

# Blended learning: definition, concept and relevance to education for sustainability

Iryna S. Mintii<sup>1,2,3,4,5,6,7</sup>

<sup>1</sup>University of Łódź, 68 Gabriela Narutowicza Str., 90-136 Łódź, Poland

<sup>2</sup>Institute for Digitalisation of Education of the NAES of Ukraine, 9 M. Berlynskoho Str., Kyiv, 04060, Ukraine

<sup>3</sup>Kryvyi Rih State Pedagogical University, 54 Universytetskyi Ave., Kryvyi Rih, 50086, Ukraine

<sup>4</sup>Zhytomyr Polytechnic State University, 103 Chudnivsyka Str., Zhytomyr, 10005, Ukraine

<sup>5</sup>Lviv Polytechnic National University, 12 Stepana Bandery Str., Lviv, 79000, Ukraine

<sup>7</sup>Academy of Cognitive and Natural Sciences, 54 Universytetskyi Ave., Kryvyi Rih, 50086, Ukraine

<sup>8</sup>Kremenchuk Mykhailo Ostrohradskyi National University, 20 University Str., Kremenchuk, 39600, Ukraine

## Abstract

A review of normative documents and scientific sources on Computer Science teacher training is made. Based on this, the contradictions that actualize the topic of the study are highlighted. The article aims to answer two research questions: 1) What is the appropriate Ukrainian scientific term for “blended learning” given the country’s European integration processes? 2) What is the meaning of the term “blended learning”? The analysis concludes that the appropriate Ukrainian scientific term for “blended learning” is “kombinovane navchannia”. The article defines blended learning as a planned, pedagogically balanced, adaptive combination, interpenetration, and integration of technologies (face-to-face and distance learning, formal and non-formal learning, real and virtual, individual and collective learning) to optimally meet the educational needs of the subjects of the educational process using intelligent ICTs.

## Keywords

blended learning, computer science education, teacher training

## 1. Introduction

One of the Sustainable Development Goals (SDGs), which is stated in “Transforming our World: the 2030 Agenda for Sustainable Development”, is SDG 4: “Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all” [1, p. 18]. Revealing the ways to achieve SDG4, UNESCO emphasizes that “teachers are the key to achieving all of the SDG4 targets, ... as teachers are a fundamental condition for guaranteeing quality education, [they] should be professionally qualified, and supported within well-resourced, efficient and effectively governed systems” [2, p. 15]. “A holistic and coherent curricular approach will require alignment between curriculum content, assessment, teacher training” [2, p. 18].

The European Commission, in its “2030 Digital Compass: the European Way for the Digital Decade” states that “in just one year, the COVID-19 pandemic has radically changed the role and perception of digitalization in societies” [3, p. 1], and digital technologies have become an imperative in education. The first step on the European path is digital professionals and a digitally literate population capable of recognizing disinformation and defending themselves against cyberattacks, living and working in an information society whose members learn from an early age to understand how to process large amounts of information presented online. Concerning systematic (formal) education and training, the European Commission emphasizes the importance of deep integration of digital technologies into school and university methods and forms of teaching in all subjects. At the same time, personality-oriented digital learning tools create conditions for educational innovation and enable teachers to apply new teaching methods [4].

*AREdu 2024: 7th International Workshop on Augmented Reality in Education, May 14, 2024, Kryvyi Rih, Ukraine*

✉ [mintii@iitlt.gov.ua](mailto:mintii@iitlt.gov.ua) (I. S. Mintii)

🌐 <https://acnsci.org/mintii/> (I. S. Mintii)

🆔 0000-0003-0789-0272 (I. S. Mintii)



© 2025 Copyright for this paper by its authors. Use permitted under Creative Commons License Attribution 4.0 International (CC BY 4.0).

To ensure quality digital education, the European Commission recommends, particularly [4, p. 12-17]:

- support the research, development, and testing of digital educational tools and new technologies, including augmented, virtual, and augmented reality, artificial intelligence, robotics, and the metaverse;
- introduces a mandatory component of professional training for future teachers – “ICT in Education”;
- ensure the development of digital competencies of teachers in the system of continuing education;
- recognize and encourage flexible, accessible, and innovative forms of digital professional development, such as online learning, short-term courses, national and international mobility programs, peer learning, collaborative projects, networks, and communities of practice and research;
- reflects the need for digital well-being in teaching and learning and the development of digital technologies and environments to support them;
- invest in high-speed Internet connections to ensure equal access for all students, modernizing digital classroom equipment and providing all teachers with personalized devices (desktop, mobile, or tablet) to enhance their teaching and learning activities, and deploying and integrating relevant centralized services, including cloud-based services, such as learning management systems.

The European Commission in “Council Recommendation on blended learning approaches for high-quality and inclusive primary and secondary education” of November 29, 2021 [5, p. 23], while fully recognizing the value of face-to-face learning, points out that learning in different environments, including school, home, outdoors, cultural sites, workplaces, and digital environments, can motivate children and young people to develop their competencies in general and increase the quality of education and inclusiveness of learning through blended learning approaches. At the same time, using digital technologies provides an opportunity to support learning in different environments and contexts, and the acquisition of the necessary digital and media competencies can be supported through blended learning.

The European Commission recommends the use of blended learning to ensure high-quality primary and secondary education through [5, p. 26]:

- developing blended learning methodologies aimed at ensuring a lasting positive impact on teaching and learning, adapted to the age, abilities, specific needs, and learning goals of students: developing and implementing learning tools, in particular for the development of science, digital and media competencies; supporting learning in different environments; creating an appropriate balance between teacher-led and self-directed learning on the one hand and collaborative learning on the other; developing new learning technologies;
- developing and disseminating training materials for teachers on the organization of blended learning;
- implementation of blended learning in the system of teacher training and retraining;
- establishing expert centres to develop approaches to blended learning and implement best practices;
- supporting the professional development of teachers and educational leaders through massive open online courses on blended learning;
- providing schools with tools and resources for blended learning, as well as guidelines for their effective use;
- developing recommendations for the use of artificial intelligence to improve curricula;
- supporting the development of resources and evidence-based recommendations for pedagogical design and organization of blended learning, including possible digital tools, approaches to learning assessment, data protection, privacy, and security on the Internet.

“Digital Education Action Plan 2021-2027” [6] defines the European approach to education in the digital age and considers the development of digital competencies as a strategic priority. The Digital

Education Action Plan states that a deep understanding of the digital world should be part of formal and non-formal education. This is especially important in the context of digital transformation and the impact of new digital tools, in particular those based on generative artificial intelligence systems.

“Council Recommendation on blended learning approaches for high-quality and inclusive primary and secondary education” [5] calls on EU countries to make efforts to accelerate the development of digital competencies of students and teachers and points out that in primary and secondary education, digital competencies are developed through a combination of different approaches, primarily within a single subject – Computer Science (computational thinking), as well as in the teaching of other STEM disciplines.

In “Council Recommendation on improving the provision of digital skills and competencies in education and training” [7] of November 23, 2023 Computer Science is considered “a distinct scientific discipline characterized by its own concepts, methods, body of knowledge, and open issues. It covers the foundations of computational structures, processes, artefacts, and systems, and their software designs, their applications, and their impact on society” [7, p. 9].

“Council conclusions on European teachers and trainers for the future” [8] emphasize that teachers are a driving force that should be involved in the development of education and training policies and supported through a comprehensive approach to their teacher education, teacher training, and continuing professional development, including digital competencies. In addition, the European Commission’s structured dialogue with EU Member States on digital education and digital competencies has highlighted the challenges faced by most Member States in recruiting (attracting), retaining, and training teachers, especially Computer Science teachers (for primary, secondary and vocational education) [7, p. 12].

To improve digital competencies, the European Commission recommends [7, p. 16-20]:

- develop digital competencies in primary, secondary, and vocational education, with a particular focus on acquiring skills to understand digital technologies and to use them safely and responsibly;
- encourage and facilitate the participation of schools in the Digital Education Hackathon and EU Code Week as a means of digital-based cross-curricular integration;
- promote an interdisciplinary approach to the development of digital competencies in different subject areas, especially science, technology, engineering, arts, and mathematics (STEAM) education;
- improve professional orientation activities for the profession of Computer Science teacher (computational thinking) for primary and secondary education and teacher of Computer Science disciplines for higher education with a high level of psychological, pedagogical, and methodological training;
- promote both the involvement of IT professionals in the work of teachers of informatics and the internships of teachers in IT enterprises, as well as their continuous professional development;
- support quality Computer Science education in primary and secondary schools through
  - teaching informatics as a separate school subject based on scientifically sound methodology;
  - providing Computer Science education by qualified teachers with access to quality educational resources;
  - inclusive and balanced teaching of Computer Science;
  - exchange of best practices in Computer Science education.

The commission intends to support reform efforts for digital skills and competencies development and high-quality informatics or computational thinking [7, p. 28].

In previous doctoral thesis research, several problems and tasks related to:

- involvement of students in *combined learning* [9], its impact on student’s motivation, performance, and behaviour [10, 11, 12];
- methodologies for course development, assessment [13, 14, 15, 16, 17] and scaling courses for blended learning [18];

- *blended learning* of foreign languages [19], Computer Science [20, 21, 22, 23], mathematics [24];
- *blended learning in vocational education institutions* [25, 11];
- *blended learning of future specialists* in philology [26, 27], physical education and sports [28], information technologies [29, 30, 21];
- *blended learning of future teachers* [31, 32, 33], in particular, foreign languages [34, 35, 36], primary school [37], Computer Science [38];
- *blended learning in teacher professional development* [39, 40, 41, 42];
- *professional training and retraining of teachers to implement blended learning* [43, 44, 45, 46].

At the same time, the analysis of regulatory documents and scientific sources on the research problem made it possible to identify several *contradictions*:

- between the existing European requirements for the professional competencies of Computer Science teachers and the lack of national standards for the training of Computer Science teachers;
- between the potential of intelligent technologies and the lack of methods of their use for the implementation of blended learning;
- between the need to form professional competence in the field of blended learning in future Computer Science teachers and the lack of development of its structure, components, and diagnostic tools.

Resolving these contradictions requires solving the problem of substantiation and developing theoretical and methodological foundations for designing a methodological system of blended learning for future Computer Science teachers, which led to the choice of the research topic.

The author's previous research has attempted to address certain issues in this area, including systematic analysis of scientific sources on the use of blended learning in teacher training and retraining [47, 48], and an analysis of students' needs for distance/blended learning in wartime [49].

The purpose of the article is to substantiate the answer to two research questions:

1. Based on the intensification of European integration processes in Ukraine, which scientific term best corresponds to the term "blended learning"?
2. What is the meaning of the term "blended learning"?

## 2. Blended learning – *zmishane* (mixed) or *kombinovane* (combined)?

In Ukrainian studies, both the terms "mixed learning" and "combined learning" are often used [50, 51, 52, 53, 54, 55]. The English translation of the word can explain this variation "blended" – mixed or combined. In official documents, the term "mixed learning" is mostly used [56, 57, 58]. Let's analyze the approaches to translating "blended learning" in the free encyclopedia Wikipedia, Wiktionary, and scientific sources (table 1). In this case, the materials from Wikipedia and Wiktionary are used rather to reflect the current state of public opinion.

Here are the generalized results of using different translations of the term "blended learning" on the map (figure 1), where we mark the countries where the term "mixed learning" is used with a red marker, green – "combined learning", blue – "blended learning" and yellow – the own term. We will also map the auxiliary words used to define the term, where countries that use the word "combining" are marked with a green marker, "mixing" with a red marker, and both "mixing" and "combining" with a blue marker (figure 2).

In the Great Explanatory Dictionary of the Modern Ukrainian Language, "combination" means a connection, conjunction, or arrangement of something homogeneous in a certain order [59, p. 558].

"Combined – which is a combination of something" [59, p. 558].

"Mixed – 1) consisting of something different, heterogeneous; 2) lacking the usual order, disorderly; jumbled, mixed up" [59, p. 467].

Table 1: Approaches to the definition of the term “blended learning”.

Language, concept	Definition	Concept (words used to define)
<b>Ukrainian,</b> zmishane navchannia [60, 61, 51, 52, 53, 54], kombinovane navchannia [62, 63, 64]	A type of hybrid methodology that combines online learning, traditional and independent learning. It means not just the use of modern interactive technologies in addition to traditional ones but a qualitatively new approach to learning that transforms and sometimes even “turns” the classroom	mixed learning
<b>Albanian,</b> mësimi i përzier [65, 66]	është një qasje ndaj arsimit dhe edukimit që kombinon materiale arsimore në internet dhe mundësi tjera për ndërveprim në internet me metodat tradicionale të mësimdhënies klasore në shkollë	mixed learning (“combining”)
<b>English,</b> blended learning [67, 68, 69, 70]	the <i>combination</i> of online educational materials and interactions with traditional classroom teaching	blended learning (“combining”)
<b>Bulgarian,</b> хибридно обучение [71, 72]	хибридно или смесено обучение е подход в ученето и съответно в педагогиката в образованието, който съчетава онлайн образователни материали и възможности за взаимодействие онлайн с традиционни методи на класната стая или студентска зала, като лекционна среда	гибридне, змішане навчання
<b>Danish,</b> blended learning [73, 74, 75]	er et begreb der anvendes inden for uddannelsesverdenen. Det betegner typisk <i>kombinationen</i> af e-learning og tilstedeværelseskurser, f.eks. instruktørledede kurser	blended learning (“combining”)
<b>Estonian,</b> põimõpe [76]	on õppevorm, mille puhul osa õppest toimub lähiõppena ja osa veebiõppena või paindõppena	–
<b>Spanish,</b> aprendizaje semi-presencial [77, 78]	el aprendizaje semipresencial (en inglés blended learning o b-learning) se refiere a la <i>combinación</i> del trabajo presencial (en aula), y del trabajo en lónea ( <i>combinando</i> Internet y medios digitales), en donde la persona que es estudiante puede controlar algunos factores como el lugar, momento y espacio de trabajo	semi-present learning (“combining”)
<b>Italian,</b> apprendimento misto [77, 78]	nella ricerca educativa si riferisce ad un <i>mix</i> di ambienti d’apprendimento diversi. Esso <i>combina</i> il metodo tradizionale frontale in aula con attività mediata dal computer (ad esempio apprendimento online, uso di DVD, ecc.) e/o da sistemi mobili (come smartphone e tablet)	mixed, hybrid learning (“mixing”, “combining”)
<b>Catalan,</b> aprenentatge mixt [79, 80]	aprenentatge que <i>combina</i> els elements de l’aprenentatge electrònic no presencial i els de l’aprenentatge tradicional a l’aula	mixed learning (“combining”)
<b>Dutch,</b> blended learning [81, 82, 83]	eén definitie is “een <i>combinatie</i> van online leren en contactonderwijs”, een andere “een <i>combinatie</i> van campusonderwijs en e-learning”	blended learning (“combining”)
<b>German,</b> integriertes Lernen [84, 85, 86]	bezeichnet eine Lernform, bei der die Vorteile von Präsenzveranstaltungen und E-Learning <i>kombiniert</i> werden sollen	integrated learning (“combining”)

Continuation of the table 1

Language, concept	Definition	Concept (words used to define)
<b>Norwegian,</b> blandet læring [87, 88]	er et begrep som benyttes innenfor utdanning og betegner vanligvis en <i>kombinasjon</i> av flere ulike tilnæringer til læring som e-læring og eksempelvis kurs ledet av en instruktør. Det kan også være ulike <i>kombinasjoner</i> som eksempelvis selvstudier, e-læring og gruppediskusjoner via Internett	blended learning (“combining”)
<b>Polish,</b> blended learning [89, 90, 91]	mieszana ( <i>zintegrowana, hybrydowa</i> ) metoda kształcenia, łącząca tradycyjne metody nauki (bezpośredni kontakt z prowadzącym) z aktywnościami prowadzonymi zdalnie za pomocą komputera (M-learning)	mixed learning (integrated, hybrid learning)
<b>Portuguese,</b> blended learning [92, 93, 94]	é um derivado do e-learning, e refere-se a um sistema de formação onde a maior parte dos conteúdos é transmitido em curso à distância, normalmente pela internet, entretanto inclui necessariamente situações presenciais, daí a origem da designação <i>blended</i> , algo <i>misto</i> , <i>combinado</i>	blended learning, mixed, combined learning
<b>Romanian,</b> învățare mixtă [95]	reprezintă procesul încorporării a diverse stiluri de învățare, care se pot realiza prin intermediul resurselor fizice și virtuale <i>mixte</i>	mixed learning
<b>Serbian,</b> mešano učenje [96]	obrazovni program (formalni i neformalni) koji <i>kombinuje</i> onlajn digitalne medije sa tradicionalnim metodama koji se koriste u učionici. Ono zahteva fizičko prisustvo i nastavnika i učenika. Učenici i dalje pohađaju tradicionalne škole u kojima je prisutan nastavnik, ali “lice u lice” predavanja su <i>kombinovana</i> sa aktivnostima na kompjuteru	mixed learning (“combining”)
<b>Slovak,</b> kombinované vzdelávanie [97, 98]	<i>kombinácia</i> štandardnej výuky (prezenčnej, prezentačnej, face-to-face) s e-learningom. <i>Kombinované</i> vzdelávanie sa snaží kompenzovať niektoré nevýhody e-vzdelávania pri plnení vzdelávacích cieľov <i>kombináciou</i> s prvkami štandardnej výuky, kedy je napríklad <i>kombinovaný</i> v distančnom štúdiu e-learningový kurz s úvodným či záverečným seminárom alebo workshopom. Tento prístup je vhodný predovšetkým tam, kde cieľová skupina nie je zvyknutá používať moderné komunikačné nástroje, ako je chat, diskusné fórum, videokonferencie a pod	combined learning
<b>Slovenian,</b> kombinirano učenje [99, 100, 101]	koncept učenja in poučevanja, pri katerem se spajajo in <i>mešajo</i> različni učni slogi in se uporabljajo najrazličnejši učni pripomočki – od virtualnih do fizičnih. Učni slogi se nanašajo na številne različne načine, ki jih ljudje uporabljajo pri učenju. <i>Kombinirano</i> učenje prav učnim slogom daje prednost: na eni strani z vključevanjem najrazličnejših nalog in dejavnosti v pouk, na drugi pa z uporabo računalniške tehnologije, e-grafov, interakcije med mentorjem in udeleženci ter med samimi udeleženci učnega procesa oz. tečaja	combined learning (“mixing”)

Continuation of the table 1

Language, concept	Definition	Concept (words used to define)
<b>Hungarian,</b> blended learning [102, 103, 104]	egy újabb oktatási forma, amelyben az internet és a digitális média nyújtotta lehetőségeket és a hagyományos tantermi oktatás módszereit együttesen használják. Tananyag el-sajátítása közben az oktató ellenőrző és segítő szerepe megmarad: ebben a modellben fontos szerepet kap a személyes kontaktus, az órák megadott helyén és idején való személyes részvétel, míg az online tér tanulástámogató felületein keresztül a diákok szintén kapcsolatba léphetnek a tanárokkal és egymással is	blended learning
<b>Finnish,</b> sulautuva oppiminen [105, 106, 107]	tarkoittaa oppimisen ympäristöjen sulautumista. Oppimisympäristön sulattaminen tarkoittaa esimerkiksi sitä, että luokkahuone ja virtuaalinen oppimisympäristö sulautetaan yhdeksi kokonaisuudeksi, jossa oppiminen tapahtuu. Usein opetuksen sulattaminen tarkoittaa, että sulautetaan synkronista ja asynkronista opetusta	
<b>French,</b> apprentissage hybride [108, 109, 110]	est une formule pédagogique qui résulte d'une <i>combinaison</i> de séquences de formation en ligne (e-learning) et de formation en présentiel. Elle offre certains avantages comme un espace de travail plus collaboratif pour les apprenants. L'utilisation des technologies de l'information et de la communication donne l'opportunité à l'apprenant d'avoir, dans une certaine mesure, un contrôle sur le temps, le lieu, les moyens et la vitesse <sup>1</sup> . À ce titre, on distingue l'apprentissage synchrone: les formateurs et les élèves suivent en même temps un module de formation et asynchrone : les élèves suivent de façon différée grâce à des ressources pré-établies par l'enseignant (vidéo, diaporama, contenu interactif...)	hybrid, mixed learning ("combining")
<b>Czech,</b> blended learning [111, 112, 113]	označení pro kombinovanou výuku, tedy pro kombinaci standardní výuky (prezenční, prezentační, face-to-face) s e-learningem. Jedná se o specifickou formu vzdělávání, která kombinuje tradiční metody výuky s online studijním obsahem. Využívá různé kombinace tradičního vzdělávání tváří v tvář (face-to-face), e-learningu a individuálního vzdělávání vlastní rychlostí (self-paced learning). Účelem je, aby se jednotlivé metody navzájem doplňovaly	blended learning ("combining")
<b>Swedish,</b> blended learning [114, 115, 116]	avser just en blandning av olika lärmiljöer. Blended learning <i>kombinerar</i> traditionella klassrumsmetoder med mer moderna datormedierade aktiviteter	blended learning ("combining")

According to the Law of Ukraine "On Education" [117] "educational process – a system of scientific, methodological and pedagogical measures aimed at developing a personality through the formation and application of its competencies".

"System" is an order caused by the correct, systematic arrangement and interconnection of something [59, p. 1320].

The analysis made it possible to answer the first research question: based on the intensification of European integration processes in Ukraine, the scientific term that best corresponds to the concept of "blended learning" is "kombinovane navchannia (combined learning)".



**Figure 1:** The term “blended learning” on the European map: the red marker indicates countries where the term “mixed learning” is used, the green marker indicates “combined learning”, the blue marker indicates “blended learning”, and the yellow marker indicates its own term.

### 3. Is blended learning a form, a method, a technology, a learning strategy, or what?

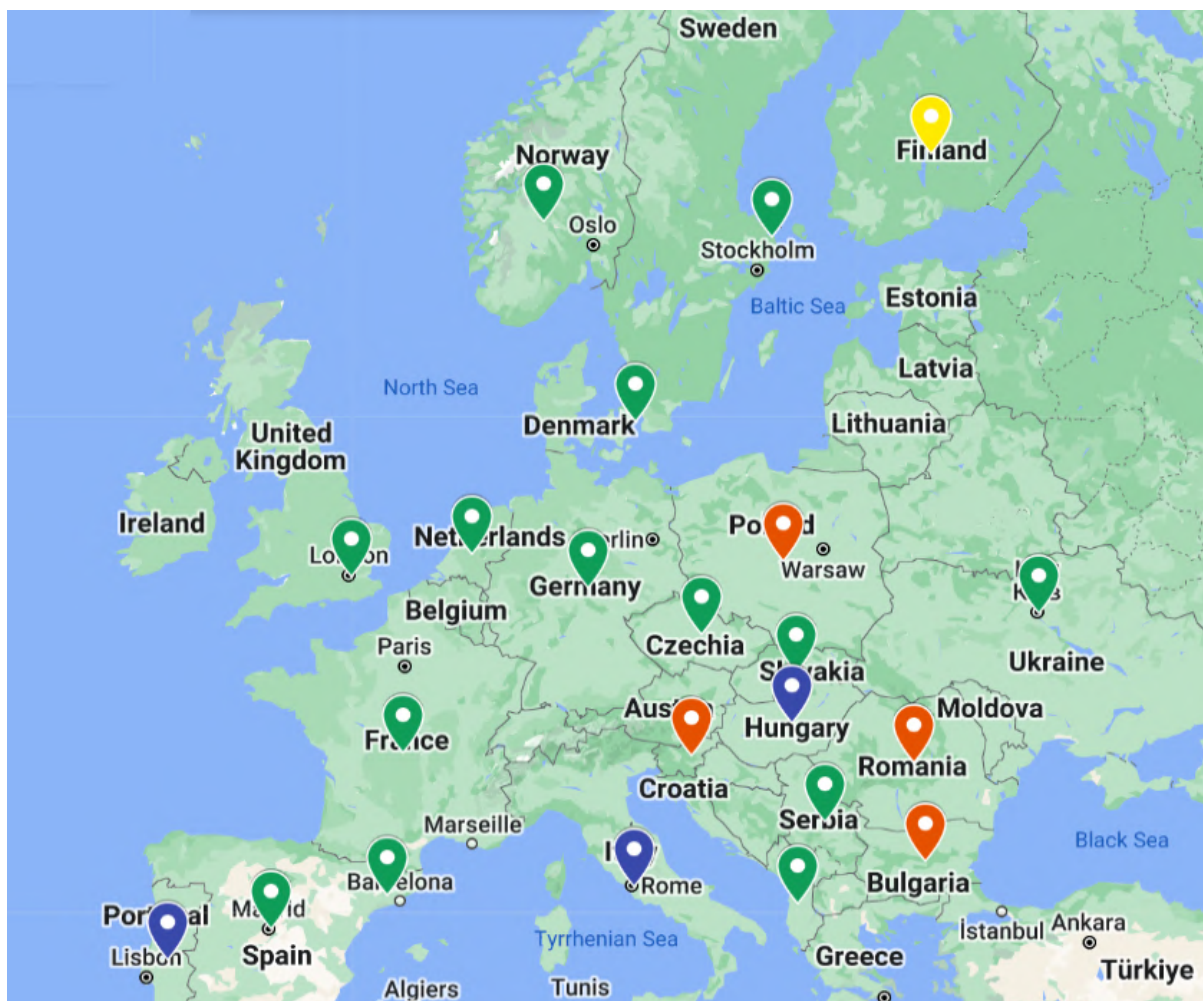
In a critical review, Oliver and Trigwell [118] concluded that the term blended learning simply requires two or more different kinds of things that can be combined. It is argued that the breadth of interpretations means that almost anything can be considered blended learning. Driscoll [119] also states that blended learning uses several components. It can be a combination of methods based on web (online) technologies, pedagogical approaches, learning technologies, and face-to-face learning meetings, and the following combinations can be considered: e-learning with traditional learning, online learning with face-to-face learning, combination of media, combination of learning theories, methods, etc.

According to *National Education Act of blended learning 2542* [120], blended learning is learning that combines the benefits of classroom (face-to-face) instruction with online learning for content delivery, activities, and assessment.

Cross and Moore [121] define blended learning as a stepping stone to the future, and Rossett and Frazee [122] note that blended learning integrates seemingly opposing approaches such as formal and informal learning, face-to-face and online learning, self-directed and guided learning, and digital reference materials and face-to-face contact to achieve individual and institutional [learning] goals.

Graham [68] identifies three common definitions of blended learning: “a combination of forms of





**Figure 2:** Definition of “blended learning” on the European map: countries that use the word “combining” are marked with a green marker, “mixing” with a red marker, “mixing” and “combining” with a blue marker.

learning (or means of learning), a combination of learning methods, and a combination of face-to-face and online learning”.

Hubackova and Semradova [123] characterize blended learning as “a combination of face-to-face (contact) learning with a teacher and self-directed learning using online learning” [123, p. 551].

Many studies determine that the primary goal is to ensure that face-to-face and online teaching and learning complement each other, combining different advantages (Bicen et al. [124], Çakır and Bichelmeyer [125], Deschacht and Goeman [126]).

Garrison and Kanuka [127] interpret blended learning as “deliberate integration of face-to-face learning activities with online learning” [127, p. 96].

Allen and Seaman [128] define “blended learning course as a course that combines online and face-to-face learning. Much of the content is delivered online, online discussions are commonly used, and there are usually fewer face-to-face meetings. Similarly, Hrastinski [115], notes that all types of education that contain some aspects of face-to-face and online learning can be defined as blended learning.

Allen et al. [129], Bonk and Graham [70], Khlaisang [130, 131], Waterhouse [132], Wilson and Smilanich [133] define the following ratio of online and face-to-face learning – 30-79% online and face-to-face learning at the level of 21-70%; Bernardet et al. [134], Porter et al. [135] estimate that at least 50% of the total learning time should be face-to-face. Diep et al. [136] distinguish two different approaches to blended learning, one of which contains 25% online learning, the other – 50% online. Online courses are defined as those that provide at least 80% of the content online [129, p. 5]. In [137, p. 2] it is noted that “as e-learning has become an agent of global change in higher education, it has

become more diverse in its form and application”. “This diversity complicates the ability to share research findings and best practices, as there is a lack of a common set of definitions to distinguish between the many variations in the field of e-learning” [138].

Ultimately, Shibley [139] states that “the advantage of blended learning is that the variety of combinations of face-to-face and online combinations is seemingly endless. In all cases, however, the goal is to use technology to make face-to-face learning more effective than it would be without online enhancements” [139, p. 6]. Finally, it is up to the teacher to decide what is taught face-to-face and what is taught online.

Blended learning encourages independent, autonomous, self-regulated, and collaborative learning (Ruiz Bolívar [140]), and blended learning involves both face-to-face and virtual (online) classes, which leads to interactivity and motivation through the collaboration of students and teachers (Gonzalez Aldana et al. [141, p. 145]).

Blended learning includes a face-to-face mode to help students clarify their issues, and teachers further enhance the level of mastery of the course (Gonzalez Aldana et al. [141, p. 147]).

When comparing blended learning and e-learning, scholars determine they have somewhat similar characteristics: physical separation of students and teachers, use of ICT tools, and independent learning. However, e-learning is based on online learning with the use of ICT tools, and blended learning uses ICT tools to develop the learning process best (Estrada Lizárraga [142]). In e-learning, a lower success rate is achieved because distance learning does not include dynamic collaboration processes, which allows for a high non-completion rate. Since online consultations are not sufficient to cover all students’ questions, the interaction between teacher and student is lost (Antúnez Sánchez et al. [143]). Blended learning provides an opportunity for students to interact more with both peers and teachers – not all classes are online; some are face-to-face, but the student has a flexible schedule. Jachin and Usagawa [144] define that “e-learning is becoming a driving force for pedagogical and technological innovations in the world’s higher education institutions. The most practical form of e-learning in higher education is blended learning”. Picciano [145] adds that “interestingly, there are few estimates of the number of students enrolled in blended learning courses. Although it is generally recognized that blended learning fits well into the mainstream of American higher education, there is no data to document this. Why is this so? First, blended learning has become so widespread that many teachers do not necessarily identify themselves as blended learning teachers when in fact they are... The mystery and aura of teaching online that existed in the mid to late 1990s is disappearing”. Masie [146] observes that the “e” in e-learning is disappearing, and it’s all just learning”. “Second, it is difficult for colleges and universities to keep accurate records of faculty teaching blended learning courses” [145].

Highly appreciating the role of ICT (both hardware and software), “National Education Act of B.E. 2542” [120] also emphasizes the importance of communication, assessment, the role of the teacher/student, and the methodology itself.

Galvis [137] expands on the above definition and characteristic features of blended learning: learning takes place in different learning environments – formal (e.g. classroom), informal (e.g. workplace, communities of practice), and informal (e.g. media, websites), based on the strengths of each. It also emphasizes the role of ICT – “the decisive role in blended learning is played not only by the teacher but also by ICT technologies [137]. Blended learning provides great opportunities for learning the subject. Thanks to ICT tools, students have a high level of satisfaction (up to 90%) [141, p. 146].

Blended learning means more than a simple combination of components, and the purpose of using this combination is to make the learning process as convenient as possible, while at the same time stimulating students to learn in other ways (Picciano [145, p. 4]).

Analyzing blended learning, Jachin and Usagawa [144, p. 1482] conclude that the most common reason for choosing blended learning is that it combines the “best of both worlds” (face-to-face and online learning).

Procter [147, p. 3] emphasizes that blended learning requires “an effective combination of different learning modes, models, and styles”.

Summarizing the research of Dick et al. [148] and Holden et al. [149] in Mirriahi et al. [150], they define blended learning as the process of integrating the most appropriate learning and teaching

strategies, technologies, and/or tools to provide meaningful, flexible learning activities to achieve results.

The goal of blended learning is to provide more flexibility and focus on educational comfort, where the student can learn dynamically and get a positive result. In the learning process, the teacher and student are physically separated. In this mode, the student starts learning independently. The main features of blended learning are its adaptability, emphasis on the development of cognitive skills, improving understanding and application of acquired skills, solving future problems, making decisions using ICT, speed in communication, development and updating of content (Gonzalez Aldana et al. [141, p. 147]). “Blended learning is the most favourable form of learning at all educational levels, as it covers different areas of the educational process, facilitating the perception of course content by students” [141, p. 147].

In higher education, blended learning has become widespread due to its flexibility, which allows teachers to integrate various educational technologies into the educational process. In addition, teachers can offer more effective teaching by implementing student-centred learning. Students can access content anywhere and anytime (Khlaisang and Likhitdamrongkiat [151, p. 760]). They can participate and exchange ideas, both face-to-face in the classroom and in an online environment. In this way, teachers can improve students’ cognitive skills and attitude towards face-to-face learning.

Personalization with blended learning is also emphasized by Hubackova and Semradova [123, p. 552], noting that “the main advantage of blended learning is an individualized learning environment. Each student chooses his/her own pace, place, and time, which is most favourable for learning. Immediate feedback plays an important role. Blended learning provides verification of the learner’s efforts and an overview of the results achieved. It often makes it possible to compare anonymously with other learners. This fact is highly appreciated by them”.

Among the benefits of blended learning, Zacharis [152] cites the following: “Blended learning facilitates learning outside the classroom since the teacher and students have limited time in the classroom, the lesson can be continued online”.

Other examples of such examples include “preparing for face-to-face activities, such as flipped classroom, video lectures at home so that the time spent in the classroom is maximized for discussing the subject and for student-centered activities (e.g., group work)” (Tan and Hew [153]).

The analysis conducted by Torres-Coronas and Vidal-Blasco [154] synthesizes the opinions of the main stakeholders of the educational process in higher education institutions: management, students, and teachers. The study shows that blended learning improves the quality of student learning, strengthens academic performance, and encourages the teaching staff to innovate in the educational process continuously.

The goal of blended learning is to maximize the benefits of both face-to-face and online learning (Pavla et al. [155]), and Shibley [139, p. 5] adds that “blended learning is not just a way to minimize face-to-face learning...a well-designed course creates learning opportunities that did not exist before. Derntl and Motschnig-Pitrik [156], Garrison and Kanuka [127], and Twigg [157] agree that simply adding technology to a traditional classroom does not make blended learning effective.

Jachin and Usagawa [144] argue that the use of blended learning in higher education institutions can increase the quality of learning. Developing and implementing BL courses in a specific situation, as well as reviewing and evaluating the quality, will not only allow sharing the experience with similar higher education institutions but will also contribute to general quality research in higher education.

In [158], it is noted that the integration of face-to-face and online learning contributes to the improvement of face-to-face learning. Blended learning improves student engagement through online activities and increases efficiency by reducing lecture time.

At the same time, implementing blended learning is a challenge for teachers with low digital competence (Mirriahi et al. [159]). Therefore, teachers need help with professional development, including demonstrating the benefits of blended learning (Chen et al. [160]). It is also necessary to recognize that ‘innovation does not happen without tension, and in fact, it is a tension that provides some of the energy that can drive innovation (Owen and Dunham [161, p. 100]).

Among the disadvantages of blended learning, other scholars also highlight its sometimes inadequate understanding by students, the difficulty of using it in some educational fields, dependence on technological equipment, and again, high requirements for teacher training (Hubackova and Semradova [123,

p. 552]).

Galvis [137] emphasizes both individual teacher initiatives and the need for institutional support for blended learning to “rethink the fundamental processes present in the education value chain, aligning technological, administrative and financial support processes with these fundamental processes by the desired combination parameters” [137, p. 9].

Shibley [139, p. 4] identifies several important emphases in the organization of blended learning, which can be briefly defined as the triad of motivation-assessment-learning activities.

Dziuban et al. [162] define blended learning as a pedagogical approach that combines the effectiveness and socialization opportunities of the classroom with the technologically enhanced opportunities for active learning in the online environment rather than as a ratio of learning modes. In other words, blended learning should be seen not just as a temporary construct but rather as a fundamental redesign of the learning model with the following characteristics: personalization of learning (moving from lecture to student-centred instruction; increased interaction between student-teacher and among students, and effective assessment mechanisms.

The review provided an opportunity to answer the second research question about the content of the concept of “blended learning”: **blended learning** is a planned, pedagogically balanced, adaptive combination, interpenetration and integration of technologies (face-to-face and distance learning, formal and non-formal learning, real and virtual, individual and collective learning) to optimally meet the educational needs of the subjects of the educational process using intelligent information and communication technologies.

A central aspect highlighted in this definition is the role of intelligent technologies, such as machine learning models and methods for processing big data in the educational process. These technologies hold the potential to predict potential crises at the learner and system levels, enabling adaptive and personalized learning experiences:

1. Learning analytics and personalization intelligent ICTs like machine learning models can analyze data on learner activities, engagement, emotions, stress levels, etc., to enable individualization and personalization of learning paths, activities, and assessments based on each learner’s needs [163, 164].
2. Automated support and feedback AI systems can automatically monitor online sessions, identify patterns of interest/disengagement and provide customized support, feedback and interventions in real-time to keep learners engaged and on track [165].
3. Virtual and immersive learning technologies like virtual reality, augmented reality and AI-driven simulations can create highly immersive and experiential learning environments, especially valuable for domains like computer science, which require interaction with abstract concepts [166, 167]
4. AI-powered tutoring systems can guide learners through concepts, provide step-by-step problem-solving support, and adapt their inputs based on the learner’s knowledge state [168].

## 4. Conclusions and prospects for further research

The answers to the research questions obtained in the course of the study made it possible to define blended learning terminologically as combined learning and content-wise as a planned, pedagogically balanced, adaptive combination, interpenetration and integration of technologies (full-time and distance learning, formal and non-formal learning, real and virtual, individual and collective learning) to optimally meet the educational needs of the subjects of the educational process using intelligent technologies.

Implementing blended learning provides access to big data on the educational process and the possibility of using intelligent technologies (primarily machine learning models and methods) to process them and predict possible crises at the level of learners and the system. In particular, intelligent technologies make it possible to determine the degree of interest of participants in an online class, their emotional state, stress level, etc., which creates conditions for automating individualization and personalization of learning. Therefore, the main concepts that need to be considered for developing a

blended learning system should be personalization of learning, intellectualization, big data, learning analytics, virtualization of learning, and immersion based on student experience.

Accordingly, it is planned to study the following dimensions of blended learning: philosophical – the ratio of real and model (virtual) in learning; psychophysiological – individualization of learning based on the emotional state, stress level, etc; sociological – the ratio of individual and collective, face-to-face and distance learning, desired and forced mobility of learners; organizational and pedagogical – the ratio of formal and informal learning; information technology – the ratio of traditional and intelligent technologies in learning, accessibility and scientificity, real and virtual visibility; synergistic – the ratio of classical machine learning methods and methods of studying complex systems to identify crisis phenomena.

**Acknowledgments:** I express my sincere gratitude for the help, inspiration, and support of my scientific advisor, Serhiy O. Semerikov.

**Declaration on Generative AI:** The authors have not employed any Generative AI tools.

## References

- [1] Transforming our World: The 2030 Agenda for Sustainable Development, United Nations, 2015. URL: <https://sdgs.un.org/publications/transforming-our-world-2030-agenda-sustainable-development-17981>.
- [2] UNESCO, Unpacking Sustainable Development Goal 4: Education 2030; guide, 2017. URL: <https://tinyurl.com/39w3pzbb>.
- [3] European Commission, Directorate-General for Communications Networks, Content and Technology, Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions 2030 Digital Compass: the European way for the Digital Decade, 2021. URL: <https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:52021DC0118>.
- [4] Council of the European Union, Council Recommendation on the key enabling factors for successful digital education and training, 2023. URL: <https://data.consilium.europa.eu/doc/document/ST-15741-2023-INIT/en/pdf>.
- [5] Council of the European Union, Council Recommendation of 29 November 2021 on blended learning approaches for high-quality and inclusive primary and secondary education, Official Journal of the European Union C 504 (2021) 21–29. URL: [https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:32021H1214\(01\)](https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:32021H1214(01)).
- [6] European Commission, Directorate-General for Education, Youth, Sport and Culture, Digital Education Action Plan 2021-2027: Resetting education and training for the digital age, 2020. URL: <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52020DC0624>.
- [7] Council of the European Union, Council Recommendation on improving the provision of digital skills and competences in education and training, 2023. URL: <https://data.consilium.europa.eu/doc/document/ST-15740-2023-INIT/en/pdf>.
- [8] Council of the European Union, Council conclusions on European teachers and trainers for the future, Official Journal of the European Union C 193 (2020) 11–19. URL: [https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52020XG0609\(02\)](https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52020XG0609(02)).
- [9] S. H. Tuiloma, Understanding the Role of Institutional Support for Student Academic Engagement in Higher Education Online and Blended Learning Settings Through the Lens of the Academic Communities of Engagement Framework, Ph.D. thesis, Brigham Young University, Utah, United States, 2022. URL: <https://scholarsarchive.byu.edu/etd/9750>.
- [10] X. Chen, Understanding student behaviors using immediate feedback features in a blended learning environment, Ph.D. thesis, Purdue University, Indiana, United States, 2015. URL: <https://www.proquest.com/docview/1780301226>.
- [11] J.-J. Yan, The Impact of Blended Learning Integrating QR Code on Motivation, Flow Experience and Learning Performance in Drafting Practice Course for Vocational High School Students,

- Ph.D. thesis, National Taiwan Normal University, Taiwan, 2017. URL: <https://doi.org/10.6345/THE.NTNU.DIE.005.2018.E01>.
- [12] H. Zhang, Towards blended learning: Educational technology to improve and assess teaching and learning, Ph.D. thesis, University of California, Santa Barbara, California, United States, 2009. URL: <https://doi.org/10.5555/1751391>.
- [13] H. Al-Jadar, The Impact of Integrated Blended Learning Technology in Higher Education Studies, Ph.D. thesis, Sakarya University, Turkey, 2018. URL: <https://doi.org/10.13140/RG.2.2.30205.74726>.
- [14] L. A. Giacomo, Asynchronous Discussion Board Facilitation And Rubric Use In A Blended Learning Environment, Ph.D. thesis, Arizona State University, 2012. URL: <http://repository.asu.edu/items/15982>.
- [15] A. Heinze, Blended learning: an interpretive action research study, Ph.D. thesis, University of Salford, 2008. URL: <http://usir.salford.ac.uk/id/eprint/1653/>.
- [16] S. B. Ibarra Vargas, Methodological approach to the design and evaluation of courses in higher education based on Blended Teaching, Ph.D. thesis, Universidad Nacional de Colombia, 2022. URL: <https://repositorio.unal.edu.co/handle/unal/81951>.
- [17] F. Owczarek-Jedrkiwicz, La formation hybride: entre conception et usage : Blended learning: between use and design, Ph.D. thesis, University of Paris 1 Panthéon-Sorbonne, 2022. URL: <http://www.theses.fr/2022PA01E012>.
- [18] D. Sichau, Technology Enhanced Scaling of Large-Scale Blended Learning Courses, Ph.D. thesis, ETH Zürich, 2018. URL: <https://doi.org/10.3929/ethz-b-000301253>.
- [19] O. F. Musiyovska, Didactic Conditions of Blended Learning Technologies Application in Foreign Languages Teaching of Technical Students, Thesis for the degree of candidate of pedagogical science, specialty 13.00.09 – Theory of Learning, Ternopil Volodymyr Hnatiuk National Pedagogical University, Ternopil, 2016. URL: <https://nrat.ukrintei.ua/searchdoc/0416U003653/>.
- [20] F. E. Ayeni, An Analysis of Blended Learning as a Pedagogical Tool for Teaching Computer Science at Historically Black Colleges and Universities, Thesis for the degree of Doctor of Philosophy in Science and Mathematics Education, Southern University and Agricultural and Mechanical College, Science and Mathematics Education, Louisiana, United States, 2020. URL: <https://doi.org/10.5555/AAI28087838>.
- [21] T. B. Bati, Blended learning in large class introductory programming courses: an empirical study in the context of an Ethiopian university, Ph.D. thesis, University of South Africa, 2015. URL: <https://tinyurl.com/yn4jsch9>.
- [22] A. A. Othman, Design, development and implementation of a blended learning strategy for a computer science course at the Faculty of Sciences, Omer Al-Mukhtar University, Libya, Ph.D. thesis, University of Huddersfield, England, 2017. URL: <https://eprints.hud.ac.uk/id/eprint/34803>.
- [23] S. T. Hurley, The Design, Development, Implementation, and Evaluation of a Flipped Instructional Unit for an Advanced Placement Computer Science A Class, Ph.D. thesis, University of Florida, 2019. URL: <https://ufdc.ufl.edu/UFE0055616>.
- [24] J. Koekemoer, Intermediate Phase Mathematics Teachers' Integration of ICT Within a Blended Learning Environment, Ph.D. thesis, University of Pretoria, South Africa, 2021. URL: <http://hdl.handle.net/2263/83378>.
- [25] T. B. Bykova, Professional training masters of industrial education in sewing with applying blended learning, Thesis for the degree of Doctor of Philosophy, specialty 015 Professional education (on specializations), Oleksandr Dovzhenko Hlukhiv National Pedagogical University, Hlukhiv, 2021. URL: <https://nrat.ukrintei.ua/en/searchdoc/0821U100938/>.
- [26] T. S. Dybska, Methodology of oral Japanese speech blended instruction to future philologists, Thesis for the degree of candidate of pedagogical science, specialty 13.00.02 – Theory and Methodology of Teaching (Oriental Languages), Taras Shevchenko National University of Kyiv, Kyiv, 2020. URL: <https://nrat.ukrintei.ua/en/searchdoc/0420U102073/>.
- [27] T. M. Sobchenko, Didactic system of blended learning of students of philological specialties in the institutions of higher education, Thesis for the degree of doctor of pedagogical sciences, specialty 13.00.09 – Theory of Learning, State Higher Educational Institution “Donbas State Pedagogical

- University”, Sloviansk, 2021. URL: <https://nrat.ukrintei.ua/searchdoc/0521U101906/>.
- [28] S. A. Lazorenko, Theory and practice of forming the information-digital culture of future specialists in physical culture and sports in the context of blended learning, Thesis for the degree of doctor of pedagogical sciences, specialty 13.00.04 – Theory and Methodology of Professional Education, Sumy State Pedagogical University named after A. S. Makarenko, Sumy, 2021. URL: <https://nrat.ukrintei.ua/searchdoc/0521U101103/>.
- [29] I. A. Klieopa, Formation of mathematical competence of future bachelors of computer industry in the conditions of blended learning, Thesis for the degree of Doctor of Philosophy, specialty 015 Professional Education (on specializations), Vinnytsia National Technical University, Vinnytsia, 2023. URL: <https://nrat.ukrintei.ua/en/searchdoc/0823U101188/>.
- [30] P. Jackson, Developing a web-based blended learning technique to improve computer programming competence of information technology students, Ph.D. thesis, Durban University of Technology, 2017. URL: <http://hdl.handle.net/10321/2488>.
- [31] J. C. d. Roza, Aprendizagem na/da docência digital na perspectiva do B-Learning e do TPACK na produção compartilhada de novas pedagogias, Ph.D. thesis, Universidade Federal de Santa Maria, 2019. URL: <http://repositorio.ufsm.br/handle/1/19485>.
- [32] C. R. Short, Preparing K-12 Teachers for Blended Teaching: An Exploration of Peer-reviewed Research, Important Practices, and Teacher Experiences, Ph.D. thesis, Brigham Young University, 2021. URL: <https://tinyurl.com/4h3e6ye4>.
- [33] M. A. G. Vallim, Vivências de professores formadores para a Educação Profissional e formação crítico-reflexiva em EaD: um estudo de caso, Ph.D. thesis, Pontifical Catholic University of São Paulo, 2018. URL: <https://tede2.pucsp.br/handle/handle/21863>.
- [34] D. M. Korovii, The formation of cultural competence of future teachers of foreign languages in the conditions of blended education, Thesis for the degree of Doctor of Philosophy, specialty 015 Professional Education (on specializations), Vinnytsia Mykhailo Kotsyubynskyi State Pedagogical University, Vinnytsia, 2023. URL: <https://nrat.ukrintei.ua/en/searchdoc/0823U100208/>.
- [35] L. J. Larsen, Teacher and student perspectives on a blended learning intensive English program writing course, Ph.D. thesis, Iowa State University, 2012. URL: <https://doi.org/10.31274/etd-180810-1937>.
- [36] S. M. De Stefani, Exploring the possible: empowering English language teachers in provincial Uruguay through blended learning, Ph.D. thesis, University of Manchester, 2012. URL: <http://ethos.bl.uk/OrderDetails.do?uin=uk.bl.ethos.568584>.
- [37] B. McHugh, An evaluation of a blended programme of teacher education in Ireland, Ph.D. thesis, Dublin City University, 2015. URL: <http://doras.dcu.ie/20406/>.
- [38] H. V. Tkachuk, Theoretical and methodical principles of practical training of future teachers of computer science in conditions of blended learning, Thesis for the degree of doctor of pedagogical science, specialty 13.00.02. – The Theory and Methods of Training (technical disciplines), National Pedagogical Dragomanov University, Kyiv, 2019. URL: <https://nrat.ukrintei.ua/en/searchdoc/0519U001057/>.
- [39] S. S. Leake, A Blended and Face-to-Face Comparison of Teacher Professional Development: What’s the Impact?, Ph.D. thesis, Arizona State University, 2014. URL: <http://repository.asu.edu/items/24911>.
- [40] J. A. Maynard, Transformational Teaching & Learning Modeled in a Flipped Classroom Environment, Ph.D. thesis, The Ohio State University, 2019. URL: [http://rave.ohiolink.edu/etdc/view?acc\\_num=osu1555355104583446](http://rave.ohiolink.edu/etdc/view?acc_num=osu1555355104583446).
- [41] R. L. Santos, Andragogy Content Knowledge Technology: A Training Model for Teaching Adults, Doctoral dissertation, Arizona State University, 2012. URL: <http://repository.asu.edu/items/14717>.
- [42] H. Yip, From design to practice: teachers’ experiences and perspectives of blended professional development in Hong Kong, Ph.D. thesis, Lancaster University, 2019. URL: <https://doi.org/10.17635/lancaster/thesis/719>.
- [43] M. Jensen, Informing Professional Development to Support K-12 Blended Teaching: A Study of Practices of Seasoned Blended Teachers and Coaching Experiences of Emerging Blended Teachers,

- Ph.D. thesis, Brigham Young University, 2022. URL: <https://tinyurl.com/2bz3cf6v>.
- [44] S. Mekhitarian, *Effective Instruction in the Blended Learning Classroom*, Ph.D. thesis, Loyola Marymount University, 2016. URL: <https://digitalcommons.lmu.edu/etd/465>.
- [45] E. B. Pulham, *K-12 Blended Teaching Competencies*, Ph.D. thesis, Brigham Young University, 2018. URL: <https://tinyurl.com/yenp7s8k>.
- [46] L. R. Tiell, *An Ethnographic Case Study on the Phenomena of Blended Learning Teachers*, Ph.D. thesis, University of Findlay, 2017. URL: [http://rave.ohiolink.edu/etdc/view?acc\\_num=findlay150056494394115](http://rave.ohiolink.edu/etdc/view?acc_num=findlay150056494394115).
- [47] I. S. Mintii, *Blended learning: definition, concept, and relevance*, *Educational Dimension* 8 (2023) 85–111. URL: <https://doi.org/10.31812/ed.539>.
- [48] I. S. Mintii, *Blended learning for teacher training: benefits, challenges, and recommendations*, *Educational Dimension* 9 (2023) 1–12. URL: <https://doi.org/10.31812/ed.581>.
- [49] S. O. Semerikov, T. A. Vakaliuk, I. S. Mintii, S. O. Didkivska, *Challenges facing distance learning during martial law: results of a survey of Ukrainian students*, *Educational Technology Quarterly* 2023 (2023) 401–421. URL: <https://doi.org/10.55056/etq.637>.
- [50] V. M. Kukhareno, S. M. Berezenska, K. L. Buhaichuk, N. Y. Oliinyk, T. O. Oliinyk, O. V. Rybalko, N. H. Syrotenko, A. L. Stoliarevska, *Theory and practice of blended learning*, Miskdruk, Kharkiv, 2016. URL: <https://repository.ldufk.edu.ua/handle/34606048/24840>.
- [51] V. M. Kukhareno, *Zmishane (hibrydne) navchannia ta profesiine navchannia (blended (hybrid) learning and vocational training)*, in: L. M. Petrenko, other (Eds.), *Teoriia i praktyka dystantsi-inoho navchannia u profesiinii osviti: zb. materialiv 1-yi Vseukr. veb-konf., 28 liutoho 2017 r., SIK-GhRUP UKRAINE*, 2017. URL: <https://repository.kpi.kharkov.ua/handle/KhPI-Press/51974>.
- [52] K. L. Buhaichuk, *Blended learning: theoretical analysis and strategy of implementation in educational process of higher educational institutions*, *Information Technologies and Learning Tools* 54 (2016) 1–18. URL: <https://doi.org/10.33407/itlt.v54i4.1434>.
- [53] O. M. Kryvonos, O. V. Korotun, *Blended Learning as a Basis for Developing Teacher's ICT Competence*, *Naukovi zapysky. Serii: Problemy metodyky fizyko-matematychnoi i tekhnolohichnoi osvity* 2 (2015) 19–23. URL: [https://nbuv.gov.ua/UJRN/nz\\_pmfm\\_2015\\_8%28%29\\_\\_6](https://nbuv.gov.ua/UJRN/nz_pmfm_2015_8%28%29__6).
- [54] O. Kuzmenko, *Blended learning as an innovative form of teaching and learning at school*, *The Scientific Issues of Ternopil Volodymyr Hnatiuk National Pedagogical University. Series: pedagogy* (2017) 140–147. URL: <https://doi.org/10.25128/2415-3605.17.3.19>.
- [55] H. Tkachuk, *Blended learning and features of the use of the rotation model in the educational process*, *Journal of Information Technologies in Education (ITE)* (2017) 143–156. URL: <https://ite.kspu.edu/index.php/ite/article/view/47>.
- [56] *Rekomendatsii shchodo vprovadzhennia zmishanoho navchannia u zakladakh fakhovoi peredvyshchoi ta vyshchoi osvity (Recommendations for the Implementation of Blended Learning in Vocational Higher Education Institutions)*, 2020. URL: <https://tinyurl.com/38vasj4m>.
- [57] O. Pasichnyk, Y. Yefymova, K. Chushak, O. Shynarovska, A. Donets, *Zmishane navchannia u zakladakh profesiinoi (profesiino-tekhnichnoi) osvity (Blended learning in vocational (vocational-technical) education institutions)*, Kyiv, 2021. URL: <https://mon.gov.ua/storage/app/media/pto/2021/11/30/Zmish.navch.u.zakl.P-PT-O.30.11.pdf>.
- [58] S. Shkarlet, *Bilshist ukrainskykh uchniv navchaitusia v ochnomu abo zmishanomu rezhymi (Most Ukrainian students study in full-time or blended mode)*, 2022. URL: <https://tinyurl.com/47p8y87w>.
- [59] V. T. Busel (Ed.), *Velykyi tлумachnyi slovnyk suchasnoi ukrainskoi movy (The Great Explanatory Dictionary of the Modern Ukrainian Language)*, Perun, Kyiv, Irpin, 2005. URL: <https://irbis-nbuv.gov.ua/ulib/item/UKR0000989>.
- [60] *Zmishane navchannia*, 2019. URL: <https://tinyurl.com/yvvhv8bv>.
- [61] H. V. Tkachuk, *Theoretical and methodical principles of practical training of future teachers of computer science in conditions of blended learning*, *Theses for obtaining Doctoral degree in pedagogical sciences, specialty of 13.00.02. – The Theory and Methods of Training (technical disciplines)*, National Pedagogical University named after M. P. Drahomanov, Kyiv, 2019. URL: <https://enpuir.npu.edu.ua/handle/123456789/25570>.



- [62] Y. V. Tryus, I. V. Herasymenko, The combined study as innovative educational technology in higher education, *Theory and methods of e-learning* 3 (2012) 299–308. URL: <https://doi.org/10.55056/e-learn.v3i1.353>.
- [63] S. O. Semerikov, A. M. Striuk, Kombinovane navchannia: problemy i perspektyvy zastosuvannia v udoskonalenni navchalno-vykhovnoho protsesu y samostiinoi roboty studentiv (Blended learning: problems and prospects of application in improving the educational process and students' independent work), in: O. A. Konoval (Ed.), *Teoriia i praktyka orhanizatsii samostiinoi roboty studentiv vyshchikh navchalnykh zakladiv*, Knyzhkove vydavnytstvo Kyreievskoho, Kryvyi Rih, 2012, pp. 135–163. URL: <https://doi.org/10.31812/0564/971>.
- [64] A. M. Striuk, Theoretical and methodological foundations of blended learning of system programming of future specialists in software engineering, volume 6 of *Theory and methods of e-learning*, Kryvyi Rih National University, Kryvyi Rih, 2015. URL: <https://doi.org/10.55056/e-learn.v6i1.581>.
- [65] Mësimi i përzier, 2022. URL: <https://tinyurl.com/wpm45t8d>.
- [66] N. Caka, Metodologjitë e mësimet elektronik, *Mësuesi* (2006). URL: <https://www.researchgate.net/publication/236231548>.
- [67] Blended learning, 2023. URL: <https://tinyurl.com/4m5s67mt>.
- [68] C. R. Graham, Blended Learning Systems: Definition, Current Trends and Future Directions, in: C. J. Bonk, C. R. Graham (Eds.), *The Handbook of Blended Learning: Global Perspectives, Local Designs*, Pfeiffer, San Francisco, CA, 2006, pp. 3–21. URL: <https://tinyurl.com/bdutazp7>.
- [69] C. R. Graham, Blended Learning Models, in: M. Khosrow-Pour (Ed.), *Encyclopedia of Information Science and Technology*, 2 ed., IGI Global, 2009, pp. 375–382. URL: <https://doi.org/10.4018/978-1-60566-026-4.ch063>.
- [70] C. J. Bonk, C. R. Graham (Eds.), *The Handbook of Blended Learning: Global Perspectives, Local Designs*, Pfeiffer, San Francisco, CA, 2006.
- [71] T. Vukadynova, S. Terzyeva, M. Popov, Developing Professional and Communication Skills of Students in Engineering Disciplines, *Chuzhdoezykovo obuchenye* 48 (2021) 255–265. URL: <https://doi.org/10.53656/for21.33razv>.
- [72] Hibridno obuchenie, 2022. URL: <https://tinyurl.com/2s495u5w>.
- [73] C. Viebig, Blended learning in entrepreneurship education: a systematic literature review, *Education + Training* 64 (2022) 533–558. URL: <https://doi.org/10.1108/ET-05-2021-0164>.
- [74] J. Buhl-Wiggers, A. Kjærgaard, K. Munk, A scoping review of experimental evidence on face-to-face components of blended learning in higher education, *Studies in Higher Education* 48 (2023) 151–173. URL: <https://doi.org/10.1080/03075079.2022.2123911>.
- [75] Blended Learning, 2021. URL: <https://tinyurl.com/3ppxya44>.
- [76] Pöimõpe, 2020. URL: <https://tinyurl.com/mcyk6vsk>.
- [77] Aprendizaje semipresencial, 2022. URL: <https://tinyurl.com/b8k5zy5f>.
- [78] A. Dasso Vassallo, I. Evaristo Chiyong, Análisis de resultados del aprendizaje presencial y aprendizaje semipresencial en dos cursos universitarios, *Educación* 29 (2020) 27–42. URL: <https://doi.org/10.18800/educacion.202002.002>.
- [79] Aprentatge mixt, 2018. URL: <https://tinyurl.com/5fhsvufr>.
- [80] V. Antoniadou, M. Dooly, Etnografía educativa en contextos d'apreñtatge mixt, in: E. Moore, M. Dooly (Eds.), *Qualitative approaches to research on plurilingual education - Enfoaments qualitatus per a la recerca en educació plurilingüe - Enfoques cualitativos para la investigación en educación plurilingüe*, Research-publishing.net, 2017, pp. 264–292. URL: <https://doi.org/10.14705/rpnet.2017.emmd2016.631>.
- [81] Blended learning, 2022. URL: <https://tinyurl.com/mr32wc6e>.
- [82] S. K. Banihashem, O. Noroozi, P. den Brok, H. J. Biemans, N. T. Kerman, Modeling teachers' and students' attitudes, emotions, and perceptions in blended education: Towards post-pandemic education, *The International Journal of Management Education* 21 (2023) 100803. URL: <https://doi.org/10.1016/j.ijme.2023.100803>.
- [83] J. H. Eggers, R. Oostdam, J. Voogt, Self-regulation strategies in blended learning environments in higher education: A systematic review, *Australasian Journal of Educational Technology* 37

- (2021) 175–192. URL: <https://doi.org/10.14742/ajet.6453>.
- [84] Integriertes Lernen, 2023. URL: <https://tinyurl.com/yh2dhppa>.
- [85] P. Dehnbostel, G. Richter, T. Schröder, A. Tisch, Lernen in der digitalen Transformation der Arbeit: Ringvorlesung der BAuA und der TU Dortmund beleuchtet Digitalisierung im Austausch mit Expertinnen und Experten, sicher ist sicher 71 (2020) 231–234. URL: <https://doi.org/10.37307/j.2199-7349.2020.05.05>.
- [86] A. Settlemeyer, G. Münchhausen, K. Schneider, Integriertes Lernen von Sprache und Fach in der Berufsorientierung und Berufsvorbereitung von Geflüchteten: wissenschaftliche Expertise zum Programm “Berufsorientierung für Flüchtlinge” (BOF), volume 207 of *Wissenschaftlichen Diskussionspapiere*, Bundesinstituts für Berufsbildung, Bonn, 2019. URL: <https://www.bibb.de/dienst/publikationen/de/10599>.
- [87] Blandet læring, 2020. URL: <https://tinyurl.com/y5yepvcs>.
- [88] R. Jentoft, Viten skapt gjennom fleksibel læring, in: A.-L. Thoresen, B. Norbye (Eds.), *Forskning og kunnskapsutvikling i helsefaglig profesjonsutdanning*, Orkana Akademisk, 2020, pp. 207–231. URL: <https://doi.org/10.33673/OOA20212>.
- [89] Blended learning, 2021. URL: <https://tinyurl.com/3fct4rkj>.
- [90] A. Ożadowicz, Interactivity – A Key Element of Blended Learning with Flipped Classroom Approach, in: 2022 IEEE 9th International Conference on e-Learning in Industrial Electronics (ICELIE), 2022, pp. 1–6. URL: <https://doi.org/10.1109/ICELIE55228.2022.9969439>.
- [91] M. Roszak, B. Kołodziejczak, W. Kowalewski, A. Ren-Kurc, Academic blended learning – competences and tools, *International Journal of Continuing Engineering Education and Life Long Learning* 24 (2014) 286–301. URL: <https://doi.org/10.1504/IJCEELL.2014.063100>.
- [92] Blended learning, 2019. URL: <https://tinyurl.com/mrx3dzkp>.
- [93] M. R. C. Santos, Blended Learning Compared to Online Learning in Business, Management, and Accounting Education: A Bibliometric Analysis and Literature Review, in: L. C. Carvalho, N. Teixeira, P. Pardal (Eds.), *Interdisciplinary and Practical Approaches to Managerial Education and Training*, IGI Global, 2022, pp. 46–55. URL: <https://doi.org/10.4018/978-1-7998-8239-8.ch003>.
- [94] N. S. Morais, R. Raposo, Blended-learning in contexts conditioned by the pandemic: the perceptions of higher education students, in: A. Balderas, A. J. Mendes, J. M. Dodero (Eds.), 23rd International Symposium on Computers in Education, SIIE 2021, Malaga, Spain, September 23-24, 2021, IEEE, 2021, pp. 1–6. URL: <https://doi.org/10.1109/SIIE53363.2021.9583650>.
- [95] Învățare mixtă, 2022. URL: <https://tinyurl.com/4ybyn4jt>.
- [96] Mešano učenje, 2021. URL: <https://tinyurl.com/5dpmd7wb>.
- [97] Kombinované vzdelávanie, 2013. URL: <https://tinyurl.com/ax3cauz9>.
- [98] J. Tej, M. Vagaš, Vzdelávanie a rozvoj talentov po COVID-19 (Talent education and development after COVID-19), in: RELIK 2020: Reproduction of human capital – mutual links and connections: conference proceedings, Prague University of Economics and Business, Praha, 2020, pp. 559–568. URL: <https://relik.vse.cz/2020/download/pdf/317-Vagas-Matus-paper.pdf>.
- [99] Kombinirano učenje, 2022. URL: <https://tinyurl.com/msd2adab>.
- [100] D. Keržič, Učna analitika kombiniranega učenja v visokem šolstvu, Ph.D. thesis, Univerza v Ljubljani, 2022. URL: <https://repozitorij.uni-lj.si/IzpisGradiva.php?id=137171>.
- [101] I. Bitenc, B. Werber, M. Urh, Kombinirano učenje - izkušnje in rešitve, *Uporabna informatika* 28 (2020). URL: <https://doi.org/10.31449/upinf.76>.
- [102] Blended learning, 2019. URL: <https://tinyurl.com/9mrsapnm>.
- [103] G. Baksa-Haskó, B. Baranyai, Data-Mining Possibilities in Blended Learning, in: M. E. Auer, D. Guralnick, I. Simonics (Eds.), *Teaching and Learning in a Digital World*, volume 716 of *Advances in Intelligent Systems and Computing*, Springer International Publishing, Cham, 2018, pp. 174–183. URL: [https://doi.org/10.1007/978-3-319-73204-6\\_21](https://doi.org/10.1007/978-3-319-73204-6_21).
- [104] F. Hegyesi, Blended learning in adult education in the Óbuda University, in: 2012 IEEE 10th Jubilee International Symposium on Intelligent Systems and Informatics, 2012, pp. 451–454. URL: <https://doi.org/10.1109/SISY.2012.6339563>.
- [105] Sulautuva oppimine, 2023. URL: <https://tinyurl.com/2z2wbpne>.

- [106] M. Sirén, Sulautuva oppiminen : kirjallisuuskatsaus opettajan ja opiskelijan uusista rooleista (Blended Learning: Literary Review of the New Roles of Teacher and Student), Pro Gradu – thesis, University of Turku, 2017. URL: <https://www.utupub.fi/handle/10024/144025>.
- [107] J. Färm, Sulautuva oppiminen koreografisessa työskentelyssä (Blended Learning in Choreographic Process), Dance Teacher Degree programme, Option of Couple Dances, Oulu University of Applied Sciences, 2018. URL: <https://www.theseus.fi/handle/10024/145540>.
- [108] Apprentissage hybride, 2022. URL: <https://tinyurl.com/4azfswd4>.
- [109] F. Bédard, P. Pelletier, C. Le Clech, L'apprentissage hybride, *Le Tableau 6* (2017). URL: <https://pedagogie.quebec.ca/le-tableau/lapprentissage-hybride>.
- [110] J.-P. Béchar, C. Carré, G. Frankel, Z. Dissou, C. Bazinet, G. Cazabon, Y. Goyette, L'apprentissage hybride en sciences de gestion: ce qu'en pensent les étudiants, *Revue internationale de pédagogie de l'enseignement supérieur* 30 (2014) 1–19. URL: <https://doi.org/10.4000/ripes.784>.
- [111] Blended learning, 2022. URL: <https://tinyurl.com/yshwvxt>.
- [112] B. Klímová, Experience in a Blended Learning Course – A Case Study, in: G. Vincenti, A. Bucciero, M. Helfert, M. Glowatz (Eds.), *E-Learning, E-Education, and Online Training - Third International Conference, eLEOT 2016, Dublin, Ireland, August 31 - September 2, 2016, Revised Selected Papers*, volume 180 of *Lecture Notes of the Institute for Computer Sciences, Social Informatics and Telecommunications Engineering*, Springer, 2016, pp. 161–168. URL: [https://doi.org/10.1007/978-3-319-49625-2\\_20](https://doi.org/10.1007/978-3-319-49625-2_20).
- [113] P. Poulouva, M. Cerna, New University Students and Blended Learning Experience, in: 2018 International Symposium on Educational Technology (ISET), 2018, pp. 18–22. URL: <https://doi.org/10.1109/ISET.2018.00014>.
- [114] Blended learning, 2022. URL: <https://tinyurl.com/43tm95xy>.
- [115] S. Hrastinski, What do we mean by blended learning?, *TechTrends* 63 (2019) 564–569. URL: <https://doi.org/10.1007/s11528-019-00375-5>.
- [116] E. Ossiannilsson, Blended Learning – State of the Nation, in: B. M. McLaren, R. Reilly, S. Zvacek, J. O. Uhomoibhi (Eds.), *Proceedings of the 10th International Conference on Computer Supported Education, CSEDU 2018, Funchal, Madeira, Portugal, March 15-17, 2018, Volume 2*, SciTePress, 2018, pp. 541–547. URL: <https://doi.org/10.5220/0006815005410547>.
- [117] The Law of Ukraine “On Education” (Zakon Ukrainy “Pro osvitu”), 2017. URL: <https://zakon.rada.gov.ua/laws/show/2145-19>.
- [118] M. Oliver, K. Trigwell, Can ‘Blended Learning’ Be Redeemed?, *E-Learning and Digital Media* 2 (2005) 17–26. URL: <https://doi.org/10.2304/elea.2005.2.1.17>.
- [119] M. Driscoll, Blended Learning: Let’s get beyond the hype, *E-learning* 2 (2002). URL: <https://tinyurl.com/dyhm2vjz>.
- [120] National Education Act of B.E. 2542 (1999), Office of the National Education Commission, Bangkok, Thailand, 1999. URL: <https://asean.org/wp-content/uploads/2016/08/Thailand184.pdf>.
- [121] J. Cross, M. G. Moore, Foreword, in: C. J. Bonk, C. R. Graham (Eds.), *The Handbook of Blended Learning: Global Perspectives, Local Designs*, Pfeiffer, San Francisco, CA, 2006, pp. xvii–xxx.
- [122] A. Rossett, R. V. Frazee, Blended Learning Opportunities, AMA Special Report, American Management Association, 2006. URL: <https://www.researchgate.net/publication/228669485>.
- [123] S. Hubackova, I. Semradova, Evaluation of blended learning, *Procedia - Social and Behavioral Sciences* 217 (2016) 551–557. URL: <https://doi.org/10.1016/j.sbspro.2016.02.044>.
- [124] H. Bicen, F. Ozdamli, H. Uzunboylu, Online and blended learning approach on instructional multimedia development courses in teacher education, *Interactive Learning Environments* 22 (2014) 529–548. URL: <https://doi.org/10.1080/10494820.2012.682586>.
- [125] H. Çakır, B. A. Bichelmeyer, Effects of teacher professional characteristics on student achievement: an investigation in blended learning environment with standards-based curriculum, *Interactive Learning Environments* 24 (2016) 20–32. URL: <https://doi.org/10.1080/10494820.2013.817437>.
- [126] N. Deschacht, K. Goeman, The effect of blended learning on course persistence and performance of adult learners: A difference-in-differences analysis, *Computers & Education* 87 (2015) 83–89. URL: <https://doi.org/10.1016/j.compedu.2015.03.020>.

- [127] D. R. Garrison, H. Kanuka, Blended learning: Uncovering its transformative potential in higher education, *The Internet and Higher Education* 7 (2004) 95–105. URL: <https://doi.org/10.1016/j.iheduc.2004.02.001>.
- [128] I. E. Allen, J. Seaman, *Class Differences: Online Education in the United States*, 2010, Babson Survey Research Group, 2010. URL: <https://files.eric.ed.gov/fulltext/ED529952.pdf>.
- [129] I. E. Allen, J. Seaman, R. Garrett, *Blending In: The Extent and Promise of Blended Education in the United States* 2005, Sloan-C, 2007. URL: <https://files.eric.ed.gov/fulltext/ED529930.pdf>.
- [130] J. Khlaisang, Development of Pedagogical Blended E-Learning Model Using Cognitive Tools Based Upon Constructivist Approach for Knowledge Construction in Higher Education, in: L. Gómez Chova, I. Candel Torres, A. López Martínez (Eds.), *Proceedings of the Fourth International e-Learning Conference 2012*, Bangkok, Thailand, June 14, 2012, Office of the Higher Education Commission, 2012. URL: <https://www.slideshare.net/jmonsakul/1-iec2012-fullpaperjrk010612completedfinalforslideshare>.
- [131] J. Khlaisang, Proposed models of appropriate website and courseware for e-learning in higher education: research based design models, in: J. Sanchez, K. Zhang (Eds.), *E-Learn: World Conference on E-Learning in Corporate, Government, Healthcare, and Higher Education*, Association for the Advancement of Computing in Education (AACE), 2010, pp. 1520–1529. URL: <https://eric.ed.gov/?id=ED515797>.
- [132] S. Waterhouse, *The Power of eLearning: The Essential Guide for Teaching in the Digital Age*, Allyn and Bacon, Boston, 2005.
- [133] D. Wilson, E. M. Smilanich, *The other blended learning: A classroom-centered approach*, Pfeiffer, 2005.
- [134] R. M. Bernard, E. Borokhovski, R. F. Schmid, R. M. Tamim, P. C. Abrami, A meta-analysis of blended learning and technology use in higher education: From the general to the applied, *Journal of Computing in Higher Education* 26 (2014) 87–122. URL: <https://doi.org/10.1007/s12528-013-9077-3>.
- [135] W. W. Porter, C. R. Graham, K. A. Spring, K. R. Welch, Blended learning in higher education: Institutional adoption and implementation, *Computers & Education* 75 (2014) 185–195. URL: <https://doi.org/10.1016/j.compedu.2014.02.011>.
- [136] A.-N. Diep, C. Zhu, K. Struyven, Y. Blicke, Who or what contributes to student satisfaction in different blended learning modalities?, *British Journal of Educational Technology* 48 (2017) 473–489. URL: <https://doi.org/10.1111/bjet.12431>.
- [137] Á. H. Galvis, Supporting decision-making processes on blended learning in higher education: literature and good practices review, *International Journal of Educational Technology in Higher Education* 15 (2018) 1–38. URL: <https://doi.org/10.1186/s41239-018-0106-1>.
- [138] F. Mayadas, G. Miller, J. Sener, *Definitions of E-Learning Courses and Programs*, 2015. URL: <https://onlinelearningconsortium.org/updated-e-learning-definitions-2/>.
- [139] I. Shibley, *Ten Strategies to Improve Blended Course Design*, White Paper, Magna Publications, Madison, 2013. URL: <https://tinyurl.com/2hew2jn2>.
- [140] C. Ruiz Bolívar, El *blended-learning*: evaluación de una experiencia de aprendizaje en el nivel de postgrado, *Investigación y Postgrado* 23 (2008) 11–36. URL: [https://ve.scielo.org/scielo.php?script=sci\\_arttext&pid=S1316-00872008000100002](https://ve.scielo.org/scielo.php?script=sci_arttext&pid=S1316-00872008000100002).
- [141] M. A. Gonzalez Aldana, K. V. Perdomo Osorio, Y. Pascuas Rengifo, Application of ICT in blended learning educational models: A systematic review of literature, *Sophia* 13 (2017) 144–154. URL: <https://doi.org/10.18634/sophiaj.13v.1i.364>.
- [142] R. Estrada Lizárraga, A. Zaldívar Colado, R. Mendoza Zatarain, L. Nava Pérez, O. V. García Sánchez, Percepción de los estudiantes acerca de la implementación de la modalidad educativa blended-learning en la educación superior, *Revista Electrónica de Investigación en Educación Superior* 1 (2013) 1–12. URL: <https://tinyurl.com/4c6er567>.
- [143] A. G. Antúnez Sánchez, K. d. I. Á. González Espinosa, Y. Soler Pellicer, S. Rodríguez Rodríguez, J. Haub, Resultados y experiencias en la enseñanza de las matemáticas: la modalidad blended learning, *Didasc@lia: didáctica y educación* 5 (2014) 89–98. URL: <https://revistas.ult.edu.cu/index.php/didascalia/article/view/292>.

- [144] N. Jachin, T. Usagawa, Potential impact of blended learning on teacher education in Mongolia, *Creative Education* 8 (2017) 1481–1494. URL: <https://doi.org/10.4236/ce.2017.89104>.
- [145] A. Picciano, Blending with purpose: The multimodal model, *Journal of the Research Center for Educational Technology* 5 (2009) 4–14. URL: <https://doi.org/10.24059/olj.v13i1.1673>.
- [146] E. Masie, E-learning, the near future, in: G. M. Piskurich (Ed.), *The AMA Handbook of E-Learning Effective Design, Implementation, and Technology Solutions*, AMACOM, 2003, pp. 411–418.
- [147] C. T. Procter, Blended Learning in Practice, in: *Education in a Changing Environment*, 17th-18th September 2003, Conference Proceedings, University of Salford, 2003. URL: <https://usir.salford.ac.uk/27428/2/BlendedLearningInPractice.pdf>.
- [148] W. Dick, L. Carey, J. O. Carey, *The systematic design of instruction*, 8 ed., Pearson, 2014.
- [149] J. T. Holden, P. J.-L. Westfall, K. I. Gamor, *An instructional media selection guide for distance learning—Implications for blended learning. Featuring an Introduction to Virtual Worlds*, United States Distance Learning Association, Boston MA, 2010. URL: [https://www.usdla.org/wp-content/uploads/2015/05/AIMSGDL\\_2nd\\_Ed\\_styled\\_010311.pdf](https://www.usdla.org/wp-content/uploads/2015/05/AIMSGDL_2nd_Ed_styled_010311.pdf).
- [150] N. Mirriahi, D. Alonzo, B. Fox, A blended learning framework for curriculum design and professional development, *Research in Learning Technology* 23 (2015). URL: <https://doi.org/10.3402/rlt.v23.28451>.
- [151] J. Khlaisang, M. Likhitdamrongkiat, E-learning system in blended learning environment to enhance cognitive skills for learners in higher education, *Procedia – Social and Behavioral Sciences* 174 (2015) 759–767. URL: <https://doi.org/10.1016/j.sbspro.2015.01.612>.
- [152] N. Z. Zacharis, A multivariate approach to predicting student outcomes in web-enabled blended learning courses, *The Internet and Higher Education* 27 (2015) 44–53. URL: <https://doi.org/10.1016/j.iheduc.2015.05.002>.
- [153] M. Tan, K. F. Hew, Incorporating meaningful gamification in a blended learning research methods class: Examining student learning, engagement, and affective outcomes, *Australasian Journal of Educational Technology* 32 (2016). URL: <https://doi.org/10.14742/ajet.2232>.
- [154] T. Torres-Coronas, M.-A. Vidal-Blasco, MOOC y modelos de aprendizaje combinado. Una aproximación práctica, *RIED-Revista Iberoamericana de Educación a Distancia* 22 (2019) 325–343. URL: <https://doi.org/10.5944/ried.22.2.24093>.
- [155] S. Pavla, V. Hana, V. Jan, Blended Learning: Promising Strategic Alternative in Higher Education, *Procedia – Social and Behavioral Sciences* 171 (2015) 1245–1254. URL: <https://doi.org/10.1016/j.sbspro.2015.01.238>, 5th ICEEPSY International Conference on Education & Educational Psychology.
- [156] M. Derntl, R. Motschnig-Pitrik, The role of structure, patterns, and people in blended learning, *The Internet and Higher Education* 8 (2005) 111–130. URL: <https://doi.org/10.1016/j.iheduc.2005.03.002>.
- [157] C. A. Twigg, Improving quality and reducing cost: Designs for effective learning, *Change: The Magazine of Higher Learning* 35 (2003) 22–29. URL: <https://doi.org/10.1080/00091380309604107>.
- [158] Teaching & Learning Centre, *Inquiry through blended learning*, 2007. URL: <https://tinyurl.com/57993pkp>.
- [159] N. Mirriahi, D. Alonzo, S. McIntyre, G. Kligyte, B. Fox, Blended learning innovations: Leadership and change in one Australian institution, *International Journal of Education and Development using ICT* 11 (2015) 4–16. URL: <https://www.researchgate.net/publication/311413055>.
- [160] P.-S. D. Chen, A. D. Lambert, K. R. Guidry, Engaging online learners: The impact of web-based learning technology on college student engagement, *Computers & Education* 54 (2010) 1222–1232. URL: <https://doi.org/10.1016/j.compedu.2009.11.008>.
- [161] H. Owen, N. Dunham, Reflections on the Use of Iterative, Agile and Collaborative Approaches for Blended Flipped Learning Development, *Education Sciences* 5 (2015) 85–103. URL: <https://doi.org/10.3390/educsci5020085>.
- [162] C. D. Dziuban, J. L. Hartman, P. D. Moskal, Blended Learning, *EDUCAUSE Center for Applied Research Research Bulletin* 2004 (2004) 1–12. URL: <https://www.educause.edu/~media/files/library/2004/3/erb0407-pdf.pdf?la=en>.
- [163] L. O. Fadieieva, Enhancing adaptive learning with Moodle’s machine learning, *Educational*

- Dimension 5 (2021) 1–7. URL: <https://doi.org/10.31812/ed.625>.
- [164] L. O. Fadieieva, Adaptive learning: a cluster-based literature review (2011-2022), *Educational Technology Quarterly* 2023 (2023) 319–366. URL: <https://doi.org/10.55056/etq.613>.
- [165] G. Pishtari, E. Sarmiento-Márquez, M. J. Rodríguez-Triana, M. Wagner, T. Ley, Mirror mirror on the wall, what is missing in my pedagogical goals? The Impact of an AI-Driven Feedback System on the Quality of Teacher-Created Learning Designs, in: *Proceedings of the 14th Learning Analytics and Knowledge Conference, LAK '24*, Association for Computing Machinery, New York, NY, USA, 2024, p. 145–156. URL: <https://doi.org/10.1145/3636555.3636862>.
- [166] S. O. Semerikov, T. A. Vakaliuk, I. S. Mintii, V. A. Hamaniuk, V. N. Soloviev, O. V. Bondarenko, P. P. Nechypurenko, S. V. Shokaliuk, N. V. Moiseienko, D. S. Shepiliev, Design methodology for immersive educational resources, *Educational Dimension* 6 (2022) 176–199. URL: <https://doi.org/10.31812/educdim.4716>.
- [167] O. Y. Burov, O. P. Pinchuk, A meta-analysis of the most influential factors of the virtual reality in education for the health and efficiency of students' activity, *Educational Technology Quarterly* 2023 (2023) 58–68. URL: <https://doi.org/10.55056/etq.435>.
- [168] A. Ni, A. Cheung, Understanding secondary students' continuance intention to adopt AI-powered intelligent tutoring system for English learning, *Education and Information Technologies* 28 (2023) 3191–3216. doi:10.1007/s10639-022-11305-z.