

The effectiveness of using mobile applications for studying in non-language specialties at higher education institutions



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Abstract Using mobile apps for learning professionally oriented English is highly topical and widely recognized as an effective and convenient method for language acquisition. Mobile apps provide a range of benefits that contribute to their popularity among undergraduates. The key reasons why using mobile apps for learning English is considered topical: accessibility, convenience, interactive and engaging content, personalized learning, variety of learning materials, social and community features, progress tracking. Therefore, the aim of the paper is to study the effectiveness of mobile applications for learning professional English during the study at higher education institutions in Ukraine. Instruments of data collection used were analysis of scientific sources, questionnaires, interviews, and focused group discussion. The results of questionnaires and interviews prove the need to use mobile apps for developing the level of English by students of higher education institutions. Searching the problem provide the opportunities to determine the most used mobile apps for studying English and describe their advantages in the process of learning English in nonlinguistic specialties. The process of learning English at higher education establishments aimed at using mobile apps proved the effectiveness of such process because of increasing English level of Ukrainian higher education students.

Keywords: communicative competence developing, foreign language, mobile application, nonphilological specialties

1. Introduction

The process of joining Ukraine to the globalized integrated environment requires perfect mastery of foreign languages from intending professionals. The informational transformation of the modern social environment dictates certain requirements that undergo constant upward dynamics, being tangential to the aspect of the competitiveness of a modern specialist and the general need for comprehensive development of the individual to effectively participate in all spheres of social life. Therefore, foreign language proficiency becomes an important ability and additional educational skill for individuals.

At the same time, teaching practices at higher education institutions prove that the number of hours allocated to studying English is insufficient for the formation of foreign language communicative competence. The formation of undergraduates' foreign language communicative competence requires the creation of conditions for their positive professional development, psychological comfort, and creative realization. It is important to build and develop the ability to use a foreign language to express a personal view of professional issues in oral and written speech. Therefore, finding ways and means for developing professionally oriented English proficiency is one of the most urgent problems.

A large number of scientific works devoted to the problem of using information and communication technologies in the process of learning a foreign language in higher education institutions confirm linguistic didactic informatization. In particular, K. Beatty (2015) studies the problem of mobile language learning; M. Bernacki, J. Greene, H. Crompton (2020) focus on the issue of advances and the role of mobile technology in education (Dudnik et al., 2020). In addition, D. Assanova and A. Prlepessova (2020) focused on the role of educational mobile apps in learning English by nonlinguistic specialty students. A. Irawan, A. Wilson, and Sutrisno (2020) developed the problem of implementing the Duolingo mobile application in English vocabulary learning. A. Basal (2016) proves the effectiveness of mobile applications in vocabulary teaching. D. Huynh, L. Zuo, H. Lida (2018) research the assessment of game elements in the Duolingo language-learning platform.



Therefore, the development of mobile technologies along with numerous mobile applications contributes to the innovative use of mobile technologies in higher education (Koliadenko et al., 2022). The introduction of mobile applications for rapid and effective learning of a foreign language is a necessary prerequisite for the needs of every Ukrainian undergraduate (Bondarenko et al., 2022).

Modern specialists who have received higher education are required to have foreign language proficiency at the B2 level according to contemporary job circumstances. To increase their competitiveness in the world labor market, there is a need to master a foreign language. However, there are some challenges in the study of English in nonlanguage specialties of higher education institutions. Therefore, it is necessary to develop professionally oriented English while intending specialist training at higher education institutions. Therefore, the aim of this article is to study the importance of mobile applications for increasing the use of professional English at higher education institutions in nonlinguistic specialties in Ukraine.

Achieving this aim is possible under the condition of the implementation of certain tasks, the solution of which will ensure the step-by-step realization of the result. The tasks are 1) to determine the current state of the use of mobile apps for developing English levels among students at higher education institutions; 2) to identify the most commonly used mobile apps for studying English and their advantages in the process of training English in nonlinguistic specialties; and 3) to examine the effectiveness of their application with the purpose of increasing the English level of Ukrainian higher education applicants.

2. Literature review

Among modern methods of teaching foreign languages, there are already a number of works related to mobile learning. Some Ukrainian researchers have addressed the issue of using modern innovative technological capabilities in the course of learning a foreign language to increase the pace and quality of the educational process. Scientists emphasize that compared with traditional methodologies, mobile learning tools have significant advantages because they stimulate independent study of materials and self-development, individualize the educational process, and increase the level of motivation of education seekers (Gorbatiuk et al., 2019; Hinze et al., 2023; Mozharovska, 2023).

A number of modern researchers are convinced of the feasibility of using the capabilities of educational robotics at all educational levels (Mia et al., 2022; Akimov et al., 2021; Huang et al., 2024). The involvement of certain elements of the studied methodology in primary school, in particular, makes it possible to increase the effectiveness of the educational process through the introduction of games, and the definition of the concept of "robotics" as an interdisciplinary concept is provided, which simplifies its use in a practical format with the help of a system of connections in the educational process of primary school. (Rakhmanina et al., 2022; Huseinović, 2024; Wang, 2023). The problem of using computer and Internet technologies in public administration has been researched by Ukrainian scientists (Akimov et al., 2020; Aleinikova et al., 2020; Kotenko et al., 2020; Levytska et al., 2020; Popovych et al., 2020; Kryshtanovych et al., 2021; Kryshtanovych et al., 2022; Akimova et al., 2022; Semenets-Orlova et al., 2022).

It is equally important to learn language with the involvement of the possibilities of information technologies in a mobile format. Foreign researchers such as K. Betti (2015), Y.-C. Hsu, Y.-H. Ching (2013), M. Hanus and J. Fox (2015), M. Sarrab (2017), V. Frank, S. Freinik, D. Richardson (2014), Q.-K. Fu and G.-J. Hwang (2018) and others.

J. Sandberg, M. Maris, and K. Geus (2011) studied the potential of mobile technology for learning English as a second language for primary school students. They concluded that the traditional format of the educational process can be successfully combined with the concept of an informal extracurricular context. Unique in its overall approach to implementing and supporting mobile learning in education was the MoLeNET project, according to which the general definitions, technical and pedagogical recommendations for support, and development of methodical materials were provided (Attewell et al., 2008; Aldahhan et al., 2023; Shehadeh, 2024).

American scientists have proven the effectiveness of technology use in foreign language learning, with a focus on empirical studies that compare the use of newer technologies and more traditional methods. Scientists are convinced of the importance of contributing to support and optimization of the English language learning process of research and scientific development focused on interactive pronunciation learning technology, including automatic speech recognition (Golonka et al., 2014; Zafrullah & Ramadhani, 2024; Zhou, 2023). At the same time, D. Hamdani (Hamdani, 2013) analyzed the potential of mobile devices in the optimization of learning and teaching processes, as well as the effective implementation of educational activities based on the communicative methodology of teaching English.

Y.-T. Sung, K.-E. Chang, J.-M. In their research, Yang (2015) implements a meta-analysis of a number of doctoral dissertation studies and peer-reviewed journal articles over a period of two decades. The authors are convinced of increasing the level of foreign language teaching through the use of mobile devices. Researchers emphasize the importance of the multifactorial aspects of the educational process on its effectiveness, in particular, the sequence of educational stages, available equipment and software, teaching methodology, and the concept of the formation of skills and abilities.

Liu P. L. and Chen C. J. (2015) studied the influence of the interactive capabilities of mobile phones on the performance indicators of students learning English as a second language (Central Taiwan). The newly acquired phrases were approximated with the sentences they constructed, and students could learn them better.

One of the important studies was aimed at developing a mobile application for intensifying the practical learning of English (Kovalko et al., 2022). The results of design and method development, which are products and tools, were applied in the above scientific research. English mobile learning has been shown to be interesting, motivating and useful for improving English (Rohani et al., 2019; Jie & Sunze, 2023; Khasawneh & Khasawneh, 2023).

It is important to note the generalized analysis of the level and vectoriality of engaging the potential of digital gamification for learning English as a second language, and sometimes a priority, in a digital environment. The results of this study provide suggestions on how to design digital gamification for students' learning English and their corresponding learning experiences and outcomes. (Dehghanzadeh et al., 2019; Kayra, 2024; Xodabande & Hashemi, 2023).

D. Assanova, A. Prlepessova (2020) examined aspects of the practical orientation of the use of educational mobile applications as an effective component of the educational process, which intensifies the systematization of the material and the process of its assimilation. Scientists pay attention to the expediency of involving the toolkit of mobile applications in the educational process and describe the most useful application for learning English.

Malaysian scientists have developed the E-Glossary application (a bilingual English-Indonesian glossary). This glossary is essential for non-English department students and lecturers in seven departments of both commerce and engineering schools at the State Polytechnic of Malang. Improving understanding of lexical material is intensified by graphic material. The results of the practical test show that the Android application is positioned as an effective tool for a more complete understanding of foreign texts (Rohani, 2021; Karhut et al., 2023; Pratiwi & Waluyo, 2023).

However, the teaching practices of the Ukrainian establishment show that despite the availability of mobile phones, mobile learning tools are not widespread enough in Ukrainian institutions of higher education. Therefore, research on practical aspects of realizing the potential of mobile applications as an auxiliary effective method of learning English during the general educational process, which aims to acquire communicative competence, is highly important.

3. Methods

For the successful implementation of the main goal of the study, a number of scientific research methods were involved, in particular, theoretical analysis of methodical and psychological-pedagogical sources, as well as empirical, in particular, observation of the educational process, questionnaires, interviews, statistical data, and graphics, etc.

The theoretical and methodological basis of the research is a number of studies on the issue of using the potential of mobile applications in higher education in an interdisciplinary context. Analysis and synthesis were involved in the study for the purpose of researching current theoretical concepts and scientific developments within the outlined issues and concretization of the terminological apparatus. The structural-logical method is in the process of developing practical proposals for improving traditional foreign language learning technologies using mobile applications.

Questionnaires and interviews were used to assess the real level of effectiveness of using mobile applications in the process of learning a foreign language in higher educational institutions within the classroom and outside the classroom, the expediency of introducing modern gadgets into the English language education process, and assessing the psychological readiness of students to engage the potential of mobile devices in the educational process.

4. Results

Active processes of transformation of the national education system are due to the forced implementation of distance learning technologies in Ukraine against the background of martial law. The basic goal of the modern system of higher education is the maximum realization of the potential of all participants in the educational process, which involves the formation of appropriate prerequisites for the development of communicative abilities in the English-speaking aspect.

The process of dynamic progress in modern society directly depends on the level of development of information technologies, which provide instant transmission of information without spatial limitations in the context of guaranteeing speed, reliability and modernity. At the same time, information technologies are directly related to linguistics (Assanova and Prlepessova, 2020).

Learning English to students of nonlinguistic specialties involves many different problems. These problems are both technical and educational in nature. A specialized mobile app can be installed on a mobile device, such as a smartphone or tablet, to help students learn English. These apps usually have various features and tools to help improve speaking levels, understand grammar, expand vocabulary and interact with other learners. This is an effective approach for unlimited sharing of information, but this opportunity is rarely used due to the priority of the entertainment concept of the functionality of mobile devices.

By analyzing the results of scientific research, highlighted in the scientific literature and the educational process on English in the system of higher education, we determined the main functions of mobile applications. Apps provide access to study materials that can be used effectively to learn new words, grammar and phrases. They can contain interactive exercises, tests and video lessons. Therefore, they are powerful means for exercise. Many apps have audio files with conversations, phrases and pronunciation to help improve listening and pronunciation skills. Most apps have built-in dictionaries and

translators that allow students to quickly look up word meanings and translate sentences. Therefore, they can serve as a dictionary and help in translation. Some apps increase motivation for the learning process by involving game elements. They can offer tasks, challenges, competitions and achievements to stimulate motivation and continue learning. Thus, they are tools for developing interactivity and gamification. Moreover, mobile apps assist in social interaction. Some of them aimed at communicating with other learners, for example, through forums, chat rooms or virtual classrooms. It can be useful to practice speaking, share experiences and obtain feedback from other users. One more function that is important is personalization. Some apps allow undergraduates to customize the training to the level, purpose and interest. They can offer individual recommendations for materials and exercises based on the individual's progress and needs.

As the experience of teaching English shows, using mobile applications for learning English can be positioned as effective and, at the same time, comfortable. Several advantages of using such applications were determined by means of survey and pedagogical observation. The mobile devices used are always provided by undergraduates, who are allowed to learn English at any convenient time and place. They can use the app during breaks at the university, during travel, or during free time. Therefore, we singled out accessibility as a positive feature of mobile apps. Many mobile applications offer different types of exercises, video lessons, audio materials, interactive tasks, etc., which allows practicing English in different ways and choosing the materials that best suit students. Obviously, we can name a variety of content among the advantages. Interactivity means that many apps offer the ability to complete exercises and tasks, answer questions, use speech recognition, and receive instant feedback. This allows an education seeker to actively interact with the materials and improve listening, speaking, reading and writing skills. Flexibility involves choosing the topics and the level of difficulty students want to work with. Apps often offer structured courses or modules at different levels, helping them progress based on their level of expertise. Many mobile applications provide a system of achievements, awards and incentives that help to maintain motivation and interest in learning English.

The potential of modern targeted mobile applications allows students of nonlanguage majors to optimize the traditional method of learning a foreign language. Notably, the most effective and popular educational applications in the studied concept include Babbel, Rosetta Stone, Lingualeo, Duolingo, Memrise, Polyglot, Easy Ten, Pussle English and a number of others. Most of them are designed for everyday communication. However, our task is to analyze apps aimed at developing professionally oriented English-speaking communicative competence among undergraduates at higher educational institutions. Therefore, we study and describe the specifics of the most effective apps that can be useful in studying English to intending specialists of some important professions (see Table 1).

Table 1 Professionally oriented mobile applications for studying English.

App title	Advantages
Medscape	A popular medical app provides healthcare professionals with access to medical news, clinical reference tools, drug information, and medical education resources. It offers a wide range of features, including articles on medical topics, drug interaction checker, medical calculators, and continuing medical education (CME) courses. It is known for its comprehensive and up-to-date content, making it a valuable resource for healthcare professionals.
Legal English Vocabulary	This app is designed to help individuals improve their vocabulary in the legal English. It likely provides a collection of legal terms and their definitions, along with example sentences and usage tips. It may also include exercises and quizzes to test and reinforce vocabulary knowledge specific to the legal domain. Such an app can be beneficial for law students, legal professionals, and anyone seeking to enhance their legal English language skills.
FluentU Business English	It is an app aimed at helping users improve their English language skills specifically for business purposes. It offers a series of interactive video lessons that cover various business topics, such as presentations, negotiations, and professional communication. The app provides real-world examples and exercises to enhance listening, speaking, reading, and writing skills in a business context. It can be useful for professionals looking to enhance their English language proficiency for business settings.
Business English Pod	An app focuses on teaching English language skills for business professionals. It provides audio and video lessons covering a wide range of business-related topics, including meetings, interviews, presentations, and business writing. The app offers practical examples, dialogs, and exercises to improve listening comprehension, speaking fluency, vocabulary, and grammar. It can be a valuable resource for individuals seeking to enhance their English communication skills in the business domain.
Engineering Vocabulary	This app is designed to support individuals in expanding their vocabulary specific to the field of engineering. It may include a comprehensive collection of engineering terms, definitions, and usage examples. The app might also offer exercises or quizzes to help users reinforce their awareness of engineering vocabulary. Such an app can be beneficial for engineering students, professionals, and enthusiasts aiming to improve their technical communication skills.
Technical English Practice	An app provides resources for individuals to practice and improve their English language skills in a technical context. It offers a variety of exercises, such as reading passages, listening comprehension tasks, writing prompts, and vocabulary drills, tailored to technical subjects. The app may cover topics like engineering, IT, sciences, or other technical fields, enabling users to develop their language proficiency in specialized areas.
Aviation English	It is an app that focuses on improving English language skills specifically for aviation professionals, such as pilots, air traffic controllers, and aviation maintenance personnel. It includes aviation-specific vocabulary, phraseology, and communication exercises. The app may cover topics like aviation regulations, weather reports, emergency situations, and cockpit communication. It aims to enhance the English proficiency required for effective communication within the aviation industry.

Source: compiled by the authors.



According to the recommendations for mobile learning of the World Organization UNESCO, given the growing variety and availability of mobile devices, the latter are currently positioned as the most popular ICT tool. The outlined trend stimulates the availability of mobile learning, which is seen by scientific circles as the result of the natural evolution of e-learning. At the same time, the specificity of the mobile phenomenon can be seen in the fact that students are not limited in space and time, providing access to educational information at any convenient time and in any location (Table 2).

Table 2 Students' responses to the questionnaire in the final study.

№	Statements	Responses			
		Fully agree	Agree	Disagree	Fully disagree
1.	I need to learn English out of the in-class activities.	63,10%	30,18%	6,72%	0,00%
2.	The educational material is interesting.	60,37%	58,81%	9,54%	1,28%
3.	The educational material is easy to understand.	22,75%	68,78%	8,07%	0,40%
4.	The educational material is challenging.	50, 25%	41,67%	7,35%	0,73%
5.	Learning English is useful.	76,88%	20,39%	2,21%	0,52%
6.	The teachers use the learning apps appropriately.	43,69%	47,58%	8,43%	0,30%
7.	Using the app motivates me to improve my English skills.	68,80%	28,57%	2,63%	0,00%
8.	The time allotment for learning English in app is adequate (except in-class activities)	43,46%	36,73%	16,53%	3,28%

Source: compiled by the authors.

Studies have shown that all students have any mobile device (a smartphone or an iPhone), 74% of them have 2 gadgets (a player, tablet or netbook except a smartphone), and 41% of respondents have 3 or more devices. All the undergraduates used more than 5 applications (the event calendar, camera, player, calculator, Instagram, etc.), while the percentage of those who exploited more than 10 apps was approximately 48%. During the implementation of the targeted survey, it was established that 99% of respondents considered it appropriate to introduce mobile apps into the educational process in English at higher education establishments. Such figures testify not only to the psychological readiness of education seekers to involve the potential of mobile devices in the educational process but also to the development of a methodology for their convergence with traditional tools in various educational situations. The research results prove the high level of mobile competence of students and their readiness to use mobile apps in education.

Thus, it can be stated that the respondents mostly use mobile devices for the purpose of completing tasks, searching for information, instant access to the dictionary and searching for relevant vocabulary, as well as translating texts and checking spelling. At the same time, to a lesser extent, devices are used to read articles and check pronunciation. It should be noted that there was no significant difference in the performance indicators of the targeted use of mobile phones during and outside of classes.

Analysis of the results of the students' final survey revealed a great interest in learning professionally oriented English using the appropriate mobile app. Undergraduates confirm that the educational material is interesting and challenging, and at the same time, it is easy to understand that learning English is useful. They believe that using the app motivates them to improve their English skills because it provides effective prerequisites for successful learning both outside and inside the educational environment. Furthermore, the students' responses to the questionnaire in the final study showed that the time allocated to improving a foreign language in the app was adequate.

5. Discussion

Considering all the advantages, it is clear that using mobile apps for the process of learning English is a highly topical and beneficial approach (Shavarskyi et al., 2022). However, it is important to note that while mobile apps can be excellent supplementary tools for language learning, they should be complemented with other forms of practice (Zayed et al., 2022). Mobile applications do not replace full communication and interaction with live people. In our opinion, it should combine the use of applications with other learning methods, such as conversation clubs, classes with a teacher, reading books, engaging in language exchanges, or real-life communication with native speakers.

6. Conclusions

Our work has led us to conclude about the importance of using mobile apps for developing the level of English among undergraduates of higher education institutions. We have outlined the most commonly used mobile apps for learning English and highlighted their advantages for the English educational process in nonlinguistic specialties. Overall, these apps cater to specific language learning needs and professional domains, providing targeted content and exercises to enhance language proficiency in medical, legal, business, engineering, technical, and aviation contexts.

The results of the study prove the main reasons why the use of mobile applications for learning English is considered relevant and necessary in today's realities of the educational process in higher education: accessibility, convenience, interactive and interesting content, personalized learning, variety of educational materials, social and community functions, progress



tracking. The results of questionnaires and interviews prove the necessity of using mobile applications to improve the level of English language proficiency of students of higher educational institutions.

The study of the problem made it possible to determine the most used mobile applications for learning English and describe their advantages in the process of learning English by students of non-linguistic specialties. The research proved the effectiveness of using mobile apps for professionally oriented English learning because the English levels of Ukrainian undergraduates increased after studying with the help of mobile apps.

Ethical considerations

Not applicable.

Conflict of Interest

The authors declare no conflicts of interest.

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References

- Akimov, O., Karpa, M., Parkhomenko-Kutsevil, O., Kupriichuk, V., & Omarov, A. (2021). Entrepreneurship education of the formation of the e-commerce managers professional qualities. *International Journal of Entrepreneurship*, 25(7).
- Akimov, O., Troschinsky, V., Karpa, M., Ventsel, V., & Akimova, L. (2020). International experience of public administration in the area of national security. *Journal of Legal, Ethical and Regulatory*, 23(3), 1-7.
- Akimova, N., Akimova, A., & Akimova, A. (2022). The study of the genesis of internet texts understanding in adolescence depending on the level of mental and speech development. *Psycholinguistics*, 31(1), 6-24. <https://doi.org/10.31470/2309-1797-2022-31-1-6-24>
- Aldahhan, A., & Razak, N. A. (2023). Literature Review of Using Digital Platforms in Enhancing Undergraduate Students' Communicative Competence. *Journal for ReAttach Therapy and Developmental Diversities*, 6(10s (2)), 1153-1160. <https://www.jrtdd.com/index.php/journal/article/view/1679>
- Aleinikova, O., Kravchenko, S., Hurochkina, V., Zvonar, V., Brechko, O., & Buryk, Z. (2020). Project Management Technologies in Public Administration. *Journal of Management Information and Decision Sciences*, 23(5), 564-576. <https://www.abacademies.org/articles/Project-Management-Technologies-in-Public-Administration-1532-5806-23-5-222.pdf>
- Ari, I., Wilson, A. (2020). The Implementation of Duolingo Mobile Application in English Vocabulary, Learning. *Journal of English Language Teaching*, 05(01), 08-14. <http://dx.doi.org/10.30998/scope.v5i1.6568>
- Assanova, D. N., & Prlepessova, A. B. (2020). The role of educational mobile apps in learning English (non-linguistic specialties). *Herald of Karaganda University. "Pedagogy" series*, 2(98), 121-125. <http://dx.doi.org/10.31489/2020Ped2/121-125>
- Athabasca University Press (2023). Retrieved June, 18. <https://www.learntechlib.org/p/148190/>
- Attewell, J., Traxler, J., Riordan, B., & Dennett C. (2008). Towards sustainable large-scale implementation of mobile learning: a mobile learning network (MoLeNET). *In the bridge from text to context. Conference materials mLearn*, 28-35.
- Basal, A., Yilmaz, S., Tanriverdi, A., & Sari, L. (2016). Effectiveness of mobile applications in vocabulary teaching. *Contemporary Educational Technology*, 7(1), 47-59. <https://files.eric.ed.gov/fulltext/EJ1105763.pdf>
- Beatty, K. (2015). Mobile language learning: the world in our hands. *Anaheim University*, 17. <https://www.anaheim.edu/schools-and-institutes/graduate-school-of-education/diploma-in-tesol/243-%20about/faculty-and-staff/tesol-faculty/886-ken-beatty-phd-ken-beatty-phd>
- Bernacki, M. L., Greene, J. A., & Crompton, H. (2020). Mobile technology, learning, and achievement: advances in understanding and measuring the role of mobile technology in education. *Contemporary Educational Psychology*, 60. <https://doi.org/10.1016/j.CEDPSYCH.2019.101827>
- Bondarenko, S., Makeieva, O., Usachenko, O., Veklych, V., Arifkhodzhaieva, T., & Lernyk, S. (2022). The legal mechanisms for information security in the context of digitalization. *Journal of Information Technology Management*, 14, 25-58. <http://doi.org/10.22059/jitm.2022.88868>
- Dehghanzadeh, H., Fardanesh, H., Hatami, J., Talaei, E., & Noroozi, O. (2019). Using gamification to support learning English as a second language: a systematic review. *Computer Assisted Language Learning*, 1-24. <https://doi.org/10.1080/09588221.2019.1648298>
- Dudnik, A., Kuzmych, L., Trush, O., Domkiv, T., Leshchenko, O., & Vyshnivskiy, V. (2020). Smart home technology network construction method and device interaction organization concept. *Paper presented at the 2020 IEEE 2nd International Conference on System Analysis and Intelligent Computing, SAIC 2020*. <https://doi.org/10.1109/SAIC51296.2020.9239220>
- Feng, Y., Liao, Y., & Ren, Y. (2018). Effects of M-Learning on Students' Learning Outcome: A Meta-analysis. *New Media for Educational Change. Springer, Singapore*, 115-123.
- Frank, V. M., Freynik, S., & Richardson, D. L. (2014). Technologies for foreign language learning: a review of technology types and their effectiveness. *Center for Advanced Study of Language, University of Maryland, College Park, MD*, 27(1). <https://www.learntechlib.org/p/153571>
- Fu, Q.-K., & Hwang, G.-J. (2018). Trends in mobile technology-supported collaborative learning: A systematic review of journal publications from 2007 to 2016. *Computers & Education*, 119, 129-143. <https://doi.org/10.1016/j.compedu.2018.01.004>
- Golonka, E. M., Bowles, A. R., Frank, V. M., Richardson, D. L., & Freynik, S. (2014). Technologies for foreign language learning: a review of technology types and their effectiveness. *Computer Assisted Language Learning*, 27(1), 70-105. <https://doi.org/10.1080/09588221.2012.700315>
- Gorbatiuk, L. V., Kravchenko, N. V., Alekseeva, H. M., & Rozumna, T. S. (2019). Mobile applications as means of forming foreign language lexical competence of students of non-philology majors. *Information technologies and teaching aids*, 2019, 74(6), 150-164. <http://dx.doi.org/10.33407/itlt.v74i6.2529>
- Hamdani, D. S. A. (2013). Mobile Learning: a Good Practice. *Procedia – Social and Behavioral Sciences*, 103, 665-674. <https://doi.org/10.1016/j.sbspro.2013.10.386>

- Hanus, M. D., & Fox, J. (2015). Assessing the effects of gamification in the classroom: a longitudinal study on intrinsic motivation, social comparison, satisfaction, effort, and academic performance. *Computers & Education*, 80, 152-161. <https://doi.org/https://doi.org/10.1016/j.compedu.2014.08.019>
- Hinze, A., Vanderschantz, N., Timpany, C., Cunningham, S. J., Saravani, S. J., & Wilkinson, C. (2023). A study of mobile app use for teaching and research in higher education. *Technology, Knowledge and Learning*, 28(3), 1271-1299. <https://doi.org/10.1007/s10758-022-09599-6>
- Hsu, Y.-C., & Ching, Y.-H. (2013). Mobile App Desing for Teaching and Learning Educators. *Experiences in an Online Graduate Course*, 14(4), 117-139.
- Hsu, Y.C. & Ching, Y.H. (2013). Mobile app design for teaching and learning: Educators' experiences in an online graduate course. *The International Review of Research in Open and Distributed Learning*, 14(4).
- Huang, C., Wang, T., & Li, Y. (2024). Mobile-assisted English learning beyond the classroom: Understanding the effects of language proficiency on Chinese undergraduate students' behavioral engagement. *Education and Information Technologies*, 29(1), 737-762. <https://doi.org/10.1007/s10639-023-12301-7>
- Huseinović, L. (2024). The effects of gamification on student motivation and achievement in learning English as a foreign language in higher education. *MAP Education and Humanities*, 4, 10-36. <https://doi.org/10.53880/2744-2373.2023.4.10>
- Huynh, D., Zuo, L., & Lida, H. (2018). An assessment of game elements in language-learning platform Duolingo. *2018 4th International Conference on Computer and Information Sciences (ICCOINS)*, 1-4. <http://dx.doi.org/10.1109/ICCOINS.2018.8510568>
- Jie, Z., & Sunze, Y. (2023). Investigating pedagogical challenges of mobile technology to English teaching. *Interactive Learning Environments*, 31(5), 2767-2779. <https://doi.org/10.1080/10494820.2021.1903933>
- Karhut, V., Semenog, O., Shumiatska, O., Palamar, N., & Rubliova, N. (2023). The need for new information technologies during foreign language learning for the quality training of a specialist. *Amazonia Investiga*, 12(65), 175-184. <https://doi.org/10.34069/AI/2023.65.05.17>
- Kayra, Z. (2024). Enhancing English Vocabulary Learning through Mobile Apps: A New Paradigm in Educational Technology. *Research Studies in English Language Teaching and Learning*, 2(2), 87-95. <https://doi.org/10.62583/rselt.v2i2.41>
- Khasawneh, M. A. S., & Khasawneh, Y. J. A. (2023). Analyzing the Effectiveness of Mobile Devices and Apps in Supporting Learning. *Migration Letters*, 20(S1), 901-910. <https://doi.org/10.59670/ml.v20iS1.3642>
- Koliadenko, N. V., Zhyvago, K. S., & Bursa, A. I. (2022). Provision of medical-psychological and psychiatric care to patients with post-covid syndrome in telemedicine conditions. *Bangladesh Journal of Medical Science*, 21(4), 719-730. <http://doi.org/10.3329/bjms.v21i4.60256>
- Kotenko, S., Nitsenko, V., Hanzhurenko, I., & Havrysh, V. (2020). The mathematical modeling stages of combining the carriage of goods for indefinite, fuzzy and stochastic parameters. *International Journal of Integrated Engineering*, 12(7), 173-180. <http://doi.org/10.30880/ijie.2020.12.07.019>
- Kovaleva, V., Bukhteeva, I., Kit, O. Y., & Nesmelova, I. V. (2020). Plant defensins from a structural perspective. *International Journal of Molecular Sciences*, 21(15), 1-23 <https://doi.org/10.3390/ijms21155307>
- Kovalko, O., Eutukhova, T., & Novoseltsev, O. (2022). Energy-related services as a business: Eco-transformation logic to support the low-carbon transition. *Energy Engineering. Journal of the Association of Energy Engineering*, 119(1), 103-121. <http://doi.org/10.32604/EE.2022.017709>
- Kryshchanovych, M., Akimova, L., Akimov, O., Kubiniy, N., & Marhitich, V. (2021). Modeling the process of forming the safety potential of engineering enterprises. *International Journal of Safety and Security Engineering*, 11(3), 223-230. <http://doi.org/10.18280/ijssse.110302>
- Kryshchanovych, M., Akimova, L., Akimov, O., Parkhomenko-Kutsevill, O., & Omarov, A. (2022). Features of creative burnout among educational workers in public administration system. *Creativity Studies*, 15(1), 116-129. <http://doi.org/10.3846/cs.2022.15145>
- Levytska, O., Mulska, O., Ivaniuk, U., Kunytska-Iliash, M., Vasylytsiv, T., & Lupak, R. (2020). Modelling the conditions affecting population migration activity in the eastern European region: The case of Ukraine. *TEM Journal*, 9(2), 507-514. <http://doi.org/10.18421/TEM92-12>
- Liu, P. L., & Chen, C. J. (2015). Learning English through actions: a study of mobile-assisted language learning». *Interactive Learning Environments*, 23(2), 158-171. <http://dx.doi.org/10.1080/10494820.2014.959976>
- Mia, M. M., Rizwan, S., Zayed, N. M., Nitsenko, V., Miroshnyk, O., Kryshstal, H., & Ostapenko, R. (2022). The impact of green entrepreneurship on social change and factors influencing AMO theory. *Systems*, 10(5). <http://doi.org/10.3390/systems1005013>
- Mozharovska, O. E. (2023). Use of Electronic Resources and Web Services in Teaching Foreign Languages. *Bulletin of Zhytomyr Ivan Franko State University. Pedagogical sciences*, (113), 273-284. [https://doi.org/10.35433/pedagogy.2\(113\).2023.273-284](https://doi.org/10.35433/pedagogy.2(113).2023.273-284)
- Nikonenko, U., Shtets, T., Kalinin, A., Dorosh, I., & Sokolik, L. (2022). Assessing the policy of attracting investments in the main sectors of the economy in the context of introducing aspects of industry 4.0. *International Journal of Sustainable Development and Planning*, 17(2), 497-505. <https://doi.org/10.18280/ijstdp.170214>
- Popovych, I., Semenov, O., Hrys, A., Aleksieieva, M., Pavliuk, M., & Semenova, N. (2022). Research on mental states of weightlifters' self-regulation readiness for competitions. *Journal of Physical Education and Sport*, 22(5), 1134-1144. <https://doi.org/10.7752/jpes.2022.05143>
- Popovych, V., Ragimov, F., Kornienko, V., Ivanova, I. B., & Buryk Z. (2020). Development of social and communicative paradigm of public administration in the field of social networks. *International Journal of Data and Network Science*, 2020, 4 (3), 319-328. <http://dx.doi.org/10.5267/ijdns.2020.6.001>
- Pratiwi, D. I., & Waluyo, B. (2023). Autonomous Learning and the Use of Digital Technologies in Online English Classrooms in Higher Education. *Contemporary Educational Technology*, 15(2). <https://eric.ed.gov/?id=EJ1385465>
- Rakhmanina, M., Pinchuk, I., Vyshnyk, O., Tryfonova, O., Koycheva, T., Sydorko, V., & Ilienko, O. The Usage of Robotics as an Element of STEM Education in the Educational Process. *International journal of computer science and network security*, 22(5), 645-651. <https://doi.org/10.22937/IJCSNS.2022.22.5.90>
- Rohani, S., & Suyono, A. (2021). Developing an Android-based bilingual e-glossary application of English for Specific Purposes (ESP). *English Language Teaching Educational Journal*, 4(3), 225-234. <http://dx.doi.org/10.12928/eltej.v4i3.5209>
- Rohani, S., Suyono, A., & Rozi, I. F. (2019). Designing a Mobile Application for Autonomous Learning of English. *First International Conference on Advances in Education, Humanities, and Language*. <http://dx.doi.org/10.4108/ea1.23-3-2019.2284960>
- Sandberg, J., Marinus, M., Kaspar, G. (2011). Mobile English learning: an evidence-based study with fifth graders. *Computer & Education*, 57(1). <http://dx.doi.org/10.1016/j.compedu.2011.01.015>
- Semenets-Orlova, I., Klochko, A., Tereshchuk, O., Denisova, L., Nestor, V., & Sadoviy, S. (2022). Special aspects of educational managers' administrative activity under conditions of distance learning. *Journal of Curriculum and Teaching*, 11(1), 286-297. <http://doi.org/10.5430/jct.v11n1p286>
- Shavarskiy, I., Falshtynskiy, V., Dychkovskiy, R., Akimov, O., Sala, D., & Buketov, V. (2022). Management of the longwall face advance on the stress-strain state of rock mass. *Mining of Mineral Deposits*, 16(3), 78-85. <http://doi.org/10.33271/mining16.03.078>

- Shehadeh, A. (2024). Using smartphones for vocabulary improvement: Insights from college students' reflections. *Anatolian Journal of Education*, 9(1), 157-168. https://www.e-aje.net/images/dosyalar/aje_2024_1_11.pdf
- Sung, Y. T., Chang, K. E., & Yang, J. M. (2015). How effective are mobile devices for language learning? A meta-analysis. *Educational Research Review*, 16, 68-84. <https://doi.org/10.1016/j.edurev.2015.09.001>
- Wang, Y. (2023). Artificial intelligence technologies in college English translation teaching. *Journal of psycholinguistic research*, 52(5), 1525-1544. <https://doi.org/10.1007/s10936-023-09960-5>
- Xodabande, I., & Hashemi, M. R. (2023). Learning English with electronic textbooks on mobile devices: Impacts on university students' vocabulary development. *Education and Information Technologies*, 28(2), 1587-1611. <https://doi.org/10.1007/s10639-022-11230-1>
- Zafrullah, Z., & Ramadhani, A. M. (2024). The use of mobile learning in schools as a learning media: Bibliometric analysis. *Indonesian Journal of Educational Research and Technology*, 4(2), 187-202. <https://ejournal.upi.edu/index.php/IJERT/article/view/65586>
- Zayed, N. M., Edeh, F. O., Darwish, S., Islam, K. M. A., Kryshstal, H., Nitsenko, V., & Stanislavyk, O. (2022). Human resource skill adjustment in service sector: Predicting dynamic capability in post COVID-19 work environment. *Journal of Risk and Financial Management*, 15(9). <http://doi.org/10.3390/jrfm15090402>
- Zhou, C. (2023). Integration of modern technologies in higher education on the example of artificial intelligence use. *Education and Information Technologies*, 28(4), 3893-3910. <https://doi.org/10.1007/s10639-022-11309-9>