Journal of
Higher Education Policy
And
Leadership Studies

JHEPALS (E-ISSN: 2717-1426)

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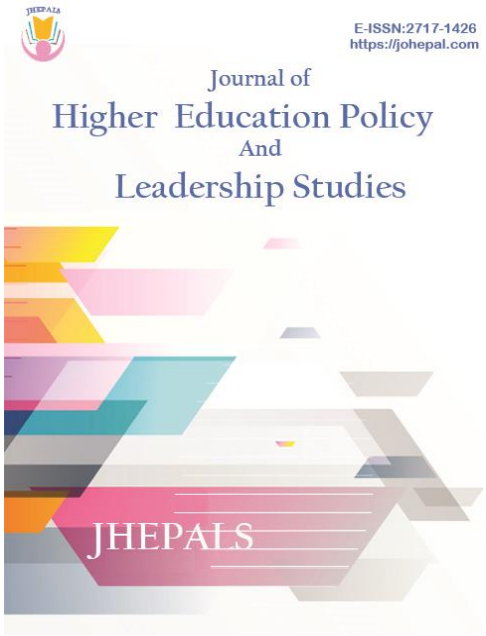

Beyond Role-Play: How Virtual Reality and Artificial Intelligence Transform Leadership Competency Development in Higher Education

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Colloquium Received **2025/01/13** | Colloquium Accepted **2025/09/15** | Published Online **2025/09/30**

Cite colloquium as:

Paul, C., Honal, A., & Beez, D. (2025). Beyond role-play: How virtual reality and artificial intelligence transform leadership competency development in higher education. *Journal of Higher Education Policy and Leadership Studies*, *6*(3), 183-191. https://dx.doi.org/10.61882/johepal.6.3.183

[DOI: 10.61882/johepal.6.3.183]

"Colloquium"

Journal of Higher Education Policy And Leadership Studies (JHEPALS)

E-ISSN: 2717-1426
Volume: 6 Issue: 3
pp. 183-191
DOI:
10.61882/johepal.6.3.183

Beyond Role-Play: How Virtual Reality and Artificial Intelligence Transform Leadership Competency Development in Higher Education

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Highlights

- VR/AI-supported environments significantly outperform traditional role-play in developing leadership competencies among business students.
- Students reported higher competence gains (very large effect size, d = 1.82), stronger engagement, and deeper practical understanding through VR/AI training.
- Immersive, interactive technologies bridge the gap between theory and practice, preparing learners more effectively for real-world leadership challenges.
- Findings provide evidence-based recommendations for integrating VR/AI into higher education curricula while noting ethical and access considerations.

Keywords: Leadership Competencies; Immersive Learning Environment; Higher Education; Virtual Reality (VR); Artificial Intelligence (AI)

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[DOI: 10.61882/johepal.6.3.183]

Introduction

The integration of innovative technologies such as Artificial Intelligence (AI) and Virtual Reality (VR) into higher education offers transformative potential for teaching and learning methods (Guo et al., 2021; Fahimirad & Shakib Kotamjani, 2018; Merchant et al., 2014). By enabling immersive, personalized, and interactive experiences, these technologies go beyond traditional approaches to develop complex skills such as leadership competencies (Qian, 2022; Pellas et al., 2021).

AI enables personalized learning by adapting educational content (Sajja et al., 2024) and streamlining administrative tasks for more efficient teaching (George & Wooden, 2023; Sreen & Majid, 2024). By combining immersive and personalized elements, VR/AI technologies create an ideal environment for developing essential leadership competencies, which are critical in both education and professional contexts. These technologies facilitate deeper reflection through interactive and immersive experiences (Boetje & van Ginkel, 2021; Guo et al., 2021; Knoll & Stieglitz, 2022).

Despite extensive research on VR and AI for technical skill training, limited empirical evidence exists regarding their combined impact on the development of soft skills, particularly leadership competencies (Almasri, 2024). This study examines the effectiveness of VR/AI-supported learning environments compared to traditional role-play methods.

The study aims to answer the following research question: How do VR/AI-supported methods compare to traditional role-play approaches in enhancing leadership competencies among business administration students? The findings of this study contribute to evidence-based recommendations for the integration of AI and VR into university teaching practices (Fernández Jiménez, 2024).

In this study, students were introduced to the theoretical framework of leader–employee relationships and the key aspects of conducting performance reviews. They were then divided into two groups: one group used partner-supported role-playing to conduct performance reviews, while the other engaged in VR/AI-supported environments. This direct comparison facilitates a systematic analysis of participants' perceptions and learning outcomes in both scenarios (Guo et al., 2021; Pellas et al., 2021). Such approaches align with recent findings, where companies are leveraging VR for soft-skill training, including leadership and negotiation, which are challenging to teach in traditional formats (Bousquette, 2024). By bridging theoretical concepts with practical applications, these findings highlight the potential of VR/AI technologies not only for academic training but also for professional development programs in corporate settings.

Leadership Competency in Higher Education Teaching

Leadership competencies are among the core qualifications required across nearly all professional fields (Müller & Turner, 2010). University graduates, particularly those in fields such as business, education, and healthcare, need these skills to lead teams effectively, manage conflicts, and make strategic decisions. However, many graduates in these areas feel inadequately prepared. Studies emphasize that employers often identify deficits in graduates' interpersonal skills, considering this a significant weakness in academic education (Andrews & Higson, 2008; Boetje & van Ginkel, 2021).

[DOI: 10.61882/johepal.6.3.183]

One explanation for this discrepancy lies in the selection and limitations of teaching methods (Freeman et al., 2014). The development of leadership competencies requires practice-oriented approaches, such as role-playing, simulations, and reflective discussions (Doyle & Brown, 2000). Traditional lecture-based formats rarely provide opportunities for such interactive exercises on a sufficient scale. A study by Prince (2004) demonstrates that active learning, which engages students more deeply in the learning process, is significantly more effective than traditional lectures. Despite this, active learning is often overlooked due to the time and resource constraints faced by academic institutions, further complicating the integration of practice-oriented approaches (Boetje & van Ginkel, 2021).

These findings align with Kolb's learning theory (Kolb, 1976; Kolb & Kolb, 2013), which emphasizes the importance of concrete experience, reflective observation, abstract conceptualization, and active experimentation in effective learning. Leadership competencies, which rely heavily on applied knowledge and interpersonal interactions, benefit particularly from such experiential approaches. Traditional methods, such as role-playing, provide partial alignment with Kolb's model by fostering active experimentation and reflection. However, immersive technologies such as VR and AI offer an enhanced experiential framework, enabling students to engage in realistic scenarios that support deeper learning cycles within this framework.

These VR/AI tools create risk-free environments where learners can experiment with new behaviors and improve skills such as emotional regulation and decision-making. AI-driven feedback systems provide real-time insights into communication patterns, highlighting areas for improvement (Rizvi et al., 2023). This is particularly beneficial in areas such as communication and negotiation skills, as these scenarios are often influenced by complex social dynamics (Zak & Oppl, 2022). Moreover, such controlled environments can be more effective than traditional role-playing exercises, as they provide a structured setting where learners can focus on tasks without being distracted by external influences (Figols Pedrosa et al., 2023). Additionally, AI has the potential to deliver personalized feedback and automatically analyze communication patterns, facilitating a more targeted and efficient development of leadership competencies (Guo et al., 2021; Merchant et al., 2014).

Methodology

This study employed an experimental design to evaluate the effectiveness of VR/AI-supported learning scenarios in comparison to traditional role-playing methods for developing leadership competencies (Freeman et al., 2014; Zak & Oppl, 2022). The experimental design was chosen because it allows for a controlled environment to directly compare the two instructional methods while minimizing external influences. Participants were randomly assigned to one of two groups to ensure internal validity and minimize selection bias:

- Group A (VR/AI Group): Students interacted with performance review scenarios in a VR/AI-supported environment.
- Group B (Role Play Group): Students engaged in traditional role-playing exercises using the same initial performance review scenarios.

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Given that all students were in their third year of a business administration program with a uniform academic background and experience level, no additional measures to verify group equivalence were deemed necessary. Since the ratio of men to women in the course was nearly balanced, no specific effort was made to impose a gender quota.

A total of 66 students enrolled in the business administration course "Leadership" at the Cooperative State University (DHBW) Mannheim participated in the study. The study was integrated into the course content while the topic of leadership relationships, particularly leader-employee dynamics, was being theoretically discussed. This alignment aimed to provide practical application opportunities for the theoretical constructs taught in class (Fernández Jiménez, 2024; Boetje & van Ginkel, 2021).

The sample consisted of 33 women and 33 men, all in their third year of study. The participants were drawn exclusively from this course (Andrews & Higson, 2008; Müller & Turner, 2010). Two students discontinued the postsurvey following the experimental study, resulting in a valid distribution of 34 students in Group A (VR/AI) and 32 students in Group B (role play).

Both groups were presented with identical initial scenarios that simulated leader–employee performance reviews. To ensure accessibility and engagement for all participants, the intervention was designed following the “low floor, high ceiling” principle. This approach emphasizes providing an easy entry point for learners while allowing advanced exploration and critical thinking. This principle ensures that both technology-savvy students and those with limited prior experience could fully participate and benefit from the VR/AI-supported scenarios (Ng et al., 2023; Sreen & Majid, 2024; Rizvi et al., 2023). However, the development of each scenario depended on participant interactions and was not predetermined:

- Group A: A brief introductory session familiarized participants with the technology, and assistance was available throughout the sessions to address technical questions. No significant technical issues were reported during the VR/AI sessions, as rigorous pre-testing ensured system reliability and user accessibility. Students used VR headsets and AI-driven interactions to simulate an environment in which they could freely communicate with avatars. In this setting, the students assumed the role of a manager and handled two different scenarios: workplace bullying and the denial of a verbally promised promotion due to failure to meet goals within the given timeframe.
- Group B: Students conducted traditional role-plays with peers assuming the roles of employees and leaders. Each participant received a fully written scenario outlining their role, including specific goals and key discussion points for the leader and employee, ensuring consistency and clarity in the role-playing exercises.

The duration of each scenario varied between five and ten minutes, reflecting the natural flow of the interaction rather than a fixed time frame. This flexibility allowed for a natural progression of interactions, closely mimicking real-world dynamics where the duration of managerial tasks is often unpredictable.

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Results and Discussion

The results demonstrate that VR/AI-supported methods outperform traditional role-playing in developing leadership competencies. However, careful attention must be given to the practical and ethical implications of implementing such technologies in educational settings as discussed in the next section [Check Online Supplement for full details].

The results confirm and extend earlier studies by demonstrating the combined impact of VR and AI on leadership competencies (Zak & Oppl, 2022; Pellas et al., 2021). By bridging theoretical constructs with practical application, VR/AI environments validate Kolb's experiential learning theory in a modern technological context.

These findings suggest significant implications for higher education and corporate training programs, where VR/AI technologies can offer scalable and immersive solutions to address the limitations of traditional methods. Universities and organizations could adopt these tools to better prepare students and professionals for leadership roles, particularly in complex scenarios such as conflict resolution. However, the high initial costs associated with these technologies may pose challenges for institutions with limited budgets (Marougkas et al., 2024). Additionally, these findings suggest that VR/AI can address limitations in conventional methods, such as the lack of interactive elements, thereby enhancing student engagement and motivation. Equitable access to these technologies is essential to prevent disparities among learners (Adetunla et al., 2024). Additionally, training scenarios should ensure inclusivity and avoid stereotypes, especially in avatar design and AI feedback systems (Skulmowski, 2023).

While this study offers valuable insights, it has three primary limitations. First, the relatively small sample size (N = 66) limits the generalizability of the findings. Second, the study focused on immediate post intervention outcomes, leaving questions about the long-term retention of leadership skills. Longitudinal studies are needed to address this gap. Third, the scenarios focused on performance reviews may not represent the full spectrum of leadership challenges.

Future studies should explore diverse contexts, such as strategic decision-making or cross-cultural leadership. Research should explore the long-term retention of leadership competencies developed through VR/AI, investigate varying immersion levels' effects on dimensions like emotional intelligence, and address ethical considerations such as biases in AI feedback and inclusivity in avatar design.

This study demonstrates that VR/AI-supported environments offer a compelling alternative to traditional role-play, paving the way for more innovative and effective approaches to leadership training in both academic and professional settings.

Conclusion

This study highlights the transformative potential of VR/AI technologies in leadership training within higher education. By enabling immersive, interactive, and personalized learning experiences, VR/AI tools offer a compelling alternative to traditional role-play methods. The findings underscore the capacity of these technologies to address critical gaps in current educational practices, paving the way for more effective and engaging approaches to leadership competency development.

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Future research should build on these insights by exploring long-term impacts and broadening the range of scenarios to include diverse leadership challenges. Addressing issues such as equitable access, cost-effectiveness, and ethical considerations, particularly in AI-driven feedback and avatar design, will be crucial for their broader implementation.

In conclusion, VR/AI technologies are not merely supplementary tools but also foundational innovations capable of reshaping leadership education. As these technologies continue to evolve, they hold the potential to redefine how both academic and professional institutions prepare individuals for the complexities of modern leadership.

Declaration of Conflicting Interests

The authors declared no potential conflicts of interest.

Funding

There is no funding to be cited here.

Human Participants

All procedures involving participants complied with the ethical standards of DHBW Mannheim, Germany.

Originality Note

The authors confirm that the manuscript is their original work, and if others' works are used, they are properly cited/quoted.

Use of Generative AI/ AI-assisted Technologies Statement

The author(s) claimed that [ChatGPT] is used in this research just for the purpose of improving the language of the manuscript. No further use of these technologies are also confirmed by the author(s) to write different parts of the research. One native speaker of English is also invited to proof-read the text prior to its online publication.

[DOI: 10.61882/johepal.6.3.183]

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[DOI: 10.61882/johepal.6.3.183]

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