(Online) ISSN 2303-4521
Periodicals of Engineering and Natural Sciences *Original Research*
Vol. 13, No. 1, March 25, pp.69-82

The role of interactive technologies in improving the quality of learning and development of scientific competences in modern education

Nataliia Prykhodkina[1], Maryna Tsynova[2], Halyna Kravets[2], Olena Hrechanovska[3], Viktoriia Nichyshyna[4]

[1]Educational and Scientific Institute of Management and Psychology of the State Institution of Higher Education "University of Educational Management" of the National Academy of Pedagogical Sciences of Ukraine, Ukraine

[2]English Language Department in Marine Engineering, National University "Odesa Maritime Academy", Ukraine

[3]Department of Philosophy and Humanities, Vinnytsia National Technical University, Ukraine

[4]Department of Mathematics and Digital Technologies, Faculty of Mathematics, Natural Sciences and Technologies, Central Ukrainian State University named after Volodymyr Vinnichenko, Ukraine

*Corresponding author E-mail: prykho2@gmail.com

ABSTRACT

In contemporary education, interactive technologies assume a pivotal role in enhancing the learning quality and the development of scientific competencies. This research substantiates their necessity within the educational framework. The study's primary objective was to identify the impact of interactive technologies on the activation of the learning process, the formation of critical thinking and the improvement of communication skills. This is achieved by examining their impact on the activation of the learning process, the cultivation of critical thinking, and the enhancement of communication skills. The methodological approach comprised a comprehensive literature review. The analysis encompassed 50 sources from esteemed academic databases, including Web of Science, Google Scholar, and Scopus, with selection executed through stratified sampling. The inclusion criteria encompassed articles published between 2019 and 2024 that investigated Ukrainian and international research in pedagogy, psychology, and teaching methodology, mainly focusing on implementing interactive instructional practices. The results showed that interactive technologies fostered active learning, enhanced critical thinking, and built practical skills. Using case studies in teaching "English for Professional Purposes" positively impacted the understanding of theoretical concepts and improved communication skills. Teachers assume the facilitator's status in this environment while students actively create content collaboratively. Nonetheless, challenges persist, including psychological barriers and adapting to innovative pedagogical methods. In conclusion, the study underscored that interactive technologies represent an effective instrument for augmenting the quality of education and fostering essential skills. Future research avenues should concentrate on developing models to promote communicative competence, thereby facilitating overcoming communication barriers among students.

Keywords: Digital resources, Educational technologies, Interactive learning, Pedagogical innovations, Quality of learning, Scientific competencies

1. Introduction

In the context of transformations in higher education in Ukraine, training a competent worker with critical thinking and reflective analysis skills has become paramount. The discernible gap between graduates' theoretical knowledge and the expectations of employers underscores the urgent need to adapt educational processes. Interactive technologies can potentially serve as an effective solution to this challenge, as they promote active student participation in the learning process and encourage the development of essential competencies [1].

The contemporary higher education system meets many challenges, driven by rapid transformations in the labor market, technological advancements, and globalization. In an era where knowledge rapidly becomes outdated, there is an urgent need to develop specialists capable of adapting to evolving demands and conditions. In this context, interactive technologies are essential, as they can significantly enhance the quality of education and help foster students' scientific skills [2].

Interactive learning technologies promote active student participation in the knowledge acquisition process, thereby fostering the improvement of critical thinking, creativity, and collaborative skills. This pedagogical approach is particularly relevant for training specialists who must acquire theoretical knowledge and adeptly apply it in practical contexts [3]. Contemporary educational strategies posit that the objective of learning extends beyond the mere accumulation of knowledge to encompass the cultivation of universal competencies that enable students to thrive in professional environments.

Reforms in higher education in Ukraine underscore the necessity of integrating interactive methodologies into the educational process, primarily through using electronic platforms and innovative assessment practices [4]. Such transformations render learning more flexible and personalized and facilitate the development of essential skills requisite for success in modern society [5].

The theoretical and methodological foundations of interactive technologies as an innovative pedagogical approach have been elucidated in the works of international scholars. These researchers conceptualize learning technologies as applying methods most conducive to achieving educational objectives [8]. This body of literature highlights the classification of interactive learning technologies and assessment methods employed during interactive sessions, alongside developing and implementing these technologies within higher education institutions [1]. Scholars emphasize the potential that interactive technologies offer for harnessing the creative capabilities of educators.

Moreover, the future of interactive technologies is examined within the "Education 4.0" paradigm framework, which advocates for a new approach centered on personalization and interactivity in learning [9]. Overall, researchers identify numerous advantages associated with interactive learning, such as enhanced material retention, which positively influences students' cognitive processes and emotional states [10]. However, interactive methods also present challenges, notably the requirement for increased time investment in lesson preparation. This necessitates the creation of educational materials and a comprehensive reorganization of the learning and assessment processes.

Interactive learning necessitates continuous, active engagement from all participants in the educational process. Historically, the origins of interactive learning can be traced back to antiquity. For instance, Socrates encouraged his students to pursue "truth" through a dialectical method of questioning and answering [11]. Similarly, Plato advocated for children's education from age six through games and discussions to foster development [12]. Confucius, too, eschewed a rigid curriculum in favor of open discussions as a mode of learning [13].

Research into learning formats highlights students' cognitive activities within the context of collaborative, group, and individual work in academic settings [14]. Interactive learning is characterized as dialogical, reflecting the active participation of all students in the learning process. It embodies a co-learning environment where students and educators are regarded as equal participants, with the educator as the learning experience's facilitator [15]. Implementing interactive learning encompasses the simulation of real-life scenarios, role-playing exercises, and collaborative problem-solving.

Ref. [16] states that developing highly skilled professionals can only be realized when educational teams come together under developmental learning and collaboration principles, utilizing contemporary interactive techniques and methods that enrich the learning experience.

A student's active engagement during lessons is pivotal for maximizing knowledge retention and practical application and nurturing critical thinking and creativity. This engagement fosters interest and a positive disposition towards the learning process [17]. Interactive learning requires ongoing interaction among all participants in the educational setting. In this context, the roles of educator and student are balanced, with both striving towards the common objective of knowledge and experience exchange.

As Ref. [18] articulates, interactive learning involves dynamic interaction among all students, fostering a co-learning environment where participants contribute equally to the educational process. This mutual learning includes collective and group activities, enabling students and educators to reflect on their actions and reassess their knowledge and skills.

The research conducted by Marukhovska-Kartunova *et al.* indicates that interactive methods significantly enhance material retention [19]. This raises the question of why innovative learning technologies yield improved educational outcomes. Scholars contend that interactive learning is inherently dialogical, with educators and students engaging in reciprocal interaction rather than one party dominating the other [20]. Lessons are conducted in a dialogue format, facilitating the development of essential competencies.

Contemporary educators must cultivate optimal conditions for student self-organization, assisting them in charting their life trajectories based on informed choices regarding social behavior, engagement, and value orientations [21].

Currently, many innovative technologies exist, and it is worthwhile focusing on some of the most prevalent. The utilization of interactive technologies in teaching foreign languages for professional purposes still requires deeper exploration.

Interactive language learning is a process based on dialogue, during which participants in the educational process engage with one another to achieve a shared understanding and address educational tasks, thereby fostering the personal qualities of students [22]. The primary aim of interactive learning is to involve all students in the process of knowledge acquisition, to develop both subject-specific and general educational competencies, and to create an atmosphere of collaboration while enhancing communicative skills [23]. Interactive methods encompass the simulation of real-life situations, the resolution of creative tasks, role-playing games, and collaborative problem-solving, all of which promote emotional engagement among participants and the development of teamwork.

These approaches engage students, boost their motivation, and promote independent thinking [24]. Interactive technologies equip individuals for real-world situations, encourage active civic engagement, and unlock students' full potential [25]. By combining educational and developmental objectives, interactive technologies enhance learning experience. Compared to traditional methods, interactive learning can significantly enhance information retention (up to 90%) by focusing not only on memorization but also on deep understanding and practical application of knowledge [26]. The primary motivator is student interest, which encourages high levels of engagement throughout the learning process. In this setting, the teacher's role transitions from an authoritative figure to a collaborative partner, emphasizing organizational and advisory duties.

The examination of the role of interactive technologies in enhancing the quality of learning and improving scientific competencies is both significant and timely. This research seeks to analyze the effectiveness of integrating these technologies into the educational process, particularly in teaching English for professional purposes, and to assess their impact on the growth of students' communicative and professional competencies.

This study builds on existing academic research highlighting the significance of interactive education methods, explicitly focusing on their practical application in the higher education context of Ukraine. In contrast to prior research, this investigation emphasizes contemporary educational technologies in wartime conditions, exploring their influence on cultivating professional skills and communicative competence among students.

The primary hypotheses of this research are as follows:

1. Integrating interactive technologies into the educational process enhances the overall quality of education.
2. Interactive methods (namely the case method) facilitate the development of students' communicative competence.

This research focuses on the educational processes within higher education institutions, specifically concentrating on English language instruction.

Research objectives:

- To elucidate the essence of interactive educational technologies.
- To analyze the theoretical frameworks and practical applications of their implementation.
- To provide illustrative examples of interactive methods employed in educational settings.

The research design involved an analysis of teaching practices at various higher education institutions, including the National University ‘Odesa Maritime Academy’ (Department of English Language), the Central Ukrainian State University named after Volodymyr Vinnichenko (Faculty of Mathematics, Natural Sciences and Technologies, Department of Mathematics and Digital Technologies), and the Department of Research Activities of Universities at the Institute of Higher Education of the National Academy of Pedagogical Sciences of Ukraine. This multi-institutional approach facilitates the verification of the primary hypotheses. Applying qualitative observational methods allowed for assessing the effectiveness of interactive technologies within authentic educational environments.

The results of this research could help advance theories related to interactive learning, especially about training professionals who can adeptly meet the job market's needs. Interactive technologies can significantly improve the educational experience, boost student motivation, and better prepare individuals for their careers. Additionally, these findings may provide a basis for creating new curricula that align with current educational demands.

The relevance of interactive technologies within the educational process is underscored by the rapid transformations occurring in the labor market and the necessity for professionals capable of operating effectively in conditions of uncertainty. Using interactive methods not only elevates educational quality but also prepares students for active participation in professional environments, fostering their adaptability and critical thinking skills.

Research in interactive learning indicates that active learning methods enhance knowledge retention and cultivate essential skills necessary for modern professional practices [6]. Techniques such as debates, discussions, and case-based learning effectively develop communicative competence [7]; however, further exploration is warranted within the specific context of Ukrainian higher education.

The research hypotheses are substantiated by the selected methodological approaches, which include the analysis of educational practices, surveys of students and faculty, and observations of interactive classes. This thorough method allows for a detailed insight into how interactive technologies enhance the educational experience and influence the growth of students' professional skills.

2. Research method

This methodology follows the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines, ensuring a transparent and replicable approach to data selection and analysis. The methodology comprises key subsections detailing participants, data sources, inclusion/exclusion criteria, and research design.

The participants of this systematic review were scholars, educators, and researchers specializing in integrating interactive technologies in education, with a particular focus on improving the quality of learning and developing scientific competencies. The participants were selected based on their contributions to the field through peer-reviewed publications and their involvement in educational practices incorporating technology.

The sampling process followed a systematic search strategy to include relevant and diverse studies addressing interactive technologies in education. PRISMA guidelines were followed to document the studies' search, screening, and selection process.

The final sample comprised 50 peer-reviewed articles selected to represent a comprehensive cross-section of current trends and practices in using interactive technologies in education. This sample size was sufficient to provide insights into the thematic trends, supported by content saturation and data triangulation.

Key themes and keywords, such as "interactive learning," "scientific competencies," "educational technologies," "pedagogical innovations," and "digital resources," were used to guide the literature search. Data were extracted based on relevance to the research questions, including study design, sample characteristics, and the results concerning the effectiveness of interactive technologies in education.

A qualitative systematic review approach was employed, integrating content analysis and meta-synthesis. The research design included critical literature analysis, forecasting, modeling, and systematization of data. The review also included studies conducted during wartime conditions in Ukraine, highlighting interactive educational technologies' unique challenges and opportunities under such circumstances.

The chosen studies investigated interactive technologies to boost student motivation, engagement, and communication skills, including digital platforms, simulations, and virtual learning environments. Moreover, the research assessed the effectiveness of the case study method, particularly in the context of "English for Professional Purposes," demonstrating its positive impact on grasping theoretical concepts and enhancing communication skills.

The investigation effectuated across multiple academic databases such as Google Scholar, ResearchGate, and Scopus, employing Boolean operators specific to each platform. Initially, 1100 unique articles were identified. Following the PRISMA flow diagram for selecting studies (identification, screening, eligibility, and inclusion), 50 studies were chosen for comprehensive analysis.

Inclusion criteria:

- Peer-reviewed articles published in the last 5 years
- Studies focusing on interactive technologies in educational contexts
- English-language publications
- Empirical studies or meta-analyses evaluating the impact of technology on learning outcomes

Exclusion criteria:

- Non-peer-reviewed literature (e.g., opinion pieces)
- Articles not focused on educational technologies or lacking empirical data

Data was extracted using a predefined coding framework focused on study objectives, methodologies, sample characteristics, interventions, and outcomes. The extracted data were synthesized using a thematic analysis approach, categorizing findings into subtopics such as interactive methods, motivation, communicative competence, and the psychological dimensions of learning.

This study uniquely examines the application of interactive educational technologies during wartime, focusing on professional and communicative competence development in higher education institutions in Ukraine. Through the use of case studies and systematic review, this research provides a comprehensive overview of how these technologies can enhance learning outcomes, particularly in teaching English for professional purposes. The study's practical implications are illustrated through examples from institutions such as the National University "Odesa Maritime Academy" and Central Ukrainian State University.

3. Results

Since 2020, a large part of education has transitioned to distance learning, allowing educational resources to be available online. This shift offers students more significant learning, skill development, and independence. According to Ref. [27], there is a growing tendency among students to conduct research online. This can be qualified for several reasons: tasks are generally more organized and easier to navigate; they often include a variety of visual and auditory aids that enhance understanding of research materials and make the learning process more engaging; and students have the freedom to decide when and where to study the materials [28].

Incorporating interactive technologies in English language instruction has proven especially effective, enabling students to acquire linguistic abilities through real-life language contexts and communicative exercises [29]. A notable benefit is that students acquire a theoretical acquaintance of the language and cultivate practical skills for using it in different communication situations. This method improves their speaking, listening, writing, and reading abilities while promoting their overall communicative competence. Moreover, using interactive technologies is essential for enhancing students' critical thinking and creativity, as they must tackle real-world problems that require analyzing and evaluating various aspects of language use [30]. This method fosters the development of specific skills (refer to Table 1):

Table 1. Skills developed through the interactive approach (Source: Authors' development)

Skill	Description
Analytical skills	The ability to distinguish between data and information, synthesize, classify, identify primary or secondary information, analyze, present, and obtain information, and think clearly and logically.
Practical skills	Developing skills through the use of theory, methods, and basic principles.
Creative skills	Generating alternative solutions.
Communicative skills	The ability to lead discussions, persuade others, use media tools, cooperate in groups, defend one's viewpoint, convince opponents, and prepare concise and convincing reports.
Social Skills	The ability to assess others' behavior, listen attentively, support discussions or argue opposing views, and control one's emotions.

Ref. [31] defines interactive learning as a specific form of organizing cognitive activity that creates comfortable learning conditions in which students feel successful and intellectually capable. Interactivity involves dialogue,

highlighting and analyzing each problem from different perspectives, rejecting stereotypes and templates (the multiplicity of logic), the presence of "incompleteness" as a natural feature of knowledge acquisition, changing the conventional role of the teacher towards facilitating student autonomy in information-seeking (embracing transformations and additions), fostering knowledge exchange and collaborative actions, developing skills in engaging with scientific and pedagogical literature and promoting interaction among micro groups, the student body, and virtual collaborators. "learning technologies" refers to a collection of strategies chosen to fulfill educational goals [32].

In recent years, particularly since 2020, much of the learning has shifted to online formats, enabling students to access educational materials in a virtual setting [31]. This shift supports independent knowledge and skill acquisition. Observations from English language courses at the National University "Odesa Maritime Academy" and Central Ukrainian State University indicate that students favor using the Internet for learning, as it offers a well-structured task layout and access to visual and audio resources, which enhances engagement. Findings reveal that interactive technologies in English language education enable students to learn linguistic concepts through authentic communication scenarios. This approach enhances their speaking, listening, reading and writing competencies and cultivates critical and creative thinking as students tackle real-life issues that necessitate analysis and evaluation.

Interactive learning is a distinct way of structuring cognitive activities that creates a supportive environment for students and promotes their success [33]. Its primary features include dialogue, varied reasoning perspectives, and active student involvement in the learning process. A wide range of interactive learning technologies exists. Learning technologies are strategies to achieve educational objectives [34]. Interactive strategies encompass methods like case studies, projects, and role-playing activities. The case study approach, in particular, fosters communication skills by examining real-world scenarios.

Implementing the case study method as part of interactive technologies in English education is pertinent. Researchers have suggested various classifications of case studies that focus on different aspects, such as problems, conflicts, or actions [35]. A recommended structure for a case study comprises familiarising learners with content, detailing the actual situation, identifying problems, analyzing the current circumstances, and applying practical solutions. When designing case studies for blended interactive learning, following a block-modular structure that aligns with educational objectives while ensuring a high degree of interactivity is essential. Moreover, it is essential to consider emotional elements when designing educational materials, as emotions significantly influence information retention. In this context, the functions of interactive technologies are diverse. They should assist students in developing communicative competence and collaborating in teams while also allowing them to evaluate their abilities and share ideas. Educational materials must be tailored to address students' needs, concentrating on specific skills requiring development.

Various interactive teaching methods exist, such as case studies, projects, quests, role-playing games, and simulations [36]. The case study approach stands out as it involves analyzing complex and uncertain knowledge from real-life situations [37]. Overall, the case study method can effectively enhance communicative abilities in English language learners. However, other teaching techniques, like lectures and textbooks, may be more beneficial for understanding intricate concepts and theories, while textbooks are helpful for mastering essential facts and grammar [19]. The most effective strategy often combines different methods and contemporary technologies tailored to each student's unique learning needs and preferences. For example, case studies might enhance vocabulary and improve communication skills, whereas lectures and textbooks can concentrate on teaching fundamental grammar and spelling rules. Researchers have put forward multiple classifications of case studies, which have been thoroughly examined in academic research [38]. They assert that the format of a case study is influenced by the specific element being investigated, such as the issue, conflict, role, event, activity, or timeframe. Despite the various types and specificities of case studies, researchers tend to generalize them into a standard structure (see Table 2):

Table 2. The general structure of interactive case studies (Source: Authors' development)

Stage	Description
Introduction to the case content	This phase aims to acquaint students with the case materials. It offers essential background information to comprehend the case, including important concepts and terminology associated with the topic.

Description of the actual situation	The case illustrates a real-world situation using chosen parameters, ensuring its context is anchored in practical examples that correspond with the specific learning goals of the course or subject.
Problem identification	The issue is articulated by determining the ideal or intended condition of the object or subject being examined. This stage emphasizes the disparity between the existing state and the desired result.
Analysis of the current situation	A comprehensive analysis of the present situation compares the existing state with the preferred or ideal state. This analysis requires critical thinking and assessment of the elements contributing to the issue.
Practical Implementation	The last phase focuses on putting the case study findings into practice. It involves providing educational and methodological assistance to help students apply their theoretical knowledge in real-life situations to address the challenges presented in the case.

When developing cases for blended learning, in addition to structuring information to ensure a logical presentation of the material, it is essential to adhere to the following requirements: adherence to a block-modular structure – the materials should be organized in clearly defined modules or blocks to allow for flexible learning paths and better understanding of each segment of content; alignment with the goals, content, and methods of learning – each case or learning module must be aligned with the overall educational goals, the content being taught, and the methods of delivery. This ensures cohesion and relevance throughout the course; self-sufficiency of materials – learning materials should be comprehensive enough to support independent learning without additional resources, allowing students to learn at their own pace; willingness to consider adding or modifying specific components.

The learning cases should allow for flexibility, making it easy to update or add new components to improve the learning experience or adapt to changes in curriculum; supporting immersive interactions – the development of cases should include interactive and immersive activities that engage students actively, such as simulations, group discussions, or problem-solving tasks; creating conditions for monitoring students' independent, out-of-class work. The learning system should provide tools or mechanisms for instructors to monitor and assess students' progress in their independent work, ensuring that students keep up with assignments and grasp the material.

Ref. [39] advocates for incorporating statistical developments, engineering projects, and technical specifications of enterprises into educational cases designed for mathematicians. They underscore that such materials can serve as diagnostic tools for professional contexts and as resources for calculating essential indicators for effective problem-solving.

The insights of Ref. [40] regarding the emotional and moral dimensions of communication processes in situational analysis are particularly pertinent. The researchers elucidate the heightened pedagogical potential of this approach, as collective activities in problem analysis and resolution present genuine challenges to the emotional, motivational, and ethical subsystems of participants in the communication process. As a result, this encourages the growth of emotions, motivation, and ethical awareness, transforming the task into an emotionally and morally stimulating experience. Consequently, situational analysis functions as a pedagogical and formative educational instrument, facilitating the realization of classical pedagogical principles regarding the developmental influence on students' personalities.

In light of the contemporary educational paradigm, which necessitates a departure from traditional information transmission to students, it is imperative to cultivate significant autonomy in knowledge acquisition, thereby preparing learners for lifelong self-directed learning. Higher education instructors must thus develop specific pedagogical tools to support this shift.

When creating educational materials, it is critical to acknowledge that information linked to emotional experiences is more effectively retained in memory. The brain region responsible for information retention is

situated adjacent to the limbic system; consequently, information that evokes strong emotions—such as excitement, curiosity, anger, or fear – is likely to be retained over extended periods [41].

When studying English for professional purposes, it is recommended that students choose relevant scenarios that encourage them to participate in discussions and promote the enhancement of their communication skills [42]. This can be achieved mainly by applying clichés specific to professional discourse. During interactive tasks designed in a case study format, multiple students can be simultaneously engaged, allowing for the assessment of their teamwork capabilities, presentation skills, and proficiency in formulating arguments and counterarguments. Typical errors frequently arise during spontaneous presentations; these should be documented and addressed, allowing substantive correction of students' spoken language.

Although interactive technologies offer countless methodological options, instructors should carefully choose a specific skill for students to focus on and work to improve effectively. When creating interdisciplinary tasks, it is crucial to structure them so that the results are primarily determined by the student's understanding of the studied subject.

4. Discussion

As educational technology advances, interactive teaching methods are becoming essential tools for higher education instructors. Hypothesis 1 posits that integrating interactive technologies enhances the overall quality of education. Ref. [43] contends that this enhancement arises from the holistic nature of interactive methods, which facilitate the integration of various components in the learning experience, encompassing epistemological, communicative, projective, and organizational dimensions.

The use of interactive technologies helps create a supportive learning environment, which is particularly important in today's educational context. Ref. [44] indicates that these technologies are crucial in establishing a safe space for students to express their ideas and suggest solutions to complex problems. This environment promotes the development of critical thinking and argumentative skills. Students gain new knowledge and actively participate in discussions, analyses, and critiques, thereby significantly enhancing the quality of their educational experience.

A study by Angelone *et al.* supports the idea that interactive teaching methods boost student engagement, positively influencing academic success [45]. For instance, applying technologies like simulations, role-playing, and group projects allows students to gain knowledge and apply it in actual or simulated environments. This form of experiential learning provides students with critical insights that better prepare them for their future careers. Interactive teaching strategies encourage the development of critical thinking skills by prompting students to analyze information and consider different viewpoints actively. Participation in discussions, teamwork, and role-playing help students express arguments, ask questions, and find evidence to back up their claims [7]. These strategies inspire students to challenge existing beliefs and seek creative solutions to problems, fostering cognitive flexibility.

Furthermore, interactive learning technologies provide students with opportunities to practice decision-making in actual and simulated environments, thereby improving their ability to assess the outcomes of their choices [1]. These methods boost student engagement and enhance their skills in critical information analysis, a vital asset in a rapidly changing professional environment. This preparation empowers students to address genuine challenges they may encounter. The importance of decision-making is highlighted as students must evaluate situations, explore different viewpoints, and identify optimal solutions within limited time frames [46]. Engaging in role-playing and collaborative projects promotes the development of communication and teamwork skills, which are crucial in today’s job market.

Ref. [47] argues that employing interactive techniques creates opportunities for building interpersonal relationships that benefit professional and social arenas. Through collaborative efforts, students acquire vital skills in teamwork, responsibility sharing, and achieving shared goals, which are essential for successful career endeavors.

We believe that incorporating these technologies into the educational framework enhances the quality of education and prepares students to confront real-world challenges throughout their careers. As a result, this integration fosters the development of more adaptable, skilled, and confident professionals who can thrive in a continually evolving environment.

Interactive technologies enhance educational experience and foster critical competencies within students, which are essential for their successful adaptation to an accelerated world [8]. The intersection of technology, communication, and active learning supports the hypothesis that integrating interactive methodologies into educational practices significantly improves the overall quality of education.

This article's analysis supports interactive technologies' effectiveness in fostering communicative competence. As suggested in Hypothesis 2, techniques such as the case method can enhance students' communication skills. A similar study confirms that these approaches encourage the development of critical and problem-solving skills, which help students better understand and retain the material [48].

Moreover, as highlighted in the source [49], interactive technologies promote personalized learning experiences, allowing students to choose strategies that fit their individual learning preferences. This customization helps students gain theoretical knowledge and enhances their practical skills and competencies, making the learning process more flexible and adaptable. Consequently, students become active participants in their education, leading to a greater understanding of the content and improved communication proficiency.

However, it is essential to recognize the challenges these demanding methods pose for both teachers and learners. In a similar study [50], interactive strategies require significant preparation and effort from educators to create and deliver lessons and foster a supportive learning atmosphere. For students, adapting to these rigorous approaches may be particularly challenging if they are used to traditional teaching methods. Support systems must be implemented to help students adjust to these new demands and alleviate potential stress. To fully harness the potential of interactive technologies in education, their advantages and challenges must be addressed. This includes ensuring thorough training for educators and offering psychological support for students, which will be crucial for successfully applying interactive strategies and ultimately improving communicative competence and overall educational quality.

In this context, interactive technologies emerge as a relevant and effective learning method that promotes the development of students' communicative skills, critical thinking, creativity, and social and emotional growth. This teaching approach encourages students to actively participate with their peers and instructors actively, enhancing their understanding of the subject matter and refining their collaboration and teamwork abilities.

Nonetheless, it is essential to identify the limitations of this research that may affect the applicability of the findings. First, the study was conducted within a specific educational program at a limited number of higher education institutions, restricting the ability to generalize the results to other contexts or educational systems. Second, the student sample might not represent the full range of learning styles, cultural backgrounds, or career goals, further impacting the generalizability of the conclusions.

The successful implementation of interactive technologies needs specific conditions, including adequate teacher training, access to technological resources, and institutional backing. If these requirements are not met, the effectiveness of the results may be diminished or even lead to adverse outcomes.

Thus, this study significantly contributes to the academic conversation by highlighting the innovative nature of incorporating interactive technologies into educational practices. It shows that using these methods improves educational quality and prepares students for real-world challenges they may face in their careers. As a result, this approach helps produce more adaptable, skilled, and confident professionals equipped to succeed in a fast-changing environment.

Therefore, despite its limitations, the findings of this research may serve as a foundational resource for further studies in this field and offer practical guidance for effectively implementing interactive technologies in educational settings.

5. Conclusions

During periods of armed conflict and in the aftermath of such events, the paramount objective of the educational sector is to ensure the quality of education at all levels. Consequently, it is entirely appropriate for academic research within the field of education to be conducted, with the findings subsequently implemented in practical applications. The results of such research indicate that effective interactive learning becomes achievable only through substantial personal investment from educators, both during the course development phase and throughout the support of the learning process. The educator's personal approach, manifested as their "presence" within the course framework, engages and retains student interest.

Investigations into the potential of interactive pedagogical tools and analyses of exemplary practices in foreign language instruction facilitate educators' and students' engagement in this domain. It has been established that judiciously selected interactive methods motivate students to learn and cultivate their intellectual curiosity, stimulate the pursuit of new knowledge, and aid in developing skills related to collaborative teamwork, productive interaction, discussion, and debate, among other competencies.

Observational data reveal several notable shifts following the implementation of these interactive methods. Students exhibit a heightened culture of discussion, demonstrate enhanced skills in reaching consensual decisions, improve their capabilities in online communication and presentation delivery, experience a deeper level of motivation, and show quantitative advancements in fundamental cognitive operations – including analysis, synthesis, generalization, and abstraction.

Educators must utilize various teaching methods in diverse combinations in all forms of educational engagement. The selection of specific interactive teaching methodologies is contingent upon the objectives and conditions of each lesson type. Overall, interactive learning—mainly through the application of case studies—facilitates a transition toward a more student-centered pedagogical approach.

This study provides valuable insights into the impact of interactive technologies on enhancing educational outcomes, but there are still some limitations. The limited scope of sources and time frame may exclude valuable insights from earlier research or restrict the inclusion of long-term studies that could provide a broader perspective on the sustained impact of interactive technologies, as well as the limited focus on long-term outcomes that could offer a more comprehensive understanding of their value in education.

A promising avenue for future research is the development of models aimed at fostering communicative competence among students who experience psychological barriers to interpersonal communication. This is a critical area of inquiry since many students encounter significant challenges in their interpersonal communication skills, which can hinder their active participation in the educational process. The formulation of individualized support programs, which may include training in communication strategies, psychological counseling, and practical exercises, could assist these students in overcoming their barriers and becoming more engaged learners.

Moreover, investigating the impact of interactive technologies on diverse student populations, carefully considering their unique characteristics and readiness for interactive learning, may provide valuable insights for enhancing educational programs. Such investigations could create more adaptive and inclusive educational environments that meet the diverse needs of all participants in the learning process. Thus, integrating interactive technologies could significantly enhance the quality of education while simultaneously promoting social equity, ensuring equal opportunities for all students.

Declaration of competing interest

The authors declare that they have no known financial or non-financial competing interests in any material discussed in this paper.

Funding information

No funding was received from any financial organization to conduct this research.

Author contribution

The contribution to the paper is as follows: N. Prykhodkina, M. Tsynova, H. Kravets, O. Hrechanovska, V. Nichyshyna: study conception and design; N. Prykhodkina, M. Tsynova, H. Kravets, O. Hrechanovska, V. Nichyshyna: data collection; N. Prykhodkina, M. Tsynova, H. Kravets, O. Hrechanovska, V. Nichyshyna: analysis and interpretation of results; N. Prykhodkina, M. Tsynova, H. Kravets, O. Hrechanovska, V. Nichyshyna: draft preparation. All authors approved the final version of the manuscript.

References

[1] N. Kantsedal, O. Ponomarenko, L. Dorohan'Pisarenko, and O. Liaska, "The methods of using interactive technologies during teaching foundations of scientific research at higher educational

establishments," *Independent Journal of Management & Production*, vol. 10, no. 7, pp. 778-797, 2019. [Online]. Available: https://doi.org/10.14807/ijmp.v10i7.917.

[2] V. Radkevych, S. Kravets, T. Herliand, O. Radkevych, and A. Kozak, "Modern technologies in the development of professional competence in teachers from professional (vocational) education schools," in *Journal of Physics: Conference Series*, vol. 1840, no. 1, p. 012041, Mar. 2021. [Online]. Available: https://doi.org/10.1088/1742-6596/1840/1/012041.

[3] V. Y. Tsekhmister, T. Konovalova, and Y. B. Tsekhmister, "Distance learning technologies in online and mixed learning in pre-professional education of medical lyceum students," *Journal of Advanced Pharmacy Education and Research*, vol. 11, no. 4, pp. 127-135, 2021. [Online]. Available: https://doi.org/10.51847/ZLy2idWa4f.

[4] R. Puyda and P. Dvorianyn, "Higher education reform in Ukraine (2014–2022) in the reception of domestic social media," *East European Historical Bulletin*, no. 31, pp. 203-217, 2024. [Online]. Available: https://doi.org/10.24919/2519-058X.31.306356.

[5] Y. Zayachuk, "Ensuring quality higher education in Ukraine in times of war," *Journal of Adult and Continuing Education*, 14779714241270254, 2024. [Online]. Available: https://doi.org/10.1177/1477971424127025.

[6] P. Díaz, A. Ioannou, K. K. Bhagat, and J. M. Spector, Eds., *Learning in a digital world: Perspective on interactive technologies for formal and informal education*. Springer, 2019. [Online]. Available: https://link.springer.com/book/10.1007/978-981-13-8265-9.

[7] N. Sharata, T. Berezovska, and T. Kravchenko, "Efficiency of the method of student thematic online debates in the development of professional competences in future specialists," *WSEAS Transactions on Environment and Development*, vol. 18, pp. 10-19, 2022. [Online]. Available: https://doi.org/10.37394/232015.2022.18.2.

[8] C. A. Peláez, A. Solano, T. Granollers, and C. Collazos, "Methodologies and trends in multimedia systems: a systematic literature review," in *Social Computing and Social Media. Design, Human Behavior and Analytics: 11th International Conference, SCSM 2019, Held as Part of the 21st HCI International Conference, HCII 2019, Orlando, FL, USA, July 26-31, 2019, Proceedings, Part I 21*, Springer International Publishing, pp. 109-127, 2019. [Online]. Available: https://link.springer.com/chapter/10.1007/978-3-030-21902-4_9.

[9] N. A. Mansor, N. Abdullah, and H. A. Rahman, "Towards electronic learning features in education 4.0 environment: literature study," *Indonesian Journal of Electrical Engineering and Computer Science*, vol. 19, no. 1, pp. 442-450, 2020. [Online]. Available: https://doi.org/10.11591/ijeecs.v19.i1.pp442-450

[10] T. V. Kramarenko, "Modern information, communication and interactive technologies for foreign language teaching," *Visnyk Universytetu imeni Alfreda Nobelia. Pedahohika i Psykholohia*, pp. 354-361, 2020. [Online]. Available: https://doi.org/10.32342/2522-4115-2020-1-19-42

[11] G. C. Okpara, G. Ekeh, O. F. Abiakwu, O. Ezeanolue Aloysius, and B. C. Nwankwo, "From Socrates to screens: examining the evolution of Socratic dialogue in online education," *Multidisciplinary Journal of Law, Education and Humanity*, vol. 1, no. 1, 2024. [Online]. Available: https://nigerianjournalsonline.com/index.php/MJLEH/article/view/4786

[12] M. J. Berk, "The limits of Platonic modelling and moral education: a view from the classroom," *Journal of Philosophy of Education*, vol. 57, no. 3, pp. 762-773, 2023. [Online]. Available: https://doi.org/10.1093/jopedu/qhad046

[13] D. Q. Dinh and V. Van Dung, "Confucius's educational ideas: content and values," *Conhecimento & Diversidade*, vol. 16, no. 42, pp. 356-369, 2024. [Online]. Available: https://doi.org/10.18316/rcd.v16i42.11711

[14] H. M. Shalatska, O. Y. Zotova-Sadylo, O. Y. Makarenko, and L. S. Dzevytska, "Implementation of E-assessment in higher education," in *Proceedings of the 16th International Conference on ICT in Education, Research and Industrial Applications. Integration, Harmonization and Knowledge Transfer. Volume II:*

Workshops, Kharkiv, Ukraine, Oct. 06-10, 2020, vol. 2732, pp. 1172-1186, CEUR Workshop Proceedings. [Online]. Available: http://ceur-ws.org/Vol-2732

[15] Y. Tsekhmister, T. Konovalova, B. Tsekhmister, A. Agrawal, and D. Ghosh, "Evaluation of virtual reality technology and online teaching system for medical students in Ukraine during COVID-19 pandemic," *International Journal of Emerging Technologies in Learning (iJET)*, vol. 16, no. 23, pp. 127-139, 2021. [Online]. Available: https://www.learntechlib.org/p/220596/

[16] H. M. Hubal, "The generalized kinetic equation for symmetric particle systems," *Mathematica Scandinavica*, pp. 140-160, 2012. [Online]. Available: https://www.jstor.org/stable/24493757

[17] M. Reva and Y. Demchenko, "The role of online psychological testing in a learning process: the Ukrainian case," *E-Learning Innovations Journal*, vol. 2, no. 1, pp. 23–40, 2024. [Online]. Available: https://doi.org/10.57125/ELIJ.2024.03.25.02

[18] I. Z. kizi Hasanova, "The Role of the Advocate's Motions and Complaints in a Criminal Trial: A Scoping Review," *Futurity Economics & Law*, vol. 4, no. 4, pp. 25–41, 2024. [Online]. Available: https://doi.org/10.57125/FEL.2024.12.25.02

[19] O. Marukhovska-Kartunova, M. Bugrov, M. Kozlovets, I. Savolainen, and T. Zaika, "Historical and cultural dimensions of the philosophy of the future: globalisation and identity," *Futurity Philosophy*, vol. 3, no. 4, pp. 20–33, 2024. [Online]. Available: https://doi.org/10.57125/FP.2024.12.30.02

[20] M. J. González, S. Surikova, and T. Pigozne, "Adaptation of a teacher training programme for character education to the Latvian context," *Human, Technologies and Quality of Education*, pp. 7-18, 2020. [Online]. Available: https://doi.org/10.22364/htqe.2020.01

[21] R. Vainola, "Evaluating the effectiveness of social media as a means of strengthening family values among young people," *Futurity of Social Sciences*, vol. 2, no. 4, pp. 24–38, 2024. [Online]. Available: https://doi.org/10.57125/FS.2024.12.20.02

[22] V. Shkola, "The role of accounting in determining social indicators of success for sustainable development of enterprises," *Law, Business and Sustainability Herald*, vol. 3, no. 4, pp. 21–32, 2023. [Online]. Available: https://lbsherald.org/index.php/journal/article/view/54

[23] Y. K. Al-Rikabi and G. A. Montazer, "Designing an e-learning readiness assessment model for Iraqi universities employing Fuzzy Delphi Method," *Education and Information Technologies*, vol. 29, no. 2, pp. 2217-2257, 2024. [Online]. Available: https://link.springer.com/article/10.1007/s10639-023-11889-0

[24] F. Estrella, "Ecuadorian university English teachers' reflections on emergency remote teaching during the COVID-19 pandemic," *International Journal of Educational Research Open*, vol. 3, p. 100141, 2022. [Online]. Available: https://doi.org/10.1007/s43545-022-00365-0

[25] T. M. Galagedarage and K. Indrasena, "Information and Communication Technologies (ICTs) for e-learning in tertiary education in Sri Lanka: A study of undergraduates from state universities in Colombo district," *International Journal of Media and Communication Research*, vol. 4, no. 2, pp. 33-48, 2023. [Online]. Available: https://journal.uir.ac.id/index.php/ijmcr/article/view/13692

[26] S. I. Atamanyuk, "Theoretical fundamentals of innovation of higher education in Ukraine," *Pedagogy and Education Management Review*, vol. 2, no. 4, pp. 30-36, 2021. [Online]. Available: https://doi.org/10.36690/2733-2039-2021-2-30

[27] M. Abdur Rehman, S. H. Soroya, Z. Abbas, F. Mirza, and K. Mahmood, "Understanding the challenges of e-learning during the global pandemic emergency: the students' perspective," *Quality Assurance in Education*, vol. 29, no. 2/3, pp. 259-276, 2021. [Online]. Available: https://www.emerald.com/insight/content/doi/10.1108/QAE-02-2021-0025/full/html

[28] M. Alotumi, "Factors influencing graduate students' behavioral intention to use Google Classroom: Case study-mixed methods research," *Education and Information Technologies*, vol. 27, no. 7, pp. 10035-10063, 2022. [Online]. Available: https://link.springer.com/article/10.1007/s10639-022-11051-2

[29] H. Adem and M. Berkessa, "A case study of EFL teachers' practice of teaching speaking skills vis-à-vis the principles of Communicative Language Teaching (CLT)," *Cogent Education*, vol. 9, no. 1, 2022. [Online]. Available: https://doi.org/10.1080/2331186X.2022.2087458

[30] M. Alhasani, "Measuring graduate students' perceptions of an academic English reading and writing course during turbulent times–a case study from Albania," in *International Perspectives on Teaching and Learning Academic English in Turbulent Times*, pp. 113-129, Routledge, 2022. [Online]. Available: https://doi.org/10.4324/9781003283409-13

[31] A. Y. Alqahtani and A. A. Rajkhan, "E-learning critical success factors during the COVID-19 pandemic: A comprehensive analysis of e-learning managerial perspectives," *Education Sciences*, vol. 10, no. 9, p. 216, 2020. [Online]. Available: https://doi.org/10.3390/educsci10090216

[32] G. Assunção, B. Patrão, M. Castelo-Branco, and P. Menezes, "An overview of emotion in artificial intelligence," *IEEE Transactions on Artificial Intelligence*, vol. 3, no. 6, pp. 867-886, 2022. [Online]. Available: https://doi.org/10.1109/TAI.2022.3159614

[33] J. C. Bustamante, M. Segura-Berges, M. Lizalde-Gil, and C. Peñarrubia-Lozano, "Qualitative analyses of e-learning implementation and hybrid teaching during the COVID-19 pandemic at Spanish universities," *Sustainability*, vol. 14, no. 19, p. 12003, 2022. [Online]. Available: https://doi.org/10.3390/su141912003

[34] T. K. Chiu, Q. Xia, X. Zhou, C. S. Chai, and M. Cheng, "Systematic literature review on opportunities, challenges, and future research recommendations of artificial intelligence in education," *Computers and Education: Artificial Intelligence*, vol. 4, 2023. [Online]. Available: https://doi.org/10.1016/j.caeai.2022.100118

[35] V. Cofini, E. Perilli, A. Moretti, V. Bianchini, M. Perazzini, M. Muselli, and S. Necozione, "E-learning satisfaction, stress, quality of life, and coping: a cross-sectional study in Italian university students a year after the COVID-19 pandemic began," *International Journal of Environmental Research and Public Health*, vol. 19, no. 13, p. 8214, 2022. [Online]. Available: https://doi.org/10.3390/ijerph19138214

[35] V. Cofini, E. Perilli, A. Moretti, V. Bianchini, M. Perazzini, M. Muselli, and S. Necozione, "E-learning satisfaction, stress, quality of life, and coping: a cross-sectional study in Italian university students a year after the COVID-19 pandemic began," *International Journal of Environmental Research and Public Health*, vol. 19, no. 13, p. 8214, 2022. [Online]. Available: https://doi.org/10.3390/ijerph19138214.

[36] M. Deja, D. Rak, and B. Bell, "Digital transformation readiness: perspectives on academia and library outcomes in information literacy," *The Journal of Academic Librarianship*, vol. 47, no. 5, p. 102403, 2021. [Online]. Available: https://doi.org/10.1016/j.acalib.2021.102403.

[37] F. Daryanes, D. Darmadi, K. Fikri, I. Sayuti, M. A. Rusandi, and D. D. B. Situmorang, "The development of articulate storyline interactive learning media based on case methods to train student's problem-solving ability," *Heliyon*, vol. 9, no. 4, 2023. [Online]. Available: https://www.cell.com/heliyon/fulltext/S2405-8440(23)02289-2.

[38] A. Nasseri, T. Zhou, V. Ha, J. Zhu, D. Wu, and H. Ohyama, "Students' perceptions of virtual interactive clinical case-based learning: A comparative study with three different cohorts," *Journal of Dental Sciences*, vol. 19, no. 3, pp. 1578-1586, 2024. [Online]. Available: https://doi.org/10.1016/j.jds.2023.12.018.

[39] R. Miftah, J. A. Dahlan, L. Kurniawati, T. Herman, and L. Lutfiana, "How does interactive case-based learning improve students' complex mathematical problem-solving abilities?," *Journal of Honai Math*, vol. 7, no. 2, pp. 307-326, 2024. [Online]. Available: https://www.journalfkipunipa.org/index.php/jhm/article/view/622.

[40] S. Jacques, A. Ouahabi, and T. Lequeu, "Synchronous E-learning in Higher Education during the COVID-19 Pandemic," in *2021 IEEE Global Engineering Education Conference (EDUCON)*, pp. 1102-1109, Apr. 2021. [Online]. Available: https://ieeexplore.ieee.org/abstract/document/9453887.

[41] J. Kim and E. J. Maloney, *Learning innovation and the future of higher education*, JHU Press, 2020. [Online]. Available: https://www.press.jhu.edu/books/title/12072/learning-innovation-and-future-higher-education.

[42] H. Baber, "Modelling the acceptance of e-learning during the pandemic of COVID-19-A study of South Korea," *The International Journal of Management Education*, vol. 19, no. 2, p. 100503, 2021. [Online]. Available: https://doi.org/10.1016/j.ijme.2021.100503.

[43] F. Latifi and H. Kasumi, "Teachers' Perspectives on Innovative and Interactive Teaching Methods: Perspective of Mobile Learning," *International Journal of Interactive Mobile Technologies*, vol. 17, no. 23, 2022. [Online]. Available: https://doi.org/10.3991/ijim.v16i23.36217.

[44] U. Tugtekin and H. F. Odabasi, "Do interactive learning environments have an effect on learning outcomes, cognitive load and metacognitive judgments?," *Education and Information Technologies*, vol. 27, no. 5, pp. 7019-7058, 2022. [Online]. Available: https://link.springer.com/article/10.1007/s10639-022-10912-0.

[45] V. Y. Tsekhmister, T. Konovalova, and Y. B. Tsekhmister, "Technologies of distance learning in online and blended learning in pre-profile education of medical lyceum students," *Journal of Advanced Pharmacy Education and Research*, vol. 11, no. 4, pp. 127-135, 2021. [Online]. Available: https://doi.org/10.51847/ZLy2idWa4f.

[46] I. Borysyuk, O. B. Haioshko, O. Korniichuk, Y. Tsekhmister, and M. Demianchuk, "Alternative approaches to clinical practice in medical education during the COVID-19 pandemic," *Journal of Curriculum and Teaching*, vol. 11, no. 2, pp. 75-89, 2022. [Online]. Available: https://doi.org/10.5430/jct.v11n2p75.

[47] Y. Tsekhmister, T. Konovalova, B. Tsekhmister, T. Pushkarova, and S. Nahornyak, "Modern education: the process of globalization and transformation under the influence of artificial intelligence," *International Journal of Evaluation and Research in Education (IJERE)*, vol. 13, no. 5, pp. 3443-3455, 2024. [Online]. Available: http://doi.org/10.11591/ijere.v13i5.29016.

[48] Y. Tsekhmister, T. Konovalova, and B. Tsekhmister, "Using predictive analytics to identify at-risk students in digital medical education: a motivational perspective," *Academia*, no. 37, pp. 3-24, 2024. [Online]. Available: https://doi.org/10.26220/aca.5051.

[49] V. M. Bilytska, O. R. Andriashyk, Y. V. Tsekhmister, O. V. Pavlenko, and I. V. Savka, "Multimodal interaction in foreign language lessons at higher educational institutions of Ukraine," *Journal of Curriculum and Teaching*, vol. 11, no. 1, pp. 218-234, 2022. [Online]. Available: https://doi.org/10.5430/jct.v11n1p218.

[50] Y. Tsekhmister, T. Konovalova, and B. Tsekhmister, "Using behavioral analytics for personalizing learning experiences in digital medical education: a practical study," *Academia*, no. 33, pp. 83-103, 2023. [Online]. Available: https://doi.org/10.26220/aca.4543.