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PAPER

Enhancing Educational Outcomes through the Integration of Virtual Learning Environment

Anwar Alwaalan (✉), Paul Manuel

Kuwait University, Kuwait City, Kuwait

anwar.alwalan@ku.edu.kw

ABSTRACT

This study examines how classroom learning environments (CLE), electronic learning environments (ELE), and virtual learning environments (VLE) compare in supporting Kuwait's evolving education system. A quantitative comparative design surveyed 200 stakeholders (students, instructors, administrators, and parents) with a bilingual, six-dimension instrument (value, engagement, knowledge, psychomotor, attitudes, and assessment) analyzed through descriptive statistics and paired-samples t-tests. Findings show VLEs significantly enhanced knowledge acquisition ($t(111) = 11.11$, $p < .001$; +13.02) and were rated higher in overall value (38% vs. CLE's 24%). CLE, however, was superior for attitude building ($t(111) = -20.71$, $p < .001$; –17.62) and slightly for psychomotor skills ($t(111) = -2.22$, $p = .028$; –1.54). Engagement remained stronger in CLE overall, though VLEs demonstrated clear gains in learner-content and instructor interaction. Assessment was viewed as more reliable in CLE (47% vs. VLE 40%). ELE consistently underperformed across dimensions. These results suggest that while VLEs cannot fully replace the strengths of CLE in shaping attitudes and skills, they provide clear advantages in knowledge retention and perceived value. A blended model that leverages VLE innovations while retaining CLE's interpersonal and practical benefits appears to be the most effective path for Kuwait's educational reform.

KEYWORDS

classroom learning environment (CLE), electronic learning environment (ELE), virtual learning environment (VLE), virtual reality, educational technology, student engagement

1 INTRODUCTION

Education is evolving with technological advances and shifting student needs. The COVID-19 pandemic accelerated the adoption of electronic learning environments (ELEs), but in Kuwait, education—especially in public schools—remains focused on traditional classroom learning environments (CLEs). The rapid move to ELEs exposed weak digital infrastructure and insufficient teacher preparation, leading to reduced learning outcomes. With innovations such as extended reality (XR) and

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virtual learning environments (VLEs), education is becoming more immersive and interactive, supporting deeper engagement and knowledge retention. These technologies are reshaping traditional structures to be more creative and collaborative.

1.1 Statement rational

This research investigates how VLEs can modernize Kuwait's education system by enriching traditional methods. VLEs provide simulations, virtual labs, and gamified elements that support individualized learning, critical thinking, and practical application. In a system still dominated by conventional methods, integrating VLEs offers a chance to align with global practices. The study evaluates the impact of VLEs on academic performance, engagement, and inclusivity, aiming to guide policymakers and educators in adopting advanced technologies.

1.2 Research hypothesis

This study hypothesizes that VLEs can eventually replace CLEs in certain aspects of university education. Specifically, VLEs are expected to outperform CLEs in knowledge acquisition and skills development by offering diverse digital resources, interactive models, and virtual labs that support immersive, self-paced learning. However, CLEs are anticipated to remain superior in attitude building, as they provide face-to-face interaction, interpersonal engagement, and emotional connections that are difficult to replicate in virtual settings.

1.3 Research objectives

The objective of this study is to evaluate the comparative effectiveness of CLEs and VLEs in supporting student outcomes. It seeks to examine how each environment influences performance across different situations, assess the feasibility of integrating VLEs within Kuwait's educational system, and determine the conditions under which VLEs could serve as a viable alternative or complement to traditional classrooms.

1.4 Research questions

This study addresses the following questions:

R1: How does the implementation of VLEs in Kuwait's educational system affect students' engagement compared to CLEs?
R2: In what ways do VLEs influence students' knowledge acquisition, skills development, and attitude building?

2 LEARNING ENVIRONMENTS EVOLUTION

Traditional classroom learning, i.e., CLE, relies on face-to-face instruction, direct feedback, and peer interaction, fostering discipline and social skills. However, it is limited by infrastructure and fixed schedules. The emergence of electronic learning, i.e., ELE, expanded access beyond classrooms, offering flexibility, multimedia

resources, and self-paced study. Despite these benefits, ELE often reduces interpersonal engagement and requires digital literacy and stable Internet access. Building on ELE, VLEs integrate immersive technologies such as augmented and virtual reality (VR), offering interactive, student-centered experiences that enhance engagement and retention.

2.1 COVID pandemic and E-learning

The COVID-19 pandemic accelerated global adoption of ELE as institutions sought to maintain continuity. While convenient, ELE struggled to replicate interactive classroom dynamics, leading to isolation, lower motivation, and uneven outcomes. Digital inequality further limits access for many students. In Kuwait, the sudden shift exposed gaps in readiness and teacher training, resulting in academic setbacks and negative perceptions of e-learning. These shortcomings highlight the need for more resilient and immersive systems such as virtual learning environments.

2.2 C-learning and E-learning

Classroom learning environments excels in real-time interaction, personalized feedback, and social engagement but lacks flexibility. ELE offers accessibility and cost advantages, but it cannot fully replace the immediacy and affective qualities of classroom learning. Both models have strengths and limitations, and their comparison underscores the potential of VLEs to combine flexibility with interactive depth.

2.3 Virtual learning environment

Advances in VR, augmented reality (AR), and XR have enabled VLEs to simulate real-world experiences and enrich learning. VR immerses learners in safe, scenario-based environments; AR overlays digital elements onto the physical world to visualize complex concepts; and XR combines these approaches into interactive, flexible spaces. Together, these technologies promote experiential and personalized learning, with applications across science, medicine, and technical education.

2.4 Educational foundations

Effective VLEs must align with educational theory. Learning styles (auditory, visual, and kinesthetic) demonstrate the need for diverse instructional approaches, while Bloom's Taxonomy highlights progression from basic recall to higher-order thinking. The domains of learning—cognitive, affective, and psychomotor—frame outcomes such as knowledge, attitudes, and skills. These foundations support the study's focus on evaluating VLEs through six educational metrics: value, knowledge acquisition, engagement, psychomotor skills, attitude, and assessment.

3 LITERATURE REVIEW

The basic metrics to assess a learning environment model are value, engagement, knowledge, psychomotor, attitude, and assessment. This section provides a comprehensive literature review of these metrics.

3.1 Value

Virtual learning environments provide value through lower costs, improved instructional quality, and greater flexibility. They reduce dependence on physical resources and make education accessible across time and place, supporting students who require self-paced learning [1]–[2].

3.2 Engagement

Virtual learning environments promote interaction on several levels: between students, between students and instructors, and between students and contents. Tools such as discussion forums and real-time feedback systems encourage collaboration and participation. However, digital engagement can never truly replicate the immediacy and the impact of face-to-face exchanges [3].

3.3 Knowledge

Immersive features of VLEs, including simulations and 3D models, support comprehension and retention of abstract concepts. Students can apply knowledge to practical scenarios, which helps to strengthen problem-solving and critical thinking skills [4].

3.4 Psychomotor

Psychomotor skills encompass the ability to execute physical actions that require coordination, precision, and motor control. These skills typically involve both fine and gross motor movements, such as hand-eye coordination and manual dexterity, and are often developed through repeated practice and guided instruction. Activities like playing musical instruments, performing surgical procedures, or participating in athletic tasks exemplify psychomotor competencies. While communication and leadership are vital in educational and professional contexts, they are generally categorized under the cognitive and affective domains rather than the psychomotor domain, as they rely more on mental processing and emotional engagement than physical execution [8] [9]. They are reinforced in VLEs through collaborative tasks, leadership opportunities, and creative applications such as virtual design tools. While some platforms include movement-based modules, physical skills remain less emphasized compared to cognitive development [5].

3.5 Attitudes

The influence of VLEs on attitudes such as respect, empathy, and ethical responsibility depends on how they are used. Limited non-verbal communication restricts emotional interaction, and issues of access and data protection continue to raise concerns [6].

3.6 Assessment

Assessment practices benefit from digital portfolios, automated testing, and interactive assignments. These tools allow for frequent feedback, flexible evaluation, and better monitoring of student progress [7].

4 RESEARCH METHODOLOGY

4.1 Research design

A quantitative, comparative design was employed to examine the effectiveness of CLE, ELE, and VLE. The study evaluated these environments across six educational metrics: value, engagement, knowledge acquisition, psychomotor skills, attitudes, and assessment.

4.2 Participants

The sample included 200 participants from Kuwait, representing four stakeholder groups: students (35%), instructors (35%), parents (15%), and administrators (15%). The gender distribution was balanced (50% male, 50% female), with participants drawn from public and private institutions across different regions.

4.3 Instruments

Data were collected using a bilingual (Arabic and English) questionnaire structured around the six metrics. Each metric was divided into indicators, and responses were recorded on a 5-point Likert scale (1 = Strongly Disagree to 5 = Strongly Agree).

4.4 Data collection

Printed questionnaires were distributed in person to ensure clarity and respondent support. Ethical standards were observed; informed consent was obtained from adults, and both parental consent and child assent were secured for minors. Participation was voluntary.

4.5 Data analysis

Responses were coded and organized in Excel, then analyzed using Python (NumPy, SciPy, and scikit-learn libraries). Descriptive statistics (means, standard deviations) were calculated and paired-sample *t*-tests were performed to compare CLE and VLE across metrics.

4.6 Metrics and indicators

Indicators for each metric were derived from recent literature and aligned with recognized educational frameworks such as Bloom's Taxonomy and the domains of learning (cognitive, affective, and psychomotor).

5 RESULTS AND DISCUSSION

The study compared CLE, ELE, and VLE across six metrics: value, knowledge acquisition, engagement, psychomotor skills, attitudes, and assessment.

5.1 Key findings

1. **Knowledge Acquisition:** VLE significantly outperformed CLE ($t(111) = 11.11$, $p < .001$; mean difference = +13.02). This confirms the hypothesis that immersive and flexible virtual platforms improve retention and comprehension.

Table 1. Paired t-test results for hypothesis 1

Metric	Mean Difference (VLE – CLE)	t-Statistic	Degrees of Freedom	p-Value	Supported?
Knowledge Acquisition	13.02	11.11	111	< 0.001	Yes. VLE significantly outperforms CLE
Skills Development (Psychomotor)	–1.54	–2.22	111	0.028	No. CLE slightly outperforms VLE
Attitude Building	–17.62	–20.71	111	< 0.001	Yes. CLE significantly outperforms VLE

2. **Psychomotor Skills:** CLE slightly outperformed VLE ($t(111) = –2.22$, $p = .028$; mean difference = –1.54). Though the difference is small, it is statistically significant, indicating that hands-on classroom practice still develops physical and practical skills more effectively than virtual simulations.
3. **Attitude Building:** CLE strongly outperformed VLE ($t(111) = –20.71$, $p < .001$; mean difference = –17.62). This emphasizes the role of face-to-face interaction and real-time emotional engagement in shaping values, empathy, and responsibility.
4. **Overall Distribution Across Metrics:** When comparing all three environments, VLE and ELE were rated highest in *Value* (38% each), while VLE led in *Knowledge Acquisition* (42%). CLE dominated *Engagement* (43%), *Psychomotor Skills* (52%), and *Attitude* (54%), and remained slightly ahead in *Assessment* (47%).

Table 2. Summary of learning environment performance

Metric	CLE (%)	ELE (%)	VLE (%)
Value	24	38	38
Knowledge	38	20	42
Engagement	43	20	37
Psychomotor	52	14	34
Attitude	54	12	34
Assessment	47	13	40

5.2 Interpretation

These results partially support the hypothesis. VLE offers a clear advantage in knowledge acquisition, but CLE remains superior in psychomotor skills and attitude building. This suggests that while VLE is effective for cognitive outcomes, it does not yet replicate the interpersonal depth and tactile experiences of traditional classrooms.

A notable counterpoint is that although VLE nearly matched CLE in assessment (40% vs. 47%), it was perceived as less credible for tasks requiring real-time monitoring, highlighting ongoing trust issues with virtual evaluations.

Eelectronic learning environment consistently scored lowest across metrics, reinforcing its role as a transitional model rather than a long-term solution.

Similarly, Sanusi et al. [8] found that well-designed immersive environments can strengthen psychomotor learning through multimodal feedback and haptic interaction, suggesting that technology-enhanced settings could complement traditional practice.

5.3 Practical implications

These findings point toward the potential of blended learning models, combining VLE's strengths in flexibility and knowledge building with CLE's advantages in practical skills and emotional engagement. Such integration could provide a balanced framework for advancing education in Kuwait.

6 CONCLUSION AND FUTURE WORK

The study compared CLE, ELE, and VLE across six educational metrics. Findings show that CLE remains strongest in attitude building, peer collaboration, and practical skills, while VLE excels in knowledge acquisition and learner-content engagement, with promising potential in learner-instructor interaction. The statistical analysis confirmed significant differences across learning environments, supporting the hypothesis that a hybrid model offers the best outcomes. Overall, results indicate that VLE cannot fully replace CLE but is most effective when integrated into a hybrid model. Integrating cognitive, affective, and psychomotor domains within interactive STEAM tasks promotes not only technical precision but also creativity and critical reflection in learners [9].

6.1 Limitations

The study did not address safety concerns such as data privacy or digital well-being. Additionally, the sample excluded elementary and middle school students, limiting findings to high school and university contexts.

6.2 Future work

Future work will extend to younger learners and emphasize the integration of safety and ethical considerations in the use of VLEs. Virtual environments represent only a small part of artificial intelligence (AI). The influence of AI on education is remarkable. Researchers anticipate that AI will fundamentally transform educational platforms [10] [11]. This study is an initial step rather than a conclusion. Naturally, future research will focus on AI-based educational learning platforms. As technology advances and adoption of virtual platforms increase, VLEs are expected to play a central role in education, supporting more immersive and accessible learning worldwide.

7 REFERENCES

[1] M. Casini, "Extended reality for smart building operation and maintenance: A review," *Energies*, vol. 15, no. 10, p. 3785, 2022. https://doi.org/10.3390/en15103785

[2] K. T. Huang, C. Ball, J. Francis, R. Ratan, J. Boumis, and J. Fordham, "Augmented versus virtual reality in education: An exploratory study examining science knowledge retention when using augmented reality/virtual reality mobile applications," *Cyberpsychology, Behavior and Social Networking*, vol. 22, no. 2, pp. 101–169, 2019. https://doi.org/10.1089/cyber.2018.0150

[3] L. Caprara and C. Caprara, "Effects of virtual learning environments: A scoping review of literature," *Education and Information Technologies*, vol. 27, pp. 3683–3722, 2022. https://doi.org/10.1007/s10639-021-10768-w

[4] C. Weng, R. Chu, S. M. Christianto, and S. Otanga, "Enhancing students' biology learning by using augmented reality as a learning supplement," *Journal of Educational Computing Research*, vol. 58, no. 4, pp. 747–770, 2019. https://doi.org/10.1177/0735633119884213

[5] D. Rohendi, M. O. Ramadhan, S. S. A. Rahim, and H. Zulnaidi, "Enhancing student's interactivity and responses in learning geometry by using augmented reality," *Eurasia Journal of Mathematics, Science and Technology Education*, vol. 21, no. 1, 2025. https://doi.org/10.29333/ejmste/15796

[6] P. Steele, C. Burleigh, M. Kroposki, M. Magabo, and L. Bailey, "Ethical considerations in designing virtual and augmented reality products—virtual and augmented reality design with students in mind: Designers' perceptions," *Journal of Educational Technology Systems*, vol. 49, no. 2, pp. 219–238, 2020. https://doi.org/10.1177/0047239520933858

[7] N. I. Lestari and D. Rosana, "Augmented reality based on learning assessment," in *Proceedings of the 6th International Seminar on Science Education (ISSE 2020)*, 2021, pp. 641–647. https://doi.org/10.2991/assehr.k.210326.093

[8] S. Limbu, "Fostering peer evaluation and cognitive, affective, and psychomotor (CAP) domains in school level science education: A critical reflection on the STEAM approach," *International Journal of Research in Education and Science*, vol. 10, no. 2, pp. 446–472, 2024. https://doi.org/10.46328/ijres.3403

[9] K. A. M. Sanusi, D. Iren, N. Fanchamps, M. Geisen, and R. Klemke, "Virtual virtuoso: A systematic literature review of immersive learning environments for psychomotor skill development," *Educational Technology Research and Development*, vol. 73, pp. 909–949, 2025. https://doi.org/10.1007/s11423-025-10449-2

[10] J. Garzón, E. Patiño, and C. Marulanda, "Systematic review of artificial intelligence in education: Trends, benefits, and challenges," *Multimodal Technologies and Interaction*, vol. 9, no. 8, p. 84, 2025. https://doi.org/10.3390/mti9080084

[11] P. Dubey and V. Kanaskar, "The role of artificial intelligence and education research: Current trends & future prospects," *Journal of Research & Method in Education*, vol. 15, no. 3, pp. 28–40, 2025.

8 AUTHORS

Anwar Alwaalan is a graduate of Kuwait University, Kuwait, with an M.S. in Computing Information Systems (E-mail: anwar.alwalan@ku.edu.kw).

Paul Manuel is a Professor in the Department of Information Science, Kuwait University, Kuwait.