Metaverse Basic and Applied Research. 2025; 4:126
doi: 10.56294/mr2025126

ORIGINAL

Virtual Reality as a Tool for Developing Intercultural Competence in the Global Educational Space

La realidad virtual como herramienta para desarrollar la competencia intercultural en el espacio educativo global

Olena Nevoenna[1], Kyryl Kotun[2], Oksana Voznyuk[3], Yuliia Zaverukha[4], Natalia Kushevska[4]

[1]V.N. Karazin Kharkiv National University, Department of General Psychology. Kharkiv, Ukraine.
[2]Ivan Ziaziun Institute of Pedagogical Education and Adult Education of the NAES of Ukraine, Department of Foreign Systems of Pedagogical Education and Adult Education. Kyiv, Ukraine.
[3]Hetman Petro Sahaidachnyi National Army Academy, Faculty of Combat Arms, Department of Military History. Lviv, Ukraine.
[4]Borys Grinchenko Kyiv Metropolitan University, Faculty of Law and International Relations, Department of Foreign Languages. Kyiv, Ukraine.

Cite as: Nevoenna O, Kotun K, Voznyuk O, Zaverukha Y, Kushevska N. Virtual Reality as a Tool for Developing Intercultural Competence in the Global Educational Space. Metaverse Basic and Applied Research. 2025; 4:126. https://doi.org/10.56294/mr2025126

Submitted: 25-08-2024 **Revised:** 10-01-2025 **Accepted:** 10-07-2025 **Published:** 11-07-2025

Editor: PhD. Dra. Yailen Martínez Jiménez

Corresponding author: Olena Nevoenna

ABSTRACT

Introduction: the study investigated the effectiveness of virtual reality (VR) technology in developing intercultural competencies among university students within the context of global education.
Objective: to evaluate the impact of virtual reality-based educational interventions on the development of intercultural competence, empathy, and intercultural communication skills among university students compared to traditional learning methods.
Method: a quasi-experimental design was employed with 120 participants aged 18–24 years from four universities in Ukraine, Spain, Poland, and Colombia. Stratified random sampling was used to ensure cultural diversity. The experimental group (n = 60) received VR-based intercultural communication training, while the control group (n = 60) followed traditional learning methods during a 14-day intervention. Data were collected using the Intercultural Competence Index (ICI) and the Intercultural Perspective Questionnaire (IPAQ) in pre- and post-intervention assessments. Statistical analysis included independent samples t-tests and descriptive statistics at a significance level of $p < 0,05$, with Cronbach's alpha coefficients above 0,8 confirming instrument reliability.
Results: the VR group demonstrated a significant improvement in overall intercultural competence ($M = 78,9$ vs $M = 64,1$, $t = 6,42$, $p < 0,001$) compared to the control group. Notable gains were also observed in empathy ($t = 5,21$, $p < 0,001$), communication flexibility ($t = 4,83$, $p < 0,001$), and tolerance ($t = 3,12$, $p = 0,003$).
Conclusions: VR-based training proved effective in enhancing intercultural awareness, empathy, and adaptive communication skills. These competencies are crucial for fostering global citizenship and preparing students for participation in a culturally diverse educational environment.

Keywords: Global Education; Intercultural Consciousness; Interactive Learning; Modern Technologies; Virtual Reality.

RESUMEN

Introducción: el estudio evaluó la eficacia de la tecnología de realidad virtual (RV) para el desarrollo de competencias interculturales en estudiantes universitarios dentro del contexto de la educación global.

Objetivo: evaluar el impacto de las intervenciones educativas basadas en la realidad virtual en el desarrollo de la competencia intercultural, la empatía y las habilidades de comunicación intercultural entre los estudiantes universitarios, en comparación con los métodos de aprendizaje tradicionales.
Método: se aplicó un diseño cuasi experimental con 120 participantes de entre 18 y 24 años, matriculados en cuatro universidades de Ucrania, España, Polonia y Colombia. El muestreo aleatorio estratificado aseguró la representatividad cultural. El grupo experimental (n = 60) recibió formación en comunicación intercultural mediante entornos de RV, mientras que el grupo de control (n = 60) siguió métodos de enseñanza tradicionales durante una intervención de 14 días. La recogida de datos se realizó utilizando el Índice de Competencia Intercultural (ICI) y el Cuestionario de Perspectiva Intercultural (IPAQ) en evaluaciones previas y posteriores a la intervención. El análisis estadístico incluyó pruebas t para muestras independientes y estadísticas descriptivas, con un nivel de significación de $p < 0,05$; la fiabilidad de los instrumentos se confirmó con coeficientes alfa de Cronbach superiores a 0,8.
Resultados: el grupo de RV mostró mejoras estadísticamente significativas en la competencia intercultural global ($M = 78,9$ frente a $M = 64,1$; $t = 6,42$; $p < 0,001$) respecto al grupo de control. Asimismo, se registraron incrementos en empatía ($t = 5,21$; $p < 0,001$), flexibilidad comunicativa ($t = 4,83$; $p < 0,001$) y tolerancia ($t = 3,12$; $p = 0,003$).
Conclusiones: la formación mediante RV demostró ser una herramienta eficaz para potenciar la conciencia intercultural, la empatía y las habilidades comunicativas adaptativas, competencias fundamentales para promover la ciudadanía global y preparar a los estudiantes para participar activamente en entornos educativos culturalmente diversos.

Palabras clave: Educación Global; Conciencia Intercultural; Aprendizaje Interactivo; Tecnologías Modernas; Realidad Virtual.

INTRODUCTION

In our rapidly interconnected world, educational institutions are failing to prepare students with essential intercultural competencies, creating a crisis that threatens the foundations of global society. This failure carries devastating consequences across multiple domains that demand immediate attention. Economically, multinational corporations report that 60 % of international business ventures fail due to cultural misunderstandings, costing the global economy billions annually.[1,2] Socially, inadequate intercultural preparation fuels xenophobia, ethnic conflicts, and the rise of nationalist movements worldwide. Educationally, universities struggle with increasing international student populations who experience cultural isolation, academic underperformance, and high dropout rates due to poor intercultural integration.[3,4,5]

This crisis is urgent and cannot be underestimated. With global migration reaching its highest level in history and international education growing rapidly, the window of opportunity for developing effective intercultural education is narrowing.[6,7] Traditional pedagogical approaches—such as lectures, textbook readings, and superficial cultural awareness activities—have proven woefully inadequate in developing the deep empathy, cultural sensitivity, and adaptive communication skills necessary for meaningful intercultural engagement.[8,9,10] Students continue to graduate with theoretical knowledge of cultural differences but lack the practical competencies to navigate real-world intercultural situations, perpetuating a cycle of misunderstanding, prejudice, and social fragmentation that undermines global cooperation and peaceful coexistence.

Virtual Reality (VR) has emerged as a potential revolutionary solution to this educational crisis, offering capabilities unmatched by traditional methods.[11,12,13] Unlike conventional approaches that rely on abstract cultural concepts, VR can create immersive and authentic cultural experiences, allowing students to practice intercultural interactions in a psychologically safe environment.[14,15,16] Through sophisticated simulations, learners can virtually visit foreign countries, interact with culturally diverse avatars, and experience cultural conflicts firsthand—while receiving instant feedback and guided reflection.[17,18,19] The theoretical promise is compelling, as VR's capabilities for embedded learning and perspective-taking can overcome a key limitation of traditional intercultural education: the inability to provide authentic cultural experiences.[20,21,22]

By creating "presence"—the psychological sensation of being in another cultural context—VR can activate the emotional and cognitive processes necessary for the development of true intercultural competence.[23,24,25] Preliminary studies suggest that immersive virtual experiences can increase empathy, reduce cultural bias, and improve intercultural communication skills beyond what is achieved by traditional methods.[26,27,28] However, despite VR's promising theoretical potential, critical knowledge gaps hinder its effective implementation in intercultural education and threaten to leave this powerful tool underutilized when it is most needed.[29,30,31]

The most significant gap lies in the lack of empirical evidence measuring the actual development of intercultural competence. Existing research has largely focused on the motivational effects of VR and its

technological features, rather than measuring the mastery of intercultural skills using valid assessment tools.[32,33,34] Furthermore, there are no controlled experimental studies that systematically compare VR-based intercultural training with traditional pedagogical approaches in different cultural contexts.[35,36] The literature also lacks a comprehensive understanding of which VR design features—scenario type, interaction complexity, cultural authenticity—are most effective for different dimensions of intercultural competence.[37,38]

Most critically, we do not know whether the apparent advantages of VR translate into measurable and sustainable improvements in real-world intercultural competence. Without this evidence, educators cannot justify the significant time, resources, and institutional changes required for VR implementation. This knowledge gap perpetuates reliance on ineffective traditional methods while potentially transformative technology remains underutilized, allowing the intercultural competence crisis to deepen.[39,40,41]

This study directly addresses this critical knowledge gap through the first rigorous experimental comparison between VR and traditional methods for developing intercultural competence across countries and cultural contexts. Our research provides the first controlled experimental data measuring the impact of VR on the cognitive, affective, and behavioral dimensions of intercultural competence using validated instruments (ICI and IPAQ) in a diverse international sample. Furthermore, we establish clear evidence of VR's effectiveness compared to conventional teaching methods, enabling educators to make informed decisions about pedagogical approaches based on measurable outcomes rather than theoretical assumptions. Finally, we developed and tested a replicable model for integrating VR into intercultural education that sets out the technical requirements, pedagogical strategies, and assessment protocols essential for successful implementation.[42,43,44,45]

The stakes could not be higher. As global cultural polarization increases and intercultural contact continues to grow, we must urgently identify and implement effective educational approaches to developing intercultural competence. This study provides the empirical foundation necessary for evidence-based educational innovation in this critical field, offering hope for overcoming one of the most pressing challenges facing global education today.

This study aims to evaluate the potential of VR to enhance students' cultural sensitivity, empathy, and adaptive communication skills compared to traditional intercultural education methods, providing empirical evidence for educational policy and practice decisions.

Research questions:

1. How does VR implementation affect students' intercultural awareness?
2. To what extent does VR improve students' ability to communicate effectively across cultures?
3. How does virtual reality influence students' attitudes toward cultural diversity?

METHOD

Research Design and Setting

A quasi-experimental research design was used, involving two different groups of participants with pre- and post-intervention evaluations. The study was conducted between March and April 2024 at four universities in different countries. The treatment group participated in immersive virtual reality (VR)-based education sessions, while the comparison group engaged in conventional learning activities without VR integration. The main objective of this study was to evaluate the impact of virtual reality on the development of cross-cultural competencies among university students.

Participants and Sampling

This study involved 120 participants aged between 18 and 24 years (M = 21,3, SD = 1,8). Participants were recruited through convenience sampling from existing intercultural communication classes at four universities: V.N. Karazin Kharkiv National University, Department of General Psychology (Kharkiv, Ukraine, n = 45); Hetman Petro Sahaidachnyi National Military Academy, Faculty of Combat Arms, Department of Military History (Lviv, Ukraine, n = 30); Kyiv Metropolitan University Borys Grinchenko, Faculty of Law and International Relations, Department of Foreign Languages (Kyiv, Ukraine, n = 30); and one university each in Spain (n = 5), Poland (n = 5), and Colombia (n = 5).

At each university, stratified allocation was applied to ensure balanced representation based on gender (58 % female, 42 % male), academic field (45 % humanities, 35 % social sciences, 20 % other), and self-reported cultural background diversity. All participants were enrolled in intercultural or related communication courses and had basic English language skills (minimum level B1).

Instruments

Data were collected using two standardized instruments validated for cross-cultural research:

1. The Intercultural Competence Index (ICI) measures the cognitive, behavioral, and emotional dimensions of intercultural awareness through 24 items using a 5-point Likert scale.

2. The Intercultural Perspective Questionnaire (IPAQ)[46], adapted for academic use, assesses perspectives on diversity, empathy, and adaptability in communication through 18 items.

Both instruments showed strong internal consistency (Cronbach's $\alpha > 0,8$) in preliminary testing. Additionally, subjective experiences with the VR environment were collected through brief open-ended questions administered after the intervention.

Intervention Description

VR Group (Experimental Condition)

Hardware: meta Quest 2 VR headsets with hand-tracking controllers were used for all sessions.

Software: a specially developed simulation using Unity Engine 2022.3 LTS, featuring photorealistic environments and culturally authentic scenarios.

Specific Scenarios**:** three main simulation modules were implemented:

1. *Virtual University Exchange*: students explored a foreign university campus, interacting with diverse student avatars in culturally specific academic situations (e.g., group projects with different communication styles, variations in dining room etiquette).
2. *Intercultural Workplace Simulation*: participants engage in business meetings with avatars representing different cultural communication patterns, learning to adapt their approach to differences in hierarchy, directness, and time orientation.
3. *Conflict Resolution Module*: students mediate cultural misunderstandings between avatar characters, practicing perspective-taking and cultural sensitivity skills.

Each scenario includes specific learning objectives targeting cultural awareness, empathy development, and adaptive communication strategies.

Control Group (Traditional Conditions)

The control group interacts with the same content through conventional methods:

1. Video: professionally produced documentaries and case studies covering the same cultural scenarios as in VR (45 minutes total per session).
2. Text: scientific articles and cultural competency frameworks corresponding to the VR simulation content.
3. Discussion: structured small group discussions (6-8 participants) using standardized questions reflecting decision points in the VR scenarios.

Procedure

The training schedule included 14 days of instruction in an existing Intercultural Communication course. Both groups completed six 45-minute sessions over a two-week period. Sessions are conducted in a university computer lab with standard lighting and minimal distractions.

Pre-intervention assessments are conducted one week before training begins. Post-intervention assessments are conducted within 48 hours after the final session. All assessments are conducted in the participant's language of choice (English, Ukrainian, Spanish, or Polish) using verified translations.

Statistical Analysis

Data analysis used Mixed ANOVA with Time (pre-post) as a within-subjects factor and Group (VR vs. traditional) as a between-subjects factor. This approach controlled for baseline differences and provided a more robust analysis than independent samples t-tests. Effect sizes were calculated using partial eta-squared ($\eta^2 p$). Analyses were performed using SPSS version 28,0 at a significance level of $p < 0,05$.

Ethical Considerations

This study was approved by the Institutional Review Board at V.N. Karazin Kharkiv National University (Protocol #2024-IC-07). All participants provided written consent after receiving detailed information about the study. No financial incentives were provided, although participants received course credit in exchange for participation. Data confidentiality was maintained through anonymous coding, and participants could withdraw at any time without consequences.

RESULTS

Table 1 shows the sociodemographic characteristics of study participants in both groups. The sample shows cultural diversity with balanced gender representation and diverse academic backgrounds.

Table 1. Sociodemographic Characteristics of Participants			
Characteristic	**VR Group (n=60)**	**Control Group (n=60)**	**Total (n=120)**
Age, M (SD)	21,2 (1,9)	21,4 (1,7)	21,3 (1,8)
Gender, n (%)			
Female	35 (58,3)	34 (56,7)	69 (57,5)
Male	25 (41,7)	26 (43,3)	51 (42,5)
Country, n (%)			
Ukraine	52 (86,7)	53 (88,3)	105 (87,5)
Spain	3 (5,0)	2 (3,3)	5 (4,2)
Poland	3 (5,0)	2 (3,3)	5 (4,2)
Colombia	2 (3,3)	3 (5,0)	5 (4,2)
Academic Field, n (%)			
Humanities	27 (45,0)	27 (45,0)	54 (45,0)
Social Sciences	21 (35,0)	21 (35,0)	42 (35,0)
Other	12 (20,0)	12 (20,0)	24 (20,0)

Development of Intercultural Competence

The mixed ANOVA results for ICI scores showed a significant interaction between Time × Group ($F(1,118) = 41,23$, $p < 0,001$, $\eta^2p = 0,26$), indicating different increases between groups over time.

Table 2. Mixed ANOVA Results for Comparison of ICI Scores Before and After Intervention						
Group	**Pre-intervention M (SD)**	**Post-intervention M (SD)**	**Mean Difference**	**F**	**p-value**	η^2p
VR Group	61,3	78,9	+17,6	41,23	<0,001	0,26
Control Group	60,7	64,1	+3,4			

The VR group showed significant improvement with an average increase of 17,6 points, while the control group showed minimal change (3,4 points). Post-hoc analysis confirmed that the post-intervention scores of the VR group were significantly higher than those of the control group ($p < 0,001$).

Specific Competence Dimensions

The mixed ANOVA results for the IPAQ subscales showed a significant interaction between Time × Group in all dimensions measured.

Table 3. Mixed ANOVA Results for IPAQ Domains					
Indicator	**VR Group M (SD)**	**Control Group M (SD)**	**F**	**p-value**	**p-value**
Empathy	4,4 ± 0,6	3,7 ± 0,8	27,14	<0,001	0,19
Communication flexibility	4,6 ± 0,5	3,9 ± 0,7	23,33	<0,001	0,17
Tolerance	4,5 ± 0,4	4,1 ± 0,6	9,74	0,003	0,08

All effect sizes ranged from moderate to large (Cohen, 1988), with empathy showing the most significant increase in the VR condition. Communication flexibility also showed a substantial increase, while tolerance showed the smallest but still significant difference between groups.

Visual Representation

Figure 1 illustrates the different patterns of improvement between groups during the intervention period, clearly showing the superiority of VR in the development of intercultural competence.

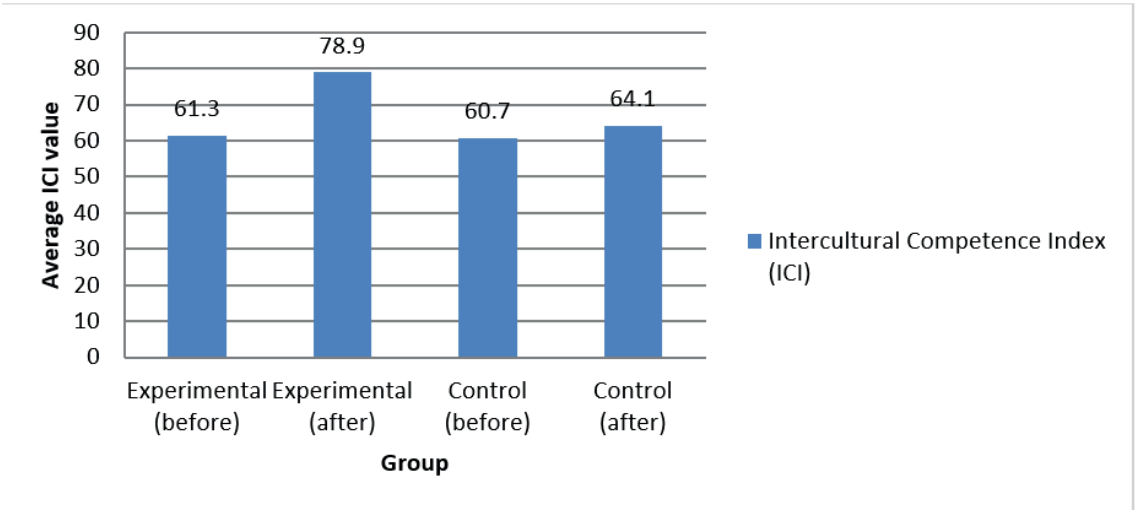

Figure 1. Changes in the overall index of intercultural competence in both groups

DISCUSSION

The findings of this study indicate that participants in the experimental group obtained higher ICI scores compared to the comparison group. Our results confirm the research of Peixoto et al. and Huang et al., who found that VR environments enhance empathy and cultural understanding in educational contexts, expanding on their findings by demonstrating measurable improvements in various dimensions of intercultural competence using valid assessment tools (ICI and IPAQ). This extends contextual learning theory by showing that virtual cultural immersion can produce learning outcomes that go beyond traditional educational approaches.[48,49]

The effect of "presence"—the psychological sensation of being within a virtual cultural context—emerges as a critical mechanism underlying our findings. This concept, supported by research showing that immersive VR experiences activate the cognitive and emotional processes necessary for perspective-taking, explains why VR facilitates immersive cultural experiences that encourage greater self-reflection and social learning among students. The immersive nature of VR creates cognitive and emotional conditions that cannot be replicated by traditional methods, allowing students to practice intercultural interactions in a psychologically safe environment while receiving immediate experiential feedback.[50]

Our findings that communication flexibility and empathy showed significant improvement confirm theoretical predictions regarding VR's ability to develop adaptive communication skills. The significant effect sizes (empathy η^2p = 0,19, communication flexibility η^2p = 0,17) indicate that structured VR scenarios targeting specific cultural dimensions produce measurably superior results compared to traditional approaches.

These visualizations support quantitative analysis and strengthen the argument for integrating VR into higher education to develop intercultural competence. Previous studies applying VR in social science and humanities education are consistent with these findings.^34,15,38^ Several studies suggest that VR can create a safe environment for cultural exploration, with previous research^34,15,38^ showing that participating in conflict simulations is beneficial for helping students understand cultural diversity and develop practical communication skills.

Participation in VR-based simulations can activate cognitive and emotional processes that encourage self-reflection and challenge participants' stereotypical views. Although these findings are consistent with other results from this study, careful interpretation is necessary given several methodological limitations. One of the most significant limitations of this study is the short two-week intervention. This timeframe is insufficient to foster resilience or firmly establish values and skills. This view is consistent with research^39^ and longitudinal studies^40^, which observe that evaluating the effectiveness of VR in educational settings requires comprehensive longitudinal assessment.

Furthermore, although the questionnaire instruments were validated, they did not fully account for participants' cultural norms and contextual factors, which could compromise data accuracy. Hudym et al. and Yuhan et al. recently highlighted these concerns, particularly in cross-cultural education. They argue that today's learning environments require adaptive measurement approaches to address unprecedented diversity.

Limited academic attention has been directed toward VR applications in this field and their impact on educational processes and outcomes; therefore, this study contributes by addressing this issue directly. This is important because participant engagement levels often correlate with interest in new technologies and engaging content.

Similar patterns have been identified in several studies on educational innovation. However, additional confirmation, especially regarding the sustained, integrated, and systematic use of VR within formal education

frameworks, is still needed. It is recommended that this issue be addressed through more inclusive methodologies, particularly mixed methods that combine quantitative data with systematic qualitative evaluation, such as observed actions, art forms, or self-descriptions of learners generated during the learning process.

As interest in adaptive learning models and virtual exchanges increases, understanding how VR is implemented and the extent to which this technology contributes to the development of intercultural competencies will be crucial in shaping inclusive and effective education systems.

CONCLUSIONS

This study provides the first controlled experimental evidence showing that VR-based intercultural training produces significantly superior results compared to traditional pedagogical approaches across various dimensions of competence. The theoretical implications are significant: our findings suggest that virtual presence can replace physical cultural immersion in developing empathy and adaptive communication skills, fundamentally challenging assumptions about the necessity of authentic cultural contact for intercultural learning.

The practical implications are equally compelling. Educational institutions can now justify implementing VR in intercultural curricula based on empirical evidence rather than theoretical speculation. Our standardized intervention protocol, which uses Meta Quest 2 headsets and Unity-based scenarios, provides a replicable framework that institutions can adapt to diverse cultural contexts and learning objectives.

For policymakers, these findings support strategic investment in VR education infrastructure. The effect sizes we documented (η^2p = 0,17–0,26) represent educationally significant improvements, justifying resource allocation, especially given the scalability advantages of VR training over traditional cultural exchange programs.

The urgency of this work cannot be overstated. As global cultural polarization increases and intercultural contact expands through migration and international education, institutions need evidence-based approaches to develop intercultural competence at scale. Our study shows that VR technology can effectively address these challenges, offering hope for systematically preparing students to participate meaningfully in culturally diverse environments.

However, critical questions remain unanswered. Future research must determine whether these competency gains persist beyond the post-intervention period and whether they translate into improved real-world intercultural performance. Longitudinal studies tracking participants 3-6 months post-intervention, combined with behavioral observations in authentic intercultural contexts, represent essential next steps to validate VR's transformative potential in intercultural education.

The window of opportunity to implement effective intercultural education solutions is narrowing as global tensions rise. This study provides the empirical foundation necessary for evidence-based educational innovation, enabling institutions to move beyond ineffective traditional approaches toward technologies that can systematically develop the intercultural competencies essential for global citizenship and peaceful coexistence.

REFERENCES

1. Alpala LO, Quiroga-Parra DJ, Torres JC, Peluffo-Ordóñez DH. Smart Factory Using Virtual Reality and Online Multi-User: Towards a Metaverse for Experimental Frameworks. Appl Sci. 2022;12(12):6258. doi: https://doi.org/10.3390/app12126258.

2. Babych V, Dubovoi O, Zaitsev V, Rydzel Y, Saienko V, Dubovoi V, et al. Improvement of teaching methods of the theoretical component of physical education (with the application of author teaching techniques) in the context of improving the level of social health of students of the special medical group. J Educ Technol Theory. 2022;13(5):1-15.

3. Bashkirova L, Hruzhevskyi O, Tyravska Yu. The first experience of teaching the elective course «instrumental methods of functional diagnostics». Prospects and Innovations in Science. Series Pedagogy, Series Psychology, Series Medicine. 2024;(6(40)):1023-1035. doi: https://doi.org/10.52058/2786-4952-2024-6(40).

4. Baker W. From intercultural to transcultural communication. Lang Intercult Commun. 2021:1-14. doi: https://doi.org/10.1080/14708477.2021.2001477.

5. Bosa V, Marieiev D, Balalaieva O, Krokhmal A, Solovei A. Implementation of virtual reality in foreign language teaching. Rev Amazon Investig. 2024;13(73):187-99. doi: https://doi.org/10.34069/ai/2024.73.01.15.

6. Braslauskas J. Developing intercultural competences and creativity: The foundation for successful intercultural communication. Creat Stud. 2021;14(1):197-217. doi: https://doi.org/10.3846/cs.2021.14583.

7. Chen C, Hung H, Yeh H. Virtual reality in problem-based learning contexts: Effects on the problem-solving performance, vocabulary acquisition and motivation of English language learners. J Comput Assist Learn. 2021. doi: https://doi.org/10.1111/jcal.12528.

8. Chen X, Zou D, Xie H, Wang FL. Metaverse in Education: Contributors, Cooperations, and Research Themes. IEEE Trans Learn Technol. 2023:1-18. doi: https://doi.org/10.1109/tlt.2023.3277952.

9. Demchenko I, Zahariichuk O, Dergach M, Porodko M, Pryzvanska R. The psychological and pedagogical aspect of the life quality of citizens with disabilities. Rev Amazon Investig. 2022;11(54):339-48. doi: https://doi.org/10.34069/ai/2022.54.06.32.

10. DeWitt D, Chan SF, Loban R. Virtual reality for developing intercultural communication competence in Mandarin as a Foreign language. Educ Technol Res Dev. 2022. doi: https://doi.org/10.1007/s11423-021-10074-9.

11. Gong Y. Application of virtual reality teaching method and artificial intelligence technology in digital media art creation. Ecol Inform. 2021;63:101304. doi: https://doi.org/10.1016/j.ecoinf.2021.101304.

12. González-Pérez LI, Ramírez-Montoya MS. Components of Education 4.0 in 21st Century Skills Frameworks: Systematic Review. Sustainability. 2022;14(3):1493. doi: https://doi.org/10.3390/su14031493.

13. Guan JQ, Wang LH, Chen Q, Jin K, Hwang GJ. Effects of a virtual reality-based pottery making approach on junior high school students' creativity and learning engagement. Interact Learn Environ. 2021:1-17. doi: https://doi.org/10.1080/10494820.2021.1871631.

14. Hackett S, Janssen J, Beach P, Perreault M, Beelen J, van Tartwijk J. The effectiveness of Collaborative Online International Learning (COIL) on intercultural competence development in higher education. Int J Educ Technol High Educ. 2023;20(1). doi: https://doi.org/10.1186/s41239-022-00373-3.

15. Huang X, Zou D, Cheng G, Xie H. A Systematic Review of AR and VR Enhanced Language Learning. Sustainability. 2021;13(9):4639. doi: https://doi.org/10.3390/su13094639.

16. Iqbal M, Mangina E, Campbell A. Current Challenges and Future Research Directions in Augmented Reality for Education. Technol Interact. 2022;6(9):75. doi: https://doi.org/10.3390/mti6090075.

17. Katsouda A, Sakkoula N, Manousou E, Lionarakis A. The philosophy of openness in terms of accessibility through virtual worlds: the case of distance education. Futurity Philosophy. 2024;3(4):47-60. doi: https://doi.org/10.57125/FP.2024.12.30.04.

18. Krasnozhon N, Lytvynska S, Senchylo-Tatlilioglu N, Revenko V, Salata H. Development of education and science in the historical industry in the conditions of transformations. Rev Line Politica Gestao Educ. 2022:e022007. doi: https://doi.org/10.22633/rpge.v26i00.16084.

19. Kye B, Han N, Kim E, Park Y, Jo S. Educational applications of metaverse: possibilities and limitations. J Educ Eval Health Prof. 2021;18:32. doi: https://doi.org/10.3352/jeehp.2021.18.32.

20. Lin H, Wan S, Gan W, Chen J, Chao HC. Metaverse in Education: Vision, Opportunities, and Challenges. In: 2022 IEEE International Conference on Big Data (Big Data); 2022 Dec 17-20; Osaka, Japan. IEEE; 2022. doi: https://doi.org/10.1109/bigdata55660.2022.10021004.

21. Liu Y, Shirley T. Without Crossing a Border: Exploring the Impact of Shifting Study Abroad Online on Students' Learning and Intercultural Competence Development during the COVID-19 Pandemic. Learn. 2021;25(1). doi: https://doi.org/10.24059/olj.v25i1.2471.

22. Losheniuk I, Kabanova O, Berher A, Karpenko V, Didyk D. The Future of Virtual Reality in Marketing and Advertising: Benefits and Challenges for Business. Futurity Economics&Law. 2023;3(3):176-89.

23. Maheswari D, Ndruru FB, Rejeki DS, Moniaga JV, Jabar BA. Systematic Literature Review on The Usage of IoT in The Metaverse to Support The Education System. In: 2022 5th International Conference on Information and Communications Technology (ICOIACT); 2022 Aug 24-25; Yogyakarta, Indonesia. IEEE; 2022. doi: https://

doi.org/10.1109/icoiact55506.2022.9971816.

24. Omelchuk M, Maksymchuk B, Ihnatenko S, Navolskyi N, Kitsak T, Vitkovskyi O, et al. Developing Professional Competency in First Aid in Future Coaches in Ukraine. Rev Romaneasca Pentru Educ Multidimens. 2022;14(3):392-411. doi: https://doi.org/10.18662/rrem/14.3/615.

25. Popel S, Mazin V, Maksymchuk B, Saienko V, Chernyshenko T, Maksymchuk I. Network Planning at the Faculties of Physical Education and Sport in the Postmodern Era. BRAIN Broad Res Artif Intell Neurosci. 2023;14(1):554-70. doi: https://doi.org/10.18662/brain/14.1/435.

26. Marougkas A, Troussas C, Krouska A, Sgouropoulou C. How personalized and effective is immersive virtual reality in education? A systematic literature review for the last decade. Multimed Tools Appl. 2023. doi: https://doi.org/10.1007/s11042-023-15986-7.

27. Marougkas A, Troussas C, Krouska A, Sgouropoulou C. Virtual Reality in Education: A Review of Learning Theories, Approaches and Methodologies for the Last Decade. Electronics. 2023;12(13):2832. doi: https://doi.org/10.3390/electronics12132832.

28. Mayer RE, Makransky G, Parong J. The Promise and Pitfalls of Learning in Immersive Virtual Reality. Int J Hum Comput Interact. 2022:1-10. doi: https://doi.org/10.1080/10447318.2022.2108563.

29. Morgulets OB, Derkach TM. Information and communication technologies managing the quality of educational activities of a university. ITLT. 2019;71(3):295-304.

30. O'Dowd R. Virtual exchange: moving forward into the next decade. Comput Assist Lang Learn. 2021;34(3):209-24. doi: https://doi.org/10.1080/09588221.2021.1902201.

31. Onggirawan CA, Kho JM, Kartiwa AP, Anderies, Gunawan AA. Systematic literature review: The adaptation of distance learning process during the COVID-19 pandemic using virtual educational spaces in metaverse. Procedia Comput Sci. 2023;216:274-83. doi: https://doi.org/10.1016/j.procs.2022.12.137.

32. Onu P, Pradhan A, Mbohwa C. Potential to use metaverse for future teaching and learning. Educ Inf Technol. 2023;29(7):8893-8924. doi: https://doi.org/10.1007/s10639-023-12167-9.

33. Papoutsi C, Drigas A, Skianis C. Virtual and Augmented Reality for Developing Emotional Intelligence Skills. Int J Contrib Eng Sci IT (iJES). 2021;9(3):35. doi: https://doi.org/10.3991/ijes.v9i3.23939.

34. Peixoto B, Pinto R, Melo M, Cabral L, Bessa M. Immersive Virtual Reality for Foreign Language Education: A PRISMA Systematic Review. IEEE Access. 2021;9:48952-62. doi: https://doi.org/10.1109/access.2021.3068858.

35. Pushkina N. Developing social skills through rhythmic gymnastics in American sport. Futurity of Social Sciences. 2024;2(2):79-102. doi: https://doi.org/10.57125/FS.2024.06.20.05.

36. Rakhimov T, Mukhamediev M. Implementation of digital technologies in the medicine of the future. Futurity Medicine. 2022;1(2):14-25. doi: https://doi.org/10.57125/FEM.2022.06.30.02.

37. Li Q, Liu Q, Jiang M, Wang R. Virtual reality as a bridge: enhancing intercultural learning and communication skills among international students. Int Commun Chin Cult. 2024. doi: https://doi.org/10.1007/s40636-024-00297-9.

38. Shu X, Gu X. An Empirical Study of A Smart Education Model Enabled by the Edu-Metaverse to Enhance Better Learning Outcomes for Students. Systems. 2023;11(2):75. doi: https://doi.org/10.3390/systems11020075.

39. Rojas-Sánchez MA, Palos-Sánchez PR, Folgado-Fernández JA. Systematic literature review and bibliometric analysis on virtual reality and education. Educ Inf Technol. 2022. doi: https://doi.org/10.1007/s10639-022-11167-5.

40. Zhou X, Tang L, Lin D, Han W. Virtual & augmented reality for biological microscope in experiment education. Virtual Real Intell Hardw. 2020;2(4):316-29. doi: https://doi.org/10.1016/j.vrih.2020.07.004.

41. Hudym I, Abilova O, Potapiuk L, Nikolenko L, Poliakova A. Strategies and best practices for promoting inclusive education to meet diverse learning needs. Conhecimento Divers. 2024;16(42):270-86. doi: https://doi.org/10.18316/rcd.v16i42.11682.

42. Yuhan N, Osipchuk H, Siroshtan T, Prykhodk V, Mytiay Z. Synergy of philological disciplines: combining the vectors of linguistics and literary studies in the context of modern science. SYNESIS. 2024;16(2):19-32.

43. Scavarelli A, Arya A, Teather RJ. Virtual reality and augmented reality in social learning spaces: a literature review. Virtual Real. 2020. doi: https://doi.org/10.1007/s10055-020-00444-8.

44. Safikhani S, Keller S, Schweiger G, Pirker J. Immersive virtual reality for extending the potential of building information modeling in architecture, engineering, and construction sector: systematic review. Int J Digital Earth. 2022;15(1):503-26. doi: https://doi.org/10.1080/17538947.2022.2038291.

45. Soliman M, Pesyridis A, Dalaymani-Zad D, Gronfula M, Kourmpetis M. The application of virtual reality in engineering education. Appl Sci. 2021;11(6):2879. doi:10.3390/app11062879.

46. Deardorff DK. Identification and Assessment of Intercultural Competence as a Student Outcome of Internationalization. J Stud Int Educ. 2006;10(3):241-66. doi: https://doi.org/10.1177/1028315306287002.

47. Lee H, Woo D, Yu S. Virtual reality metaverse system supplementing remote education methods: based on aircraft maintenance simulation. Appl Sci. 2022;12(5):2667. doi: https://doi.org/10.3390/app12052667.

48. Lee S, Jeon J, Choe H. Enhancing pre-service teachers' global Englishes awareness with technology: a focus on AI chatbots in 3D metaverse environments. Tesol Q. 2025;59(1):49-74. doi: https://doi.org/10.1002/tesq.3300.

49. Sipii V, Kurtiak F, Mykhalluk I, Hryhorchuk I, Zasiekina T. Virtual laboratories as a means of increasing accessibility of biological education in Ukraine. Periodicals of Engineering and Natural Sciences. 2024;12(4):627-636. doi:10.21533/pen.v12.i4.64. Available from: https://lib.iitta.gov.ua/744205.

50. Danilyan OG, Arbeláez-Campillo DF, Rojas-Bahamón MJ. The influence of globalization processes on the cultural sphere. Revista de Filosofia. 2022;39(100):143-154.

FINANCING

The authors did not receive financing for the development of this research.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

AUTHORSHIP CONTRIBUTION

Conceptualization: Olena Nevoenna; Kyryl Kotun; Oksana Voznyuk; Yuliia Zaverukha; Natalia Kushevska.
Data curation: Kyryl Kotun; Oksana Voznyuk; Natalia Kushevska.
Formal analysis: Olena Nevoenna; Kyryl Kotun; Oksana Voznyuk.
Research: Olena Nevoenna; Kyryl Kotun; Oksana Voznyuk; Yuliia Zaverukha; Natalia Kushevska.
Methodology: Olena Nevoenna; Kyryl Kotun; Oksana Voznyuk; Yuliia Zaverukha.
Project management: Olena Nevoenna; Kyryl Kotun.
Software: Kyryl Kotun; Oksana Voznyuk; Natalia Kushevska.
Supervision: Olena Nevoenna; Kyryl Kotun.
Validation: Kyryl Kotun; Oksana Voznyuk; Natalia Kushevska; Yuliia Zaverukha.
Visualization: Yuliia Zaverukha; Natalia Kushevska.
Drafting – original draft: Natalia Kushevska; Yuliia Zaverukha.
Writing – proofreading and editing: Olena Nevoenna; Kyryl Kotun; Oksana Voznyuk; Yuliia Zaverukha; Natalia Kushevska.