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Tetyana LYSENKOVA,

orcid.org/0000-0001-8493-1790

*Senior Lecturer at the Department of Pedagogy, Foreign Philology and Translation
Simon Kuznets Kharkiv National University of Economics
(Kharkiv, Ukraine) e.lysenkova@gmail.com*

Maryna TYKHONOVA,

orcid.org/0000-0001-5040-1185

*Senior Lecturer at the Foreign Languages Department
National Technical University "Kharkiv Polytechnic Institute"
(Kharkiv, Ukraine) mtikhonova11@gmail.com*

INTERACTIVITY AND PERSONALIZATION EVOLUTION IN HIGHER EDUCATION

With the globalization of education and technological development, higher education is undergoing profound changes. The traditional model of universal learning, one for all, is gradually being replaced by personalized and interactive learning, which not only meets diverse learning needs, but also provides opportunities for improving the quality of teaching and learning efficiency. In this context, personalized and interactive learning are considered key factors in increasing the competitiveness of higher education. The central objective of this study is to find effective methods and strategies for improving the management of interactive and personalized learning in higher education environments. As to the methods, this paper addresses the emergence of these concepts and includes the identification of the main problems of modern educational models through an analysis of existing literature and case studies. The results present some theoretical basis of interactive and personalized approaches to education as well as technology-oriented solutions in accordance with the principles of educational management. At the heart of these modern approaches to learning are digital technologies that allow for flexible responses to individual needs of students, offering real-time feedback. Conclusion should be made, that among notable advances in digital technologies, connected with education, online learning platforms, virtual classrooms, intelligent learning systems, and learning analytics should be highlighted. Online platforms expand access to a wide range of courses and enrich the learning experience through multimedia content, interactive assessment, and personalized learning trajectories. Using algorithms and big data analytics, these systems can offer optimal learning resources tailored to individual student profiles. Virtual classrooms facilitate synchronous interaction between teachers and students, overcoming geographical barriers and providing greater flexibility. However, the question concerning how to effectively manage interactivity and personalization of education while making full use of available resources remains one of the challenges in today's education environment.

Key words: *personalized learning, interactive learning, educational technology, flexible responses, individual needs, real-time feedback, artificial intelligence.*

Тетяна ЛИСЕНКОВА,

orcid.org/0000-0001-8493-1790

*старший викладач кафедри педагогіки, іноземної філології та перекладу
Харківського національного економічного університету імені Семена Кузнеця
(Харків, Україна) e.lysenkova@gmail.com*

Марина ТИХОНОВА,

orcid.org/0000-0001-5040-1185

*старший викладач кафедри іноземних мов
Національного технічного університету «Харківський політехнічний інститут»
(Харків, Україна) mtikhonova11@gmail.com*

ЕВОЛЮЦІЯ ІНТЕРАКТИВНОСТІ ТА ПЕРСОНАЛІЗАЦІЇ У ВИЩІЙ ОСВІТІ

З глобалізацією освіти та технологічним розвитком вища освіта зазнає глибоких змін. Традиційна модель універсального навчання, одна для всіх, поступово замінюється персоналізованим та інтерактивним навчанням, яке не лише задовольняє різноманітні потреби в навчанні, але й надає можливості для підвищення якості викладання та ефективності навчання. У цьому контексті персоналізоване та інтерактивне навчання вважаються ключо-

вими факторами підвищення конкурентоспроможності вищої освіти. Центральною метою цього дослідження є пошук ефективних методів та стратегій для покращення управління інтерактивним та персоналізованим навчанням у середовищі вищої освіти. Що стосується методів, то ця стаття розглядає появу цих концепцій та включає визначення основних проблем сучасних освітніх моделей шляхом аналізу існуючої літератури та тематичних досліджень. Результати представляють теоретичні основи інтерактивних та персоналізованих підходів до освіти, а також технологічно-орієнтованих рішень відповідно до принципів управління освітою. В основі цих сучасних підходів до навчання лежать цифрові технології, які дозволяють гнучко реагувати на індивідуальні потреби студентів, пропонуючи зворотний зв'язок у режимі реального часу. В якості висновку зазначимо, що помітні досягнення в галузі цифрових технологій в освіті включають онлайн-платформи навчання, віртуальні класи, інтелектуальні системи навчання та аналітику навчання. Онлайн-платформи розширюють доступ до широкого спектру курсів та збагачують навчальний досвід завдяки мультимедійному контенту, інтерактивному оцінюванню та персоналізованим траєкторіям навчання. Використовуючи алгоритми та аналітику великих даних, ці системи можуть пропонувати оптимальні навчальні ресурси, адаптовані до індивідуальних профілів студентів. Віртуальні класи сприяють синхронній взаємодії між викладачами та студентами, долаючи географічні бар'єри та забезпечуючи більшу гнучкість. Однак, питання ефективного управління інтерактивністю та персоналізацією освіти, одночасно повноцінно використовуючи доступні ресурси, залишається одним із викликів у сучасному освітньому середовищі.

Ключові слова: персоналізоване навчання, інтерактивне навчання, освітні технології, гнучкі реакції, індивідуальні потреби, зворотний зв'язок у режимі реального часу, штучний інтелект.

Problem statement. Higher education is facing significant transformations. Traditional teaching models, characterized by uniform approaches to instruction, are no longer sufficient to meet the increasingly diverse needs of learners. Personalized and interactive learning have become essential to enhance both educational quality and institutional competitiveness.

Purpose of the article. The purpose of this article is to systematically explore the management of interactivity and personalized learning in higher education.

Research analysis. The article is built upon a detailed examination of relevant theoretical frameworks and practical examples. It reviews key theories such as Moore's Interaction Framework and Bloom's Mastery Learning theory, highlighting how interactivity (learner-teacher, learner-learner, learner-content) and personalized learning paths can be effectively managed and implemented. The article also discusses student-centered learning principles and adaptive learning technologies that tailor educational experiences to individual student needs.

By integrating theoretical insights with practical applications, the article not only contributes to academic knowledge in educational management but also offers actionable solutions for real-world educational settings. This dual focus on theory and practice enhances its significance for both researchers and practitioners aiming to optimize teaching effectiveness in higher education.

Presentation of the main material. Many universities around the world have begun to try to enhance teacher-student interaction and meet individualized learning needs by introducing educational technology and intelligent tutoring systems. However, in practice, there are still many challenges, such as uneven application of technology, insufficient teacher capacity, and

uneven allocation of resources. Therefore, systematic research on how to manage interactivity and personalized in higher education has important theoretical significance and practical value.

The object of research is the issue of interactivity and personalized management in the process of higher education tutoring. As an important component of educational and teaching activities, the quality of the tutoring process directly affects students' learning outcomes and the overall quality of education. Therefore, studying management methods and optimization strategies in this process is an important path to achieving research goals.

The subject of research is the core methods and strategies for interactive and personalized tutoring management in higher education. This includes how to enhance the interactivity and personalization level in the educational process through technical support, instructional design, and resource management.

To achieve these goals, various methods, including intelligent literature review, and case studies, are applied. First, theories and research findings in related fields are systematically reviewed and the fundamental concepts and models of interactivity and personalized management are systematized. Then, representative examples of educational practice are selected for in-depth analysis and effective management plans and strategies are derived. This paper focuses on the management issues of interactivity and personalized tutoring in higher education, attempting to provide guiding suggestions for related fields through theoretical exploration and empirical analysis. In the context of rapid changes in higher education, in-depth research on this topic can not only improve teaching quality, but also make positive contributions to achieving educational equity and personalized development goals.

Interactivity focuses on the multidimensional interactions between learners and teachers, between learners, and between learners and content, which have a direct impact on learning outcomes and motivation (Dewey J., 2003: 12). At the same time, personalized learning identifies students' differentiated needs, provides targeted learning support and path optimization, and lays the foundation for students' autonomous learning and lifelong development.

The rapid development of educational technology has provided new tools and methods for interactive teaching. The Interaction Framework proposed by Moore is one of the important theories for studying interactivity in educational technology. This model divides the interaction in education into three types: Learner Teacher Interaction, Learner Learner Interaction, and Learner Content Interaction (Moore M.G., 1989: 3).

Teacher-student interaction is the core of the educational process, aimed at promoting knowledge transfer and skill enhancement through direct communication between teachers and students. In traditional teaching, this interaction is mainly reflected in classroom questioning, after-school tutoring, and exam feedback. In the digital learning environment, teacher-student interaction can be achieved through forms such as instant messaging, virtual classrooms, and learning management systems. Student interaction with content is the foundation of the learning process, which refers to learners understanding and internalizing knowledge through interaction with learning materials. In traditional teaching, this interaction is manifested as reading textbooks, completing assignments, and listening to lectures. With the support of educational technology, the presentation of learning content has become more diverse. For example, intelligent tutoring systems use artificial intelligence algorithms to recommend personalized content based on students' learning progress and weak areas, thereby improving learning efficiency.

The interaction model provides a clear framework for the study of interactivity in educational technology. The application of this model is not only limited to the traditional classroom, but also widely involves online education and hybrid learning environment. In higher education, the tutoring process can build a more flexible and efficient learning ecosystem by integrating teacher-student interaction, student to student interaction, and student to content interaction. For example, in the flipped classroom mode, students interact with learning content through online platforms, and then engage in in-depth discussions with teachers and peers in the classroom, thus achieving an effective combination of interactivity and personalization.

Benjamin Bloom is one of the important pioneers of personalized teaching research, who proposed the Mastery Learning theory in the 1970s. This theory emphasizes that as long as sufficient time and appropriate teaching support are provided, almost all students can master learning objectives. Unlike traditional teaching methods, the teaching progress in the mastery learning mode is adjusted based on the students' learning speed rather than the teacher's teaching plan.

Bloom also proposed two core elements of personalized teaching.

Diagnostic evaluation: At the beginning of learning, assess students' current level through testing to design suitable teaching content and methods.

Formative evaluation: During the learning process, teachers regularly assess students' progress and adjust teaching strategies in a timely manner.

The application of this theory in higher education is mainly reflected in online course platforms and blended learning models. For example, platforms such as Coursera and Khan Academy use built-in learning assessment tools to help students identify knowledge blind spots in a timely manner and engage in targeted learning, thereby achieving personalized teaching.

In practice, student-centered learning is mainly achieved through the following methods.

Self directed learning: Students choose learning content and methods based on their own interests and goals.

Collaborative learning: Students work together in teams to solve problems and promote deep learning.

Reflective learning: Students continuously improve their learning strategies through self-assessment and teacher feedback.

In higher education, many universities have integrated the student-centered concept into their curriculum design.

In addition, adaptive learning is also an important practical form of student-centered learning philosophy, which utilizes artificial intelligence and big data technology to dynamically adjust learning content and pace based on learners' behavior and performance. Adaptive learning systems use data about learners' behavior and performance to customize content delivery, pacing, and support, thus enhancing both engagement and outcomes (Siemens G., 2005: 8). This model not only emphasizes personalized teaching, but also provides the optimal learning path for students through real-time analysis of their data (Wang Z., Chen L., Anderson T., 2014: 131).

One-on-One Tutoring is the most classic form of traditional education, typically provided by teachers or mentors with personalized guidance for individual

students. This model is considered one of the most effective teaching methods in the history of education due to its high degree of customization and strong targeting. It has three characteristics. Personalized guidance: Teachers can adjust teaching content and pace according to students' specific needs and learning levels.

Instant feedback: Teachers can promptly identify and correct students' comprehension issues, which enhances learning efficiency in real-time.

However, one-on-one this mode requires a significant amount of teaching resources and time investment, making it difficult to popularize in large-scale education systems. Student dependency is also a problem, as excessive reliance on teacher guidance may limit the development of students' self-directed learning abilities. Compared to one-on-one instruction, group tutoring is a traditional form of tutoring with higher resource efficiency, typically led by a teacher or mentor guiding a group of multiple students. Group tutoring emphasizes cooperation and collective learning among students, promoting the common construction of knowledge through interaction and discussion. There are also three advantages of group instruction.

Collaborative learning: Through interaction and knowledge sharing with peers, students are able to understand learning content from different perspectives.

Improving Participation: Group tutoring usually adopts diverse forms such as discussions, case studies, and practical projects, which can help enhance students' interest and participation in learning.

Efficient resource utilization: Compared with one-on-one tutoring, group instruction can better utilize limited teaching resources and provide tutoring services for more students.

With the rapid development of information technology, the education sector has undergone significant changes, and traditional tutoring models are gradually moving towards modernization. The modern instruction model emphasizes the application of digitalization and online learning, redefining the content, form, and goals of education through innovative teaching methods and technological tools. Intelligent tutoring systems replicate some functions of human tutors, providing learners with personalized feedback, guidance, and assessments. Digital technology is the core driving force of modern tutoring models. By utilizing educational technology tools, modern education can more flexibly adapt to students' personalized needs and provide real-time feedback. The following are several typical applications of digital technology in modern education.

Online learning platform: Online learning platforms provide students with a wide range of course

choices and enhance the learning experience through video lectures, real-time quizzes, and personalized learning paths. These platforms utilize algorithms and big data analysis to recommend the most suitable courses and learning content for students.

Virtual classroom: Virtual classroom is a teaching form that connects teachers and students to the same online space, achieving remote tutoring through real-time videos and interactive tools. Compared with traditional classrooms, virtual classrooms break geographical limitations in space and provide students with more flexible learning opportunities. For example, during the COVID-19, most universities around the world turned to virtual classroom models, such as Zoom, Microsoft Teams, and Blackboard Collaboration. This change ensured the continuity of teaching, and also stimulated more exploration of digital teaching methods. With the war in our country many students are scattered throughout the country and abroad, so using such flexible learning opportunities became especially commonly spread.

Learning analytics is a method of providing teaching decision support by collecting and analyzing students' learning data. This technology provides data-driven personalized teaching support for modern educational models which provide students with the opportunity to learn anytime, anywhere through online learning. Personalized technology-enhanced learning in higher education significantly improves learner performance when supported by proper design and implementation (Martin F., Chen Y., Moore R.L., Westine C.D., 2018: 1920.)

Online learning has also lowered the geographical and economic barriers to education, allowing more students to access educational resources from top universities. At the same time, it should be recognized that online learning also has some shortcomings. For example, online learning has to some extent weakened emotional communication and real-time interaction between teachers and students. Especially in the tutoring process, the establishment of teacher-student relationships and the effectiveness of personalized guidance may be affected. "Personalized technology-enhanced learning in higher education significantly improves learner performance when supported by proper design and implementation" (Liu V., Latif E., Zhai X., 2025: 23).

The blended learning model is a comprehensive teaching mode that combines the flexibility of online teaching with the deep interaction of offline teaching. Blended learning is defined by scholars as "the integration of face-to-face teaching with digital tools to achieve interactive and personalized improvements in the teaching process" (Choi-Lundberg D.L.,

Williams A.M., Harper B., 2019: 137). Its core features can be simply summarized into three aspects.

Diversified teaching tools and resources: Students can receive direct guidance from teachers in the classroom, as well as access a vast amount of learning resources through online platforms, such as video courses, e-books, and virtual laboratories.

Flexible learning pace: Students can schedule online learning according to their personal time, while engaging in targeted problem discussions and practical activities in the classroom. This flexibility helps meet the needs of different learners.

The balance between interactivity and personalization: The blended tutoring model fully leverages the advantages of online and offline teaching. On the basis of traditional face-to-face teaching, the online learning section provides more personalized content to ensure that students can receive targeted guidance at different levels and fields. For example, in a flipped classroom, students preview basic concepts through online resources before class, while classroom time is used for interaction with teachers and classmates, in-depth discussions, and problem-solving. This model not only enhances classroom interaction, but also strengthens the pertinence of learning.

Flexible adaptation to different learning needs: The blended learning model is suitable for various types of learners, including full-time students, on-the-job learners, and remote learners. For example, many higher education institutions adopt a hybrid model for career development courses, allowing students to receive high-quality education in their spare time. In addition, in the hybrid mode, some students may not fully utilize online learning resources due to a lack of self-discipline, or exhibit low participation in face-to-face sessions. How to effectively motivate students to participate in two learning environments is still a problem that needs to be addressed (Greener S., 2023: 35).

In the future, with the development of virtual reality (VR), augmented reality (AR), and artificial intelligence (AI), hybrid tutoring models will be able to provide more immersive and personalized learning experiences. For example, VR technology can be used to create virtual laboratories and enhance students' practical abilities. In order for teachers to be compe-

tent in the blended learning model, comprehensive technical training and instructional design guidance need to be provided. Universities can provide continuous support for teachers by setting up specialized teacher development centers. In order to enhance students' participation in the hybrid mode, universities need to provide more online support services, such as learning advisors, technical assistance, and psychological counseling services, to help students better adapt to this new mode. Intelligent Tutoring System (ITS) is a software system that uses artificial intelligence technology to simulate teacher behavior and provide personalized learning support for students. Its goal is to customize a unique learning path for each student by analyzing their learning behavior and knowledge mastery in real-time. The application of this technology not only improves students' learning efficiency, but also to some extent solves the problem of uneven distribution of educational resources.

Nevertheless, the traditional model of face-to-face emotional support and the establishment of teacher-student relationships still play an irreplaceable role. In higher education, how to combine the advantages of both to form a blended tutoring model will be an important direction for future research and practice.

Conclusion. In the context of globalization and rapid technological advancement, higher education must adapt to meet the growing demands for personalized and interactive learning experiences. Traditional one-size-fits-all instructional models are no longer sufficient to support the diverse needs of modern learners. This article has explored the theoretical foundations and practical challenges of managing interactivity and personalization in higher education, drawing on established models such as Moore's Interaction Framework and Bloom's Mastery Learning theory. The findings highlight that effective management of personalized and interactive tutoring requires a holistic approach that integrates technological tools, thoughtful instructional design, and strategic resource allocation. While educational technology offers powerful means to enhance learning, its uneven application and the need for teacher training remain significant challenges. Moreover, balancing the roles of technology and educators is critical to maintaining human-centered learning experiences.

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