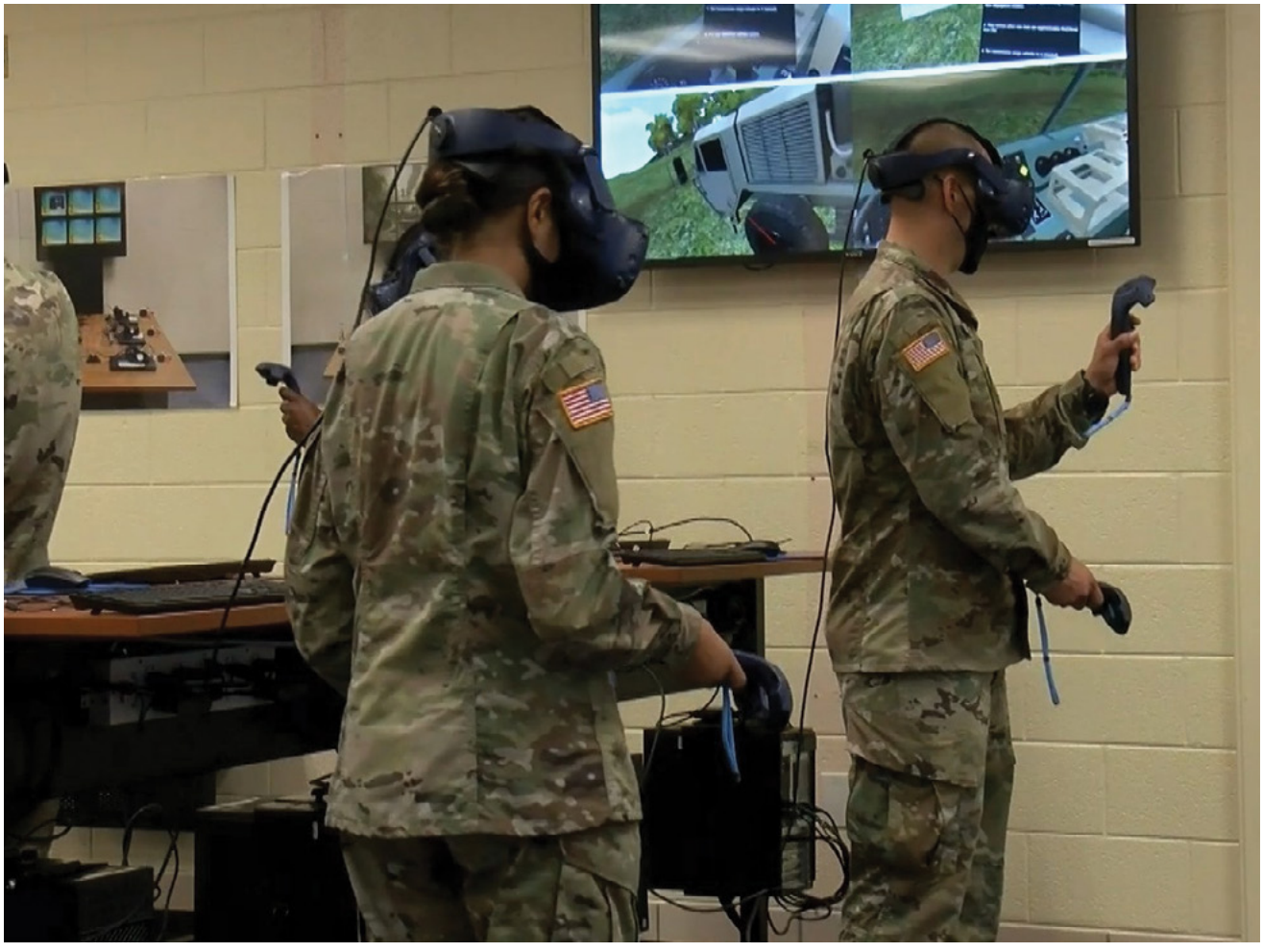

The U.S. Army Quartermaster School's Petroleum and Water Department pioneered the Army Virtual Learning Environment in October 2021 for fuel, water, and laboratory specialists. Benefits included cost savings, more efficient and effective use of instruction time, and a continual learning capability that increased proficiency and readiness of all Army components. (Photo by Capt. Chris Lancia)

Blended Learning: Retention and Engagement

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This article uses a comprehensive literature review to examine the impact of implementing blended military and civilian learning on knowledge retention and learner engagement. "Blended learning, a combination of online and face-to-face instruction" became increasingly relevant due to global crises such as COVID-19 and the Russia-Ukraine war.[1] These events have reinforced the necessity for flexible, technology-enhanced learning models to support military and civilian operational readiness and professional development. The review presents recent research from 2019 to 2024. The article is structured to answer the core research question: What impact does the implementation of blended military and civilian training have on knowledge retention and learning engagement?

> **Instructors supported students' personal studies, facilitated face-to-face group discussions, and offered individual coaching and feedback to ensure students experienced personalized learning.**

Knowledge Retention

Findings

Blended learning (BL) enhances knowledge retention, which refers to the participants' ability to remember and apply the information, concepts, and skills learned during the training program over time. It is particularly beneficial for military personnel and Army civilians, as it allows flexible, self-paced access to content and reinforces learning through various formats.[2]

Support

Appiah-Kubi et al. write about the importance of the BL formats in civilian engineering education during an emergency like COVID-19.[3] The authors show the harmonizing benefits of BL and how it accommodates students' learning styles, improves engagement, supports knowledge retention, and improves outcomes.[4] The article describes how BL combines online and face-to-face classroom learning, utilizing the strengths of both formats. The authors present three general BL formats: (1) The online preparation for face-to-face sessions at the end of the same week; (2) The online follow-up conducted after face-to-face sessions to reinforce and expand on the content covered during the in-person classes; and (3) The online elements during traditional classroom sessions when online tools and simulated environments are integrated into face-to-face courses.[5] The article provides several examples of how BL supports knowledge retention. Students can watch recorded lectures or class discussions to review difficult topics and better remember what they have learned to improve comprehension.[6]

Compared to traditionally taught classes, where students relied only on their memories and notes, the BL strategy showed higher learning satisfaction rates and preference for the BL.[7] Online resources like study materials and tutorial videos published on the learning management system gave students references for future assignments and projects, allowing them to improve their knowledge retention.[8] BL introduced technologies and prepared students for professional transitions by familiarizing them with digital tools like Zoom and Microsoft Teams, which are used daily in workplace environments.[9]

O'Neal et al. examine an asynchronous "just-in-time" online learning program that allows service members to engage with the course material conveniently.[10] The program taught financial accountability to military service members during critical life transitions that could be shared with their family members, reflecting the program's broader goal of positively influencing military families.[11] The adaptive teaching methods included tailoring content to address general financial topics, like family budgeting and military-specific information relevant to life transitions related to a permanent change of station.[12] The program's online format allowed service members to learn the material at their own pace and repeat

content as needed, with the opportunity to revisit it after completion, improving knowledge retention and learning engagement.[13]

Smith et al. describe three strategies that support knowledge retention by promoting better student interaction and content understanding.[14] Repetitions helped instructors adjust their teaching strategies using continuous reflection and feedback. It made the content easier for students to understand and adjust to their changing needs.[15] By connecting teaching methods with students' learning preferences, the repetitive approach helped students retain knowledge.[16]

The chunking teaching method was used to divide online teaching material classes into smaller "25–30-minute units to increase students' attention" and reengage them using pre-work, interactive, and reflective activities.[17] This approach helped students effectively manage their time and focus on the main concepts, promoting knowledge retention.[18] Another teaching strategy that encouraged social connections was also successfully used during the pandemic. Instructors actively supported students in sharing their life and work experiences and created opportunities to join informal group discussions.[19] This approach helped students feel included and created a supportive online environment for understanding and long-lasting memories.[20]

The chunking teaching method, the hybrid-flexible "HyFlex" model, where students were allowed to choose the mode of class participation, and the "Read-Watch-Do-Discuss" technique described in the article, are not exclusive to military students.[21] Though the study focused on the United States Military Academy during COVID-19, the strategies can be successfully used in Army civilian training. The strategies are referred to by Strawn as the specialized professional development opportunities and training provided to civilian employees and are echoed by Smith et al. to enhance employee performance, effectiveness, participation, and knowledge retention.[22]

Additionally, Fisher et al. and Smith et al. examine the implementation of the flipped model in BL education. This instructional technique is commonly used in BL environments to increase critical thinking and long-term content mastery in both military and civilian training settings, where military training refers to the process of preparing military personnel to effectively perform their duties in conflict situations.[23] Both Fisher et al. and Smith et al. describe the flipped model in BL education as an instructional technique to improve problem-solving, decision-making, student engagement, and performance.[24] Fisher et al. advocate that investing in digital technology, such as online videos and interactive modules, provides repeated exposure to experiential knowledge and increases memory of complex concepts.[25]

Smith et al. write that balancing online instructions with collaborative traditional face-to-face lessons is important for maintaining student engagement, receiving immediate feedback, reinforcing knowledge, improving mental health, and facilitating effective learning outcomes.[26] Face-to-face interactions provided opportunities for personal connections and positively impacted mental health, especially during periods of social isolation caused by the pandemic.[27] Hence, balancing online and traditional instruction can improve knowledge retention and learning engagement and address students' diverse educational and welfare needs.[28]

Learner Engagement

Findings

Blended learning environments increase learner engagement, which is defined by Weiser as the active participation and collaboration of participants in BL.[29] It encourages interactivity, supports diverse learning styles and personal learning, and integrates group learning strategies.

Support

Strawn applies the Army learning model to blended training, showing that integrating online and in-person experiences promotes active participation, leadership development, and critical thinking.[30] For Army civilians, particularly those in leadership and administrative roles, the mix of digital forums and instructor-led sessions led to sustained engagement and higher completion rates. Strawn conducted a qualitative case study exploring how ten instructors working remotely for the School for Family and Morale, Welfare, and Recreation, located at the Joint Base in San Antonio, Texas, transitioned to using

the Army University Experiential Learning Model (ALM) for curriculum design and delivery.[31] The instructors were formally trained through the faculty development program and studied necessary skills using ALM.

The study captures instructors' professional and emotional shift from initial resistance to eventual support of the ALM based on David Kolb's experiential learning model.[32] After learning how to use ALM, instructors moved on to adapt the model while teaching themselves. Some instructors reported feelings about the model's limitations in creative freedom while facilitating and designing the lessons.[33] Moreover, some spoke about difficulties with specific steps, such as adapting to teach concrete experience since it requires provoking learners' emotional responses before studying the content; in the end, instructors communicated increased student engagement and improved learning outcomes.[34] Therefore, despite the challenges described in the study, it offers important discoveries about adopting experiential learning models in military and civilian education.

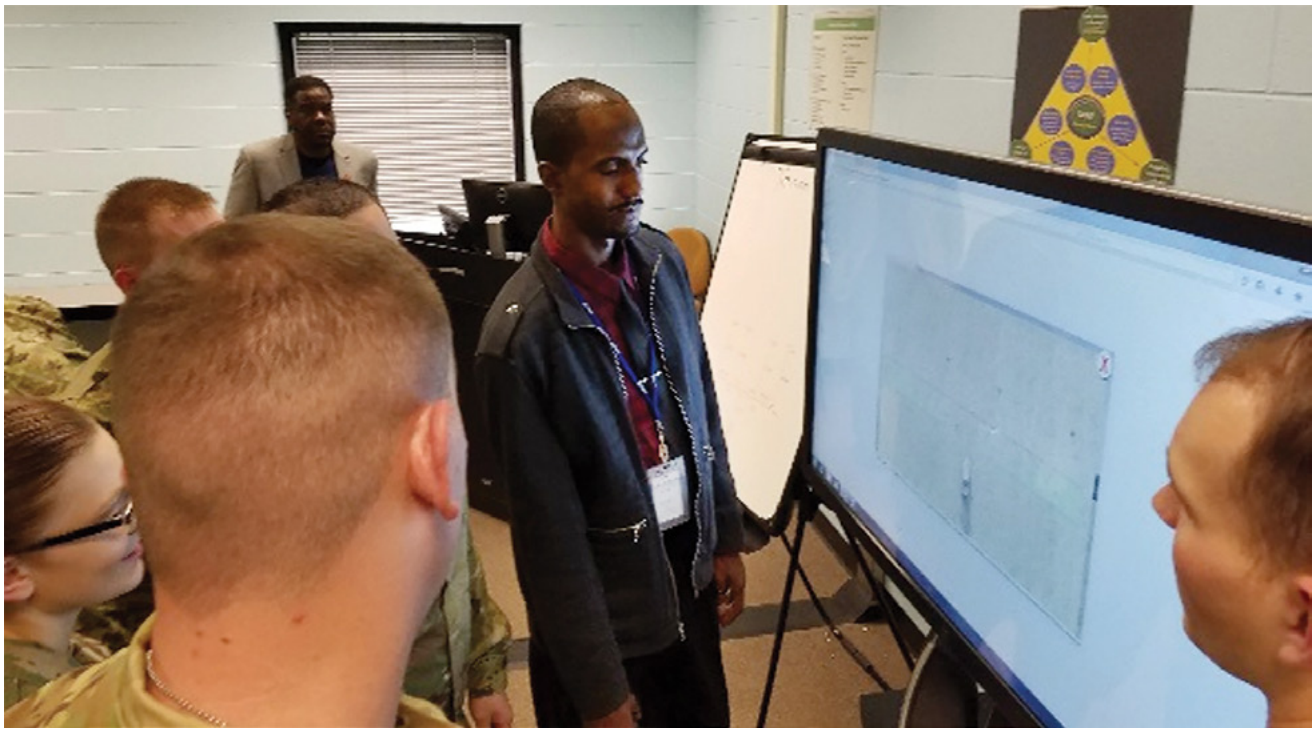
"The Army learning platforms support synchronous and asynchronous studies, including web conferences, allowing for synchronous lectures and facilitating interaction between students and instructors to ensure continuity in education."

Weiser provides examples of how the BL approach enhances learning in diverse ways to support military and civilian training.[35] The article presents a case study with self-taught learning and face-to-face teaching. Students worked independently, absorbed knowledge, and later, during face-to-face sessions, received instructor feedback and guided reflection.[36] The self-learning experience often included interactive exercises, working with multimedia, and explanatory learning videos, encouraging participants to self-reflect and respond to the content.[37] The tasks helped learners to adapt new learning to their work environment, encouraging practical application and experiential learning.[38]

Instructors supported students' personal studies, facilitated face-to-face group discussions, and offered individual coaching and feedback to ensure students experienced personalized learning.[39] They divided students into small groups to promote student engagement and collaboration.[40] The case study learning arrangement allowed peer-to-peer discussions and enhanced students' knowledge using feedback from peers and instructors alike.[41] The program was conducted online and allowed students to participate anytime, from anywhere, learning at their own pace.[42] Thus, the BL approach combined diverse methods and tools such as Learning Management Systems along with the Sharable Content Object Reference Model, emails, video messaging, and explanatory videos to support their study and created a comprehensive, engaging, and practical learning experience.[43]

Lee-Tauler et al. discuss a pilot evaluation of the military Chaplains-CARE online program.[44] The program was a self-paced, asynchronous learning experience. Over 90 percent of the learners answered that the course was helpful and that they learned new skills, and over 80 percent would recommend the course to their peers.[45] The study shows that despite the success of the course, chaplains recommended incorporating blended learning into the Chaplains-CARE program. Specifically, some chaplain learners suggested adding experiential learning opportunities such as in-person workshops, simulations, and interactive role plays.[46] The recommendations shows that BL would enhance the effectiveness of the training by providing real-time instructors with peer-to-peer feedback, hands-on practice valued by students, and increased learning engagement.

Shahbodaghi and Farnell, while not explicitly mentioning BL, write about the importance of including discussions about real-world operational and deployment experience analysis by medical residents while in training, benefiting from the official and unofficial curriculum that includes the values, lessons, and perspectives of different service branches' members sharing their experiences.[47] The course



An instructor and students of the 92-Foxtrot Petroleum Supply Specialist Course at Fort Lee observe and talk their way through a training scenario being presented on a touch-screen television 9 March 2017. The session is part of a "Blended Learning Experiment" that places more emphasis on the use of digital technology and group conferencing, as opposed to instructor-led lectures and PowerPoint slide presentations. Leaders of the Quartermaster School Petroleum and Water Department course gave the experiment high marks, saying it creates a "competitive learning environment" that appeals to the current generation of digitally minded advanced individual training students. (Photo by Lesley Atkinson)

leadership training included traditional classroom instruction and practical, hands-on experiences in real-world settings. When military graduate medical education residents are placed in leadership roles early in their careers, there is practical application of their training on how to quickly assume leadership roles and learn how to make decisions in stressful situations.[48] This training indicated that experiential learning was a significant component of leadership training, where traditional classroom instruction blended theoretical knowledge with experiential.[49]

Pham and Sampson highlight how artificial intelligence tools in BL platforms personalize content delivery based on learner behavior, enhancing participation.[50] Pham and Sampson discuss examples of AI tools tailoring learning based on students' learning behavior and enhancing learning experiences through personalization.[51] The authors provide an example of an AI adaptive learning program at Arizona State University, which is often visited by Department of Defense civilians because of AI research. The example shows how AI helped students struggling with math improve by passing "rates from 66% to 75%" and reducing "dropout rates by 7%."[52] Pham and Sampson and Qu et al. also examine AI in assisting in BL experiences and suggest that AI provide significant support for the BL environment.[53] Pham and Sampson's and Qu et al.'s research has shown that AI can contribute to personalized learning experiences and instructor training.[54] Qu et al. determine that AI helps collect learners' educational data that, in the future, could improve students' and instructors' training experiences.[55] The authors propose different AI platforms to assist training and state that AI could potentially enhance student learning engagement and knowledge outcomes.[56]

Another example described in the article was language learning with Duolingo. AI-driven platforms like Duolingo enabled learners to complete the equivalent of a first-semester college Spanish curriculum in just "8 weeks by putting in 34 h. of practice time per week."[57] These examples demonstrate how AI tools analyze learner behavior and adapt content delivery to improve student engagement and outcomes. In

Army-civilian contexts, adaptive technologies can help tailor professional development modules for civilians in acquisition, human resources, and technical fields. Adaptive technologies use AI-driven analytics to personalize learning experiences, track students' progress, address individual skill gaps, and enhance workforce readiness and efficiency.[58]

Other Findings

Blended Learning as Adaptive Education in Crisis

Zhumbei et al. analyze training delivery during the Russo-Ukrainian war and find that BL enables continued professional military and civilian education even in wartime.[59] For Army civilians deployed or supporting operations overseas, blended learning offers flexibility in "integrating calendar and thematic planning."[60] Flexibility planning is helpful in wartime when students can experience frequent disruptions in learning. Online accessibility, using synchronized and asynchronous learning models, allows students to utilize educational materials anytime and anywhere.[61] Flexible planning permits students to study and use their own time effectively and revisit the material as needed, enabling learners to continue their professional development while maximizing the effectiveness of limited time and resources.[62] Establishing flexible submission deadlines and opportunities for face-to-face consultations with mental health professionals using videoconferences can help sustain learning motivation and provide stress management tools during wartime.[63]

BL also promotes the development of professional digital literacy, competencies, resourcefulness, and innovation among instructors and students, preparing Army civilians for the increasing use of educational technology in a constantly evolving operational environment.[64] These examples illustrate how BL adapts to challenging times, ensuring continuity, flexibility, and educational quality. Strategies described by the authors and used during the Russo-Ukrainian war make BL a practical and adaptive solution for Army civilians to continue their professional growth during overseas operations and answer the article's thesis question.

Integration of ICT and VR Enhances Learning Outcomes

Osodlo et al. find that BL, when combined with traditional methods with information and communication technologies tools, considerably improved language training outcomes for Ukrainian officers learning a foreign language.[65] Information and communication technologies tools like the management learning system Moodle, virtual classrooms, webinars, chatrooms, blogs, online interviews, discussion forums, and Internet resources enable personalized learning and individual studies, saving travel time and money and providing effective online collaboration.[66] The information and communication technologies tools also supported innovative methods like flipped classrooms, case studies, and real-world experiential learning, improving students' learning motivation, foreign language communicative competence, and professional readiness.[67] For Army civilians in global support roles, this model can assist in technical communication and improve digital literacy, cultural awareness, and negotiation skills.

Sudiarno et al. demonstrate that virtual reality (VR) shooting simulation games provide realistic environments for practicing major skills, like shooting accuracy and precision, with an excellent system usability score rate over eighty, with the system usability score scale ranging from 0 to 100.[68] The study records the ability of VR to effectively replicate real-world conditions and offer flexible and evolving training environments.[69] Applying VR technologies to civilian safety, maintenance, or engineering roles training could enable safe, cost-effective simulation and review of critical procedures. VR civilian drills can reduce risks, eliminate the need for physical resources, and allow practicing to improve real-world performance, making simulations ideal for industries requiring accuracy and safety.[70] Integrating information and communication technologies and VR enhances learning outcomes by providing flexible, interactive, and immersive environments that improve engagement and skill development. For Army civilians working globally, information and communication technologies and VR models can enhance technical communication and improve intercultural interactions by practicing real-world scenarios

through immersive experiences such as multinational missions or negotiations, allowing learners to develop practical skills and confidence in applying them.[71]

Role of Administrative and Faculty Support

Fan et al. emphasize that institutional support, including digital infrastructure and faculty development in distributed learning, is key to implementing educational technologies.[72] The article discusses both online and BL programs. It examines students' challenges and support structures in both learning modes. The authors emphasize that institutional, school-level, subject-teacher, peer, work colleagues, and family support is important for student motivation, engagement, and knowledge retention.[73] The study compares the experiences of asynchronous online students and BL ones. It concludes that BL students often benefit from diverse support, including traditional face-to-face interactions that are not always available to online students. Fan et al. also stress that institutional support, including digital infrastructure and faculty development, is critical for the success of online and BL programs.[74] Effective organizational support systems should be proactive, transparent, and tailored to the needs of online and BL students and teachers.[75] Faculty development in improving distributed learning and taking digital literacy classes enhances student engagement and retention.[76] The study finds that subject-level teacher support, including content design, pedagogical strategies, and teacher-student exchanges, is the most significant factor influencing student online and BL success.[77]

Ionașcu also points out the critical role of digital infrastructure in ensuring the success of online systems through facilitating modern learning tools, such as Army platforms for digital learning.[78] The Army learning platforms support synchronous and asynchronous studies, including web conferences, allowing for synchronous lectures and facilitating interaction between students and instructors to ensure continuity in education.[79] The reliable digital infrastructure support tools like the OU-Analyze software developed in the United Kingdom uses predictive learning analytics to identify students at risk of failure and helps institutions personalize learning to improve student engagement and knowledge retention.[80]

At the international level, digital infrastructure enables the massive open online courses that facilitate access to important online materials and resources.[81] The massive open online courses support NATO interactive environments through different digital tools like chat boxes, video lectures, and collaborative applications, enhancing student engagement and teamwork.[82] The tools also help to create dynamic learning environments that are accessible and effective for civilian and military education systems worldwide.[83] The author writes about upgrading technology and education systems to better support multimedia learning and fix problems like weak performance tracking and poor coordination in faculty development.[84] Thus, digital infrastructure is the foundation for online and BL success. It facilitates access to modern tools, supports various learning formats, enhances predictive analytics, promotes collaboration, and addresses systemic challenges in education systems.[85]

Gaps in the Research

Although more research has been done on the impact of the implementation of blended military and civilian training on knowledge retention and learning engagement in recent years, several gaps have been identified. There is a lack of research on the effectiveness of technology in blended military education in military settings.[86] More research is needed to integrate diverse technology types, such as augmented reality and management learning systems, and better technology integration into existing distributed management platforms.[87] Research about improving technology integration could enhance the platforms' effectiveness and functions. The improvement could make the management learning systems more interactive, engaging, and useful to fulfill modern educational needs.[88] This is relevant for civilian and military education systems to optimize learning outcomes and adapt to evolving technological trends.

There is a need for deeper investigation into integrating advanced technologies, particularly AI and VR, within BL environments.[89] There are research gaps regarding the application of AI, specifically in personalized student learning, improving learners' engagement, and managing different ethical issues.[90] Pham et al. and Qu et al. identify an important gap in educational research concerning integrating AI in

areas such as instructor preparation and institutional administration.[91] While AI has made progress in enhancing learning and classroom management, the AI role in educator training and institutional leadership remains untapped.[92] Research needs to address the practical barriers educators face when they try to adopt digital tools in the classrooms.[93]

The authors also emphasize the need for a stronger philosophical foundation to guide the use of AI in education, calling for establishing ethical guidelines.[94] As Holmes et al. point out, AI is already reshaping many parts of society, from household work and personal assistants to law enforcement and military operations; the education sector is slow to adapt to the rapid development of AI technologies.[95] Pham et al. and Qu et al. recognize a gap between AI advancements and educational practices.[96] To close the gap, the authors stress that research must be done to help educational leaders understand and use AI effectively to improve and transform learning environments.[97] Although AI quickly transforms many sectors, education has struggled to keep up with these changes.[98] Sudiarno et al. identify a gap in exploring VR integration into military and civilian training.[99] While VR can improve training by making it more efficient, realistic, and user-friendly, there is still little research on its use in specific areas like shooting accuracy for military personnel and critical procedure practice for civilian jobs.[100] This gap presents opportunities for further studies to streamline VR technologies for broader training applications.[101]

There are specific gaps in research on adapting BL strategies to crises, particularly during wartime and pandemics, and developing and discussing policy decision-making process for military and civilian contexts.[102] More research is needed to tailor BL methodologies to address the unique challenges of wartime and pandemic conditions, such as infrastructure limitations, psychological stress, and digital literacy gaps.[103] The article also emphasizes the absence of analysis on how military and civilian training policies adapt during crises like pandemics or war, showing the need for research on how decisions are made to use BL during any crisis.[104] Additionally, research should examine how institutional decision-making processes adapt during crises and how ethical and administrative contexts can evolve to support adaptable BL models.[105] The gaps emphasized the need for further research to optimize BL in military and civilian environments.

Conclusion

Implementing BL in military and civilian training has positively impacted knowledge retention and learner engagement. Across both military personnel and Army civilians, BL approaches have provided flexible, personalized, and interactive learning experiences that improved comprehension, supported long-term knowledge retention, and promoted active engagement.[106] The integration of online and face-to-face instruction, along with tools such as AI-driven platforms, VR simulations, and learning management systems, allowed learners to revisit materials, practice critical skills, and collaborate with peers in ways that traditional models alone cannot achieve.[107] These findings support the increasing need for adaptable learning solutions in the face of global disruptions, such as COVID-19 and the Russo-Ukrainian war.[108]

The review further emphasizes the role of administrative and faculty support in enhancing the effectiveness of BL, especially through infrastructure development, faculty training, and policy alignment.[109] For Army civilians, BL creates countless possibilities for continued professional development despite location or operational demands, making BL a critical tool for mission readiness and workforce capability.[110] The research shows that BL is not a temporary solution during times of crisis; it is a strategic approach with full potential to transform military and civilian education and take it to higher levels using advanced educational technology, like AI and VR. The research identifies several gaps despite the promising developments. Bridging the gaps identified in this review will ensure that BL continues to enhance knowledge retention, promote engagement, and support readiness across the military and public service sectors. ■

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