (Mutimukwe et al., 2023).

CONCLUSIONS AND PROSPECTS FOR FURTHER RESEARCH

The article theoretically and methodologically substantiates that the didactic design of pedagogical technologies in blended learning should be considered as a manageable and reproducible system of solutions, in which digital tools play the role of means of implementation, but do not replace pedagogical logic. The starting point is the design from learning outcomes and evidence of their achievement, with the subsequent selection of learning events and resources in accordance with the principles of instructional design

The feasibility of a clear distinction between the levels of methodology - pedagogical technology - digital tool as a methodological condition for the quality of blended learning is proven. Such a distinction prevents instrumental reduction, when technology is mistakenly identified with the platform, and shifts the emphasis to the systemic coordination of goals, activities and assessment.

It is shown that the technological feasibility of pedagogical technology in blended learning is ensured by three interrelated characteristics: manageability (the availability of planning, monitoring and correction procedures), reproducibility (the description of stages and actions suitable for repetition in other groups) and diagnosticity (the operationalization of results and assessment criteria that provide valid “evidence” of educational achievements).

The methodological framework for designing pedagogical technologies in blended learning is substantiated as an integration of competency-based, activity-based and constructivist approaches. In such integration, the competency-based approach sets requirements for measurable learning outcomes, the activity approach sets requirements for the design of educational action and interaction, and the constructivist approach sets requirements for the priority of authentic tasks, reflection and transfer of knowledge into meaningful contexts.

The operational principles of instructional design for blended courses are systematized: backward design as the logic of movement from results to evidence and learning events; constructive alignment as a criterion of coherence; and the principles of effective learning as requirements for the quality of learning events. Additionally, it is indicated that the quality of the online/blended component is expedient to describe through the parameters of teaching, social, and cognitive presence.

The author's model of the implementation of didactic design is proposed as a five-stage cycle: context analysis → design → implementation → evaluation and correction → scaling and QA cycle, with feedback from evaluation to re-analysis and redesign. The model strengthens the institutional governance of blended courses and is consistent with the logic of continuous improvement as a component of internal quality assurance.

The "core" of the model is defined - a system of quality criteria (coherence of results, activities and assessment; quality of learning events; quality of interaction; justified integration of digital tools) and performance indicators (achievement of results by rubrics; dynamics of progress; parameters of participation/engagement; repeatability of results as an indicator of technology reproducibility). This creates a basis for internal examination of courses and comparability of educational practices within HEIs.

A practically significant conclusion is that the effectiveness of pedagogical technologies in blended learning is determined not by the "saturation with digital tools", but by the quality of pedagogical solutions and the digital-pedagogical competence of the teacher. In this context, the DigCompEdu and TPACK frameworks can be used as guidelines for professional development and institutional support for teachers.

Practical implications. For the design of blended courses in HEIs, it is advisable to: (a) use the design matrix "results → evidence → activities → tools" as the basic course artifact; (b) standardize the minimum quality package (rubrics, feedback rules, integrity protocols, interaction scenarios); (c) introduce a cycle of regular course revision based on assessment data and internal expertise. A promising direction for further research is to test the model in different fields of knowledge and clarify the weight of individual quality criteria depending on the type of discipline and assessment forms.

Competing Interests
The author declares that there are no competing interests regarding the publication of this article. The author has no financial, professional, scientific, or personal relationships that could have influenced the study design, data interpretation, or the presentation of the results.

Declaration on Generative AI

During the preparation of this manuscript, AI tools were used in a limited and supportive manner. Grammarly Pro was used solely to improve the accuracy and clarity of the English translation and to refine language formulation. Claude 4.6 was used to assist with formatting tasks and for preliminary support in identifying relevant scholarly literature. All sources were subsequently selected, verified, and critically evaluated by the author, and all interpretations, argumentation, structure of the article, and final conclusions remain the sole responsibility of the author. AI tools were not used to generate research results, fabricate data, or replace the author's original scientific analysis.

REFERENCES

Kharchenko, A., Nalyvaiko, O., Kreydun, N., Sheiko, A., Ptushka, A., Khatuntseva, S., & Zotova, L. (2024). Digital technologies as a factor of transformation of learning in university education. *Revista Romaneasca Pentru Educatie Multidimensionala, 16*(4), 97-126. https://doi.org/10.18662/rrem/16.4/909

Hodges, C., Moore, S., Lockee, B., Trust, T., & Bond, A. (2020, March 27). The difference between emergency remote teaching and online learning. *EDUCAUSE Review*.

Nalyvaiko, O., Vakulenko, A., & Zemlin, U. (2020). Features of forced quarantine distance learning. *Scientific Notes of the Pedagogical Department*, *47*, 78-87. https://doi.org/10.26565/2074-8167-2020-47-09

Graham, C. (2006). Blended learning systems: Definition, current trends, and future directions. In C. Bonk & C. Graham (Eds.), *Handbook of blended learning: Global perspectives, local designs* (pp. 3-21). Pfeiffer.

Garrison, D., & Kanuka, H. (2004). Blended learning: Uncovering its transformative potential in higher education. *The Internet and Higher Education, 7*(2), 95-105. https://doi.org/10.1016/j.iheduc.2004.02.001

Bernard, R., Borokhovski, E., Schmid, R., Tamim, R., & Abrami, P. (2014). A meta-analysis of blended learning and technology use in higher education. *Journal of Computing in Higher Education, 26*(1), 87-122. https://doi.org/10.1007/s12528-013-9077-3

Means, B., Toyama, Y., Murphy, R., Bakia, M., & Jones, K. (2010). *Evaluation of evidence-based practices in online learning: A meta-analysis and review of online learning studies*. U.S. Department of Education.

Kalyniuk, N., Franchuk, V., Selskyy, P., Humenna, N., & Hladii, O. (2024). Blended form of education as an innovative approach in the training of medical students: The experience of Ukraine. *Educación Médica, 25*(6), 100965. https://doi.org/10.1016/j.edumed.2024.100965

Schmid, R., Borokhovski, E., Bernard, R., Pickup, D., & Abrami, P. (2023). Technology-enabled higher education instruction: A meta-analysis of face-to-face, online, and blended approaches. *Computers and Education Open, 5*, 100142. https://doi.org/10.1016/j.caeo.2023.100142

Biggs, J., & Tang, C. (2011). *Teaching for quality learning at university* (4th ed.). McGraw-Hill Education.

Wiggins, G., & McTighe, J. (2005). *Understanding by design* (Expanded 2nd ed.). ASCD.

Merrill, M. (2002). First principles of instruction. *Educational Technology Research and Development, 50*(3), 43-59. https://doi.org/10.1007/BF02505024

Vygotsky, L. (1978). *Mind in society: The development of higher psychological processes*. Harvard University Press.

Engeström, Y. (1987). *Learning by expanding: An activity-theoretical approach to developmental research*. Orienta-Konsultit.

Council of the European Union. (2018). *Council recommendation of 22 May 2018 on key competences for lifelong learning (2018/C 189/01)*. Official Journal of the European Union, C 189, 1-13.

Redecker, C. (2017). *European framework for the digital competence of educators: DigCompEdu*. Publications Office of the European Union. https://doi.org/10.2760/159770

Mulder, M., Weigel, T., & Collins, K. (2009). The concept of competence in the development of higher education. *Journal of European Industrial Training, 33*(8/9), 755-770. https://doi.org/10.1108/03090590910993616

Jonassen, D. (1991). Objectivism versus constructivism: Do we need a new philosophical paradigm? *Educational Technology Research and Development, 39*(3), 5-14. https://doi.org/10.1007/BF02296434

Branch, R. (2009). *Instructional design: The ADDIE approach*. Springer. https://doi.org/10.1007/978-0-387-09506-6

Garrison, D. R., Anderson, T., & Archer, W. (2000). Critical inquiry in a text-based environment: Computer conferencing in higher education. *The Internet and Higher Education, 2*(2-3), 87-105. https://doi.org/10.1016/S1096-7516(00)00016-6

Mishra, P., & Koehler, M. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. *Teachers College Record, 108*(6), 1017-1054. https://doi.org/10.1111/j.1467-9620.2006.00684.x

Yurdakul, I., Odabasi, H., Kilicer, K., Coklar, A., Birinci, G., & Kurt, A. (2012). The development, validity and reliability of TPACK-deep. *Computers & Education, 58*(3), 964-977. https://doi.org/10.1016/j.compedu.2011.10.012

Biggs, J. (1996). Enhancing teaching through constructive alignment. *Higher Education, 32*, 347-364. https://doi.org/10.1007/BF00138871

European Association for Quality Assurance in Higher Education (ENQA). (2015). *Standards and guidelines for quality assurance in the European Higher Education Area (ESG)*.

Garrison, D. (2007). Online community of inquiry review: Social, cognitive, and teaching presence issues. *Journal of Asynchronous Learning Networks, 11*(1), 61-72.

Shumeiko, N. (2024). The use of learning management systems in the educational process: The expediency and benefits. *Educological Discourse, 45*(2). https://doi.org/10.28925/2312-5829.2024.2.5

Nalyvaiko, O., Malysh, K., Prykhodko, Y., & Chaban, S. (2024). Neural networks at the service of education: Challenges of the new era of educational transformation. *Scientific Notes of the Pedagogical Department, 54*. https://doi.org/10.26565/2074-8167-2024-54-09

Mutimukwe, C., Han, S., Viberg, O., & Cerratto-Pargman, T. (2023). Privacy as contextual integrity in online proctoring systems in higher education: A scoping review. https://doi.org/10.48550/arXiv.2310.18792

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ДИДАКТИЧНИЙ ДИЗАЙН ПЕДАГОГІЧНИХ ТЕХНОЛОГІЙ У ЗМІШАНОМУ НАВЧАННІ: ТЕОРЕТИКО-МЕТОДОЛОГІЧНІ ЗАСАДИ ТА МОДЕЛЬ ВПРОВАДЖЕННЯ У ЗВО

Оксана Мкртічян
доктор педагогічних наук, доцент, доцент кафедри теорії, технологій та методики дошкільної освіти
Харківський національний педагогічний університет імені Г. С. Сковороди, Харків, Україна
oksana.mkrtichan@gmail.com
ORCID: 0000-0003-4962-3631

Анотація. Стаття присвячена обґрунтуванню дидактичного дизайну педагогічних технологій у змішаному навчанні як умови переходу від ситуативної «цифровізації» до керованої, відтворюваної та діагностичної організації освітнього процесу у закладах вищої освіти. Мета публікації полягає в теоретико-методологічному обґрунтуванні дидактичного дизайну педагогічних технологій у змішаному навчанні та розробленні моделі їх упровадження на рівні освітнього компонента з визначенням критеріїв якості й показників результативності. Методологічну основу становить синтез компетентнісного, діяльнісного й конструктивістського підходів, операціоналізований через логіку instructional design: проєктування від очікуваних результатів і доказів їх досягнення до навчальних активностей та ресурсів. Уточнено розмежування рівнів «методологія – педагогічна технологія – цифровий інструмент», що запобігає інструментальному редукціонізму та фіксує пріоритет педагогічної логіки над вибором платформи. Запропоновано авторську модель упровадження як п'ятиетапний цикл (аналіз контексту → дизайн → реалізація → оцінювання та корекція → масштабування і QA-цикл) зі зворотними зв'язками, які забезпечують редизайн на підставі даних оцінювання. Визначено «ядро» моделі: критерії якості (узгодженість результатів, активностей і оцінювання; якість навчальних подій і взаємодії; обґрунтованість інтеграції цифрових інструментів) та індикатори результативності (досягнення результатів за рубриками, динаміка прогресу, залученість і повторюваність результатів у різних групах). Показано, що нейронні мережі та генеративні інструменти є новим етапом розвитку педагогічних технологій у змішаному навчанні, однак їхня освітня цінність реалізується за умов прозорого оцінювання, академічної доброчесності та цифрово-педагогічної компетентності викладача. Практичні імплікації включають використання дизайн-матриці «результати → докази → активності → інструменти» та регулярний цикл ревізії курсу на основі даних.

Ключові слова: дидактичний дизайн; педагогічна технологія; змішане навчання; внутрішнє забезпечення якості; критерії якості; цифрово-педагогічна компетентність; нейронні мережі; заклади вищої освіти