

TLIC PAPER

Transforming Learning with AI-Driven Avatars and Readiness in Education: From Traditional Pedagogy to Simulation-Based Mastery

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ABSTRACT

Education and professional training are increasingly challenged by a persistent gap between knowledge acquisition and the ability to perform effectively in real-world contexts. While digital learning, extended reality (XR), and artificial intelligence (AI) have expanded access to education, many implementations still replicate transmissive pedagogical models, offering limited support for decision-making, adaptability, and professional judgment. This paper argues that the central challenge is not technological adoption *per se*, but the redefinition of *readiness* as a dynamic, systemic, and measurable construct. We propose a readiness-oriented framework in which learning environments are designed to support cognitive, emotional, and social preparedness through deliberate practice, reflective feedback, and psychologically safe experimentation. Within this framework, AI-driven conversational avatars are conceptualized not merely as instructional tools but as mediating agents that scaffold learning, reduce the emotional cost of errors, and enable repeated exposure to complex, high-stakes scenarios. By combining immersive environments, adaptive dialogue, and analytics-driven feedback, avatar-mediated simulations support the transfer of learning across contexts and cultures. Drawing on empirical evidence from multi-year studies, cross-sector case analyses, and survey-based research, the paper examines how readiness-oriented, multimodal learning ecosystems enhance engagement, accelerate skill acquisition, and improve decision-making under pressure. The discussion highlights implications for higher education, healthcare, corporate training, and leadership development, emphasizing inclusivity, bias mitigation, and ethical alignment. Ultimately, the paper positions readiness—not content mastery—as the primary outcome of contemporary education, and AI-driven avatars as a key enabler of scalable, equitable, and practice-centered learning.

KEYWORDS

readiness, AI-driven avatars, simulation-based learning, psychological safety, adaptive learning ecosystems, decision-making

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1 INTRODUCTION

Over the past decades, education and professional training have undergone repeated waves of innovation, from digital learning platforms to immersive and extended reality environments. Despite these advances, a persistent concern remains: learners often complete educational programs with strong theoretical knowledge yet struggle to apply it effectively in real-world, high-pressure situations. This disconnect is evident across domains such as healthcare, law, engineering, finance, and leadership, where success depends not only on knowing *what* to do but also on deciding, communicating, and acting under conditions of uncertainty.

This paper argues that the core limitation of many contemporary learning models is their implicit assumption that knowledge acquisition naturally translates into performance. In practice, however, professional effectiveness depends on *readiness*: the capacity to mobilize knowledge, skills, and judgment in context-sensitive, socially embedded situations. Readiness is not a static outcome achieved at the end of a curriculum but an emergent property of learning ecosystems that align pedagogy, emotional engagement, institutional culture, and opportunities for reflective practice.

Recent advances in simulation-based education, psychological safety research, and experiential learning theory suggest that readiness develops through cycles of action, feedback, and debriefing rather than through linear content delivery. Within this perspective, immersive environments and AI-driven conversational avatars offer a distinctive contribution. Rather than substituting for human instructors, avatars can serve as *mediating agents* that support deliberate practice, scaffold decision-making, and provide consistent, unbiased feedback. Their value lies not in realism alone but in creating a safe container in which learners can experiment, fail, and improve without reputational or emotional penalties.

At the same time, the rapid proliferation of XR and AI technologies has revealed a critical risk: when immersive tools are deployed without a corresponding shift in educational design, they risk becoming digital replicas of traditional classrooms. In such cases, learners remain passive observers, and technological sophistication fails to translate into meaningful learning gains. Addressing this risk requires reframing technology's role within a broader readiness-oriented architecture that integrates cognitive science, organizational learning, and ethical governance.

This study contributes to that reframing in three ways. First, it conceptualizes readiness as a central organizing principle for education and training, distinct from competence or short-term performance. Second, it examines the role of AI-driven avatars as boundary objects that bridge theory and practice, individual learning and organizational expectations. Third, it analyzes empirical evidence from cross-sector implementations and controlled studies to assess how multimodal, avatar-mediated environments influence engagement, skill transfer, and decision-making under pressure.

By situating AI-driven avatars within a readiness-based framework, the paper aims to move beyond technology-centered narratives and toward a more integrated understanding of how learning ecosystems can support professional judgment, inclusivity, and resilience in complex socio-technical environments.

2 READINESS AS A THEORETICAL CONSTRUCT: BEYOND COMPETENCE AND PERFORMANCE

In contemporary education and professional training, the concepts of *competence* and *performance* have traditionally dominated curricular design and assessment

frameworks. Competence is commonly defined as the possession of knowledge, skills, and abilities within a given domain, while performance refers to the observable execution of tasks in specific situations. Although both constructs remain relevant, they are insufficient to explain why individuals who demonstrate strong competence often struggle when facing complex, uncertain, or high-pressure real-world scenarios.

This paper introduces *readiness* as a distinct and more comprehensive theoretical construct. Readiness is not reducible to competence, nor is it synonymous with performance. Instead, it describes a learner's capacity to *mobilize* knowledge, skills, emotional regulation, and judgment in context-sensitive situations, particularly when conditions are ambiguous, time-constrained, or socially demanding. From this perspective, readiness emerges not as an endpoint of instruction, but as a dynamic and relational property of learning ecosystems.

2.1 Competence, performance, and readiness: A conceptual distinction

Competence-based models focus primarily on what learners *know* or are *able to do* in controlled or standardized settings. Assessment typically relies on tests, rubrics, or demonstrations that isolate specific skills. Performance-based models, by contrast, emphasize outcomes in concrete situations, often measured through efficiency, accuracy, or task completion. While performance captures action in context, it is frequently episodic and does not necessarily indicate transferability across situations.

Readiness differs from both constructs in three fundamental ways.

First, readiness is *temporal*. Unlike competence, which is relatively stable, and performance, which is situational, readiness fluctuates over time as learners encounter new challenges, feedback, and emotional demands. Second, readiness is *contextual but transferable*. It develops within specific environments yet supports adaptive behavior across different settings. Third, readiness is *integrative*: it encompasses cognitive understanding, emotional regulation, social awareness, and ethical judgment.

These distinctions help explain why traditional education often fails to prepare learners for real-world complexity. Programs may successfully certify competence without cultivating readiness, resulting in graduates who possess knowledge but lack confidence, adaptability, or situational awareness when confronted with authentic professional challenges [1].

2.2 Readiness as an emergent property of learning systems

Rather than viewing readiness as an individual trait, this paper conceptualizes it as an *emergent property* of socio-technical learning systems. Readiness develops through repeated cycles of action, feedback, reflection, and recalibration, embedded within organizational cultures and pedagogical designs that support experimentation and learning from error.

Simulation-based education has demonstrated that readiness is fostered when learners are exposed to progressively complex scenarios, supported by structured debriefing and psychological safety. In such environments, learners are encouraged to explore decision pathways, experience consequences, and reflect on both successful and ineffective strategies. This process shifts the focus from error avoidance to error *use* as a learning resource.

Importantly, readiness depends on the alignment between instructional design, emotional engagement, and institutional expectations. When learning environments prioritize compliance, speed, or superficial completion, readiness

remains underdeveloped. Conversely, when learners are provided with a safe container that legitimizes uncertainty and reflection, readiness becomes a realistic and attainable objective.

2.3 The role of psychological safety in readiness development

Psychological safety is essential for readiness-oriented learning. Learners cannot develop adaptive judgment if they fear negative evaluation, reputational damage, or irreversible failure. Research on simulation and team learning shows that environments characterized by trust, clear roles, and constructive feedback enable deeper engagement and more effective transfer of learning.

Within readiness-oriented systems, psychological safety does not imply the absence of challenge. Rather, it supports *productive discomfort*: learners are exposed to demanding scenarios while knowing that errors will be treated as opportunities for analysis rather than as personal shortcomings. This balance is essential for developing professional resilience and confidence, particularly in high-stakes domains such as healthcare, law, and leadership.

2.4 AI-driven avatars as mediators of readiness

Within this theoretical framework, AI-driven conversational avatars are best understood not as digital instructors, but as *mediating agents* that support readiness development. Their primary function is not content delivery, but the orchestration of deliberate practice through dialogue, feedback, and adaptive scenario progression.

By engaging learners in repeated, structured interactions, avatars reduce the emotional cost of experimentation and enable consistent exposure to complex decision-making situations. Unlike human instructors, avatars can offer standardized yet adaptive feedback, anchored in predefined criteria, thereby mitigating variability and bias in assessment. This consistency reinforces fairness and inclusivity while preserving the flexibility needed for personalized learning paths.

Moreover, avatars act as boundary objects between theory and practice. They translate abstract principles into situated challenges, prompting learners to articulate reasoning, manage emotional responses, and evaluate consequences in real time. In doing so, they facilitate the transition from knowing *about* a concept to being ready to *apply* it in professional contexts.

2.5 Implications for contemporary education and training

Reframing education around readiness has significant implications for curriculum design, assessment, and technology adoption. Learning objectives must shift from content coverage toward the development of transferable judgment. Assessment practices should prioritize patterns of decision-making and reflective capacity over isolated task performance. Technologies such as XR and AI-driven avatars should be evaluated not on their level of realism, but on their capacity to support readiness through adaptive practice and feedback.

In this sense, readiness provides a unifying theoretical lens through which multimodal learning, simulation-based education, and AI-mediated interaction can be coherently integrated. Rather than asking whether learners have completed

a curriculum, readiness-oriented systems ask a more demanding question: *are learners prepared to act competently, ethically, and adaptively when it matters most?*

3 AI-DRIVEN AVATARS AS BOUNDARY OBJECTS AND BIAS-MITIGATING DEVICES

The increasing adoption of AI-driven conversational avatars in education and professional training raises a fundamental theoretical question: what role do these systems play within learning ecosystems? Beyond their technical capabilities, avatars reshape how knowledge, practice, and evaluation are mediated. This section conceptualizes AI-driven avatars as *boundary objects* and *bias-mitigating devices*, clarifying their function as connectors between theory and practice, individual learning and organizational expectations, and human judgment and technological mediation.

3.1 Avatars beyond instruction: From tools to mediating agents

Conventional educational technologies are often designed as delivery mechanisms—repositories of content, assessment engines, or communication channels. In contrast, AI-driven avatars introduce a qualitatively different form of mediation. They do not merely transmit information but participate in structured interactions that require learners to articulate reasoning, manage emotional responses, and make decisions under conditions of uncertainty.

From a theoretical standpoint, avatars function as *mediating agents* within socio-technical systems of learning. They shape the learner's experience by framing situations, posing challenges, responding to choices, and guiding reflection. This mediation is neither neutral nor purely instrumental: it actively influences how learners interpret scenarios, evaluate options, and construct meaning from experience. As such, avatars cannot be reduced to digital tutors; they operate at the intersection of cognition, emotion, and social interaction.

3.2 Avatars as boundary objects between theory and practice

The concept of *boundary objects* provides a useful lens for understanding the role of avatars in readiness-oriented learning. Boundary objects are entities that inhabit multiple domains simultaneously, enabling coordination and shared understanding without requiring full consensus. In educational contexts, AI-driven avatars occupy precisely this intermediary position.

On one side, avatars are grounded in formal knowledge: rules, protocols, models, and conceptual frameworks embedded in their design. On the other, they engage learners in situated practice, where decisions unfold in real time and consequences emerge dynamically. By bridging these domains, avatars translate abstract principles into actionable challenges, allowing learners to test and refine their understanding through interaction rather than passive consumption.

This boundary function is particularly valuable in professions where theoretical mastery alone is insufficient. In healthcare, law, leadership, or crisis management, practitioners must integrate technical knowledge with situational awareness, ethical judgment, and interpersonal skills. Avatars create a shared space where these dimensions converge, enabling learners to move fluidly between explanation and action, reflection and decision-making.

3.3 Reducing the emotional cost of error

One of the most significant barriers to effective learning in high-stakes domains is the emotional cost of error. Fear of judgment, reputational damage, or failure often discourages learners from experimenting, asking questions, or revealing uncertainty. AI-driven avatars help address this barrier by offering a controlled environment in which errors are expected, reversible, and analyzable.

Unlike interactions with supervisors, peers, or evaluators, avatar-mediated scenarios decouple learning from immediate social consequences. This decoupling reduces anxiety and fosters risk-taking, both essential for developing adaptive judgment. Learners can explore alternative strategies, test assumptions, and experience the outcomes of their decisions without compromising professional identity or status.

By normalizing error as part of the learning process, avatars foster the development of professional resilience. This resilience is a core component of readiness, enabling individuals to remain effective under pressure and to recover constructively from mistakes in real-world contexts.

3.4 Avatars as bias-mitigating devices

Human instruction and assessment are inevitably shaped by cognitive biases, implicit assumptions, and contextual variability. Factors such as fatigue, expectations, cultural background, and interpersonal dynamics can influence feedback and evaluation, often in subtle and unintentional ways. AI-driven avatars, when designed with explicit criteria and structured interaction models, offer a complementary approach.

As bias-mitigating devices, avatars provide consistency in scenario presentation, feedback delivery, and performance evaluation. Their responses are not influenced by personal impressions or momentary emotional states, but by predefined parameters aligned with learning objectives. This consistency supports fairness and transparency, particularly in settings where equity and inclusion are critical concerns.

Moreover, avatars can be designed to adapt to linguistic and cultural diversity, offering multilingual interaction and context-sensitive dialogue. By doing so, they reduce barriers faced by learners who may be disadvantaged in traditional instructional settings, contributing to more inclusive learning environments.

3.5 Standardization without rigidity: A paradox resolved

A common critique of technology-mediated learning is that standardization risks oversimplification or rigidity. However, AI-driven avatars enable a productive balance between standardization and adaptability. Core elements—such as scenario structure, evaluation criteria, and feedback logic—remain stable, ensuring comparability and reliability. At the same time, dialogue paths, scenario complexity, and pacing can be dynamically adjusted based on learner behavior.

This combination allows avatars to support individualized learning trajectories without sacrificing coherence or quality assurance. Learners encounter challenges that are calibrated to their current level of readiness, while organizations retain confidence in the integrity of training outcomes.

3.6 Implications for case-based and simulation-based learning

Understanding AI-driven avatars as boundary objects and bias-mitigating devices clarifies their role in simulation-based education. Rather than replacing human educators or actors, avatars extend the reach of experiential learning by making deliberate practice scalable, repeatable, and analytically tractable.

4 OPERATIONALIZING READINESS-ORIENTED LEARNING ENVIRONMENTS

Building on the theoretical framework of readiness and avatar-mediated learning outlined in the previous sections, this chapter shifts from conceptual analysis to implementation. The aim is not to advance new theoretical claims, but to illustrate how readiness-oriented principles can be operationalized through multimodal environments, AI-driven conversational avatars, and hybrid delivery models.

Although e-REAL is used here as a reference implementation, the architectural principles described in this section are not platform-specific. Rather, they exemplify a broader class of readiness-oriented learning environments that can be replicated, adapted, or scaled across different institutional, technological, and cultural contexts.

4.1 From traditional instruction to multimodal learning architectures

For much of the twentieth century, education and professional training relied on classroom-based instruction centered on lectures, textbooks, and linear curricula. While effective for transmitting information, these approaches privileged passive reception and offered limited opportunities for learners to develop adaptive judgment, decision-making under pressure, or contextual awareness. This limitation became particularly evident in professional domains—such as healthcare, law, engineering, and management—where theoretical mastery alone is insufficient for effective practice.

Research has consistently shown that knowledge acquired through purely expository methods is subject to rapid decay and limited transferability. Learners often struggle to apply abstract concepts to real-world situations, especially when emotional stress, uncertainty, or interpersonal dynamics are involved. Moreover, traditional models frequently disadvantage learners with diverse cognitive styles, linguistic backgrounds, or accessibility needs, reinforcing inequities in educational outcomes.

Multimodal learning environments address these limitations by integrating multiple channels of interaction—visual, auditory, kinesthetic, and dialogic—within structured experiential frameworks. When instructional design balances these modalities effectively, learners are better able to anchor abstract knowledge in concrete experience, supporting deeper comprehension and longer-term retention. Experiential and simulation-based approaches, including XR and avatar-mediated interaction, enable learners to engage in cycles of action, feedback, and reflection rather than linear content consumption.

4.2 Accessibility, psychological safety, and readiness

Accessibility is a foundational requirement for readiness-oriented learning. Digital ecosystems that combine cloud-based platforms, mobile devices, and immersive

environments make it possible to deliver learning experiences independent of time and location. Multilingual conversational agents and inclusive design frameworks further reduce barriers related to language, culture, and ability, transforming accessibility from a logistical concern into a core pedagogical principle.

Equally important is psychological safety. Readiness cannot develop in environments where learners fear negative evaluation, reputational harm, or irreversible failure. Effective learning systems provide a safe container in which experimentation, error, and uncertainty are treated as integral components of professional development. In this context, immersive environments and AI-driven avatars support productive discomfort: learners face challenging scenarios while knowing that errors will be analyzed rather than penalized.

Readiness, therefore, extends beyond knowledge acquisition. It involves preparing learners cognitively, emotionally, and socially to act in authentic contexts. Multimodal environments support this process by enabling deliberate practice through repeated exposure to progressively complex situations, aligning curricula with frontline practice and organizational culture.

4.3 Hybrid delivery and multimodal environments

Readiness-oriented learning environments are characterized by hybrid delivery architectures that integrate digital and physical spaces. In the reference implementation discussed here, learners can engage with avatar-mediated simulations through cloud-based platforms, immersive rooms, projection walls, interactive totems, or mobile training units. This hybrid configuration allows continuity of experience across settings while ensuring scalability and flexibility.

Rather than emphasizing technological novelty, the value of such environments lies in how they structure interaction. Learners are positioned as active participants who must interpret situations, make decisions, and respond to feedback in real time. Immersive visual contexts provide situational grounding, while conversational avatars guide interaction and reflection. Figures 1–4 illustrate different instantiations of this design logic across healthcare, legal, corporate, and emergency response settings.

Importantly, the same underlying architecture supports both individual and collaborative learning. Learners can engage independently with avatars for focused practice or participate in group-based simulations that emphasize communication, coordination, and shared decision-making.

4.4 Extended reality as an enabling layer

Extended reality technologies—including augmented, mixed, and virtual reality—serve as enabling layers rather than ends in themselves. Hybrid XR solutions combine physical and digital environments, allowing learners to engage at different levels of immersion depending on context, resources, and learning objectives [4–5]. This continuum of access ranges from device-free interaction to fully immersive VR experiences, enhancing deployability across institutions with varying technological capacities (Figures 5 and 6).

By supporting gradual engagement rather than all-or-nothing immersion, XR environments reduce entry barriers and cognitive overload. Learners can progress from observation to interaction and from guided practice to autonomous decision-making, aligning technological intensity with readiness development.

4.5 Data-driven feedback and conversational analytics

A defining feature of readiness-oriented environments is the integration of data-driven feedback. Real-time analytics capture learner interactions, decision pathways, and behavioral indicators, enabling adaptive feedback and personalized learning trajectories. Rather than serving as surveillance tools, these analytics support reflection and debriefing, helping learners identify patterns in their reasoning and communication.

Figure 7 illustrates a conversational feedback interface that analyzes interaction quality across dimensions such as empathy, active listening, emotional regulation, and problem-solving [6]. Visualizations provide learners with immediate insight into strengths and areas for improvement, while structured hints and recommendations guide subsequent practice. This feedback loop reinforces deliberate practice and supports the transfer of learning to real-world contexts.

4.6 Reference implementation and transferability

While e-REAL offers a mature and integrated implementation of readiness-oriented principles, the relevance of this chapter lies in the broader design logic it exemplifies. The combination of avatar-mediated interaction, multimodal immersion, psychological safety, and analytics-driven feedback can be implemented through different technological stacks and institutional arrangements.

The figures presented in this section should therefore be read not as product documentation, but as illustrative examples of how readiness-oriented learning environments can be operationalized across domains with varying levels of complexity and risk. The following case studies build on this foundation, examining how these principles function in practice and how readiness is cultivated through avatar-mediated interaction in diverse professional settings.

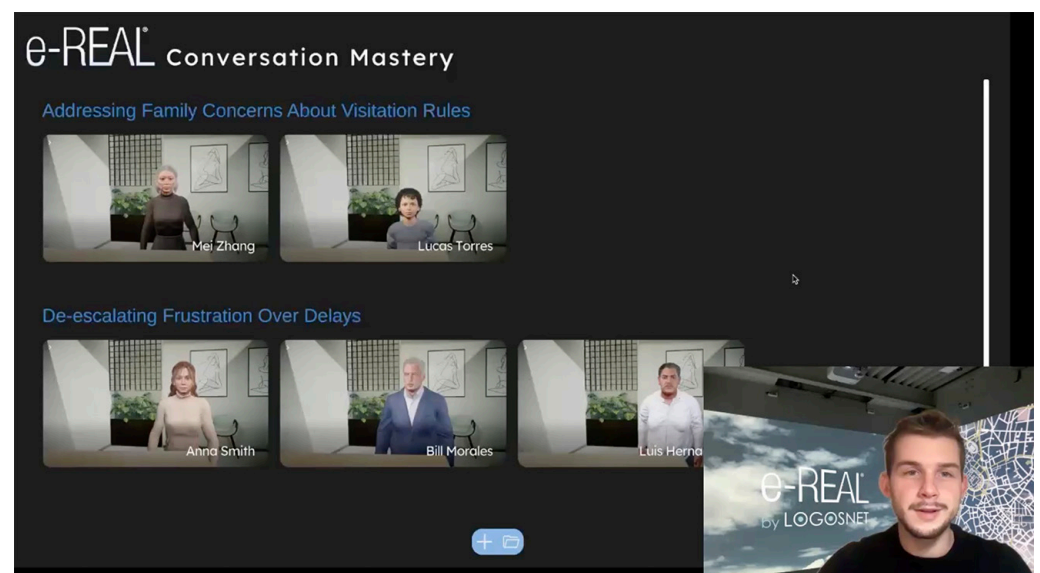


Fig. 1. e-REAL Conversation Mastery offers AI-driven training for communication and conflict resolution, available both online and on-site. Learners engage with avatars in realistic scenarios, receiving real-time feedback. The platform facilitates remote access through cloud-based simulations and VR, as well as in-person training using immersive rooms, projection walls, and interactive totems. It provides a scalable and adaptable solution for developing decision-making and negotiation skills in various professional and educational environments



Fig. 2. e-REAL provides flexible on-site training solutions, which include immersive simulation rooms, modular learning spaces, and mobile training units (as illustrated in these visualizations, the e-REAL team has installed them at NW Medical School in Chicago, GW School of Medicine and Health Sciences in Washington D.C., and Eastern Piedmont University in Novara, Italy). These setups offer realistic, scenario-based education in medical and emergency response, allowing for hands-on practice in controlled environments. The blend of fixed, adaptable, and mobile formats guarantees accessibility and prepares learners for real-world challenges in diverse settings

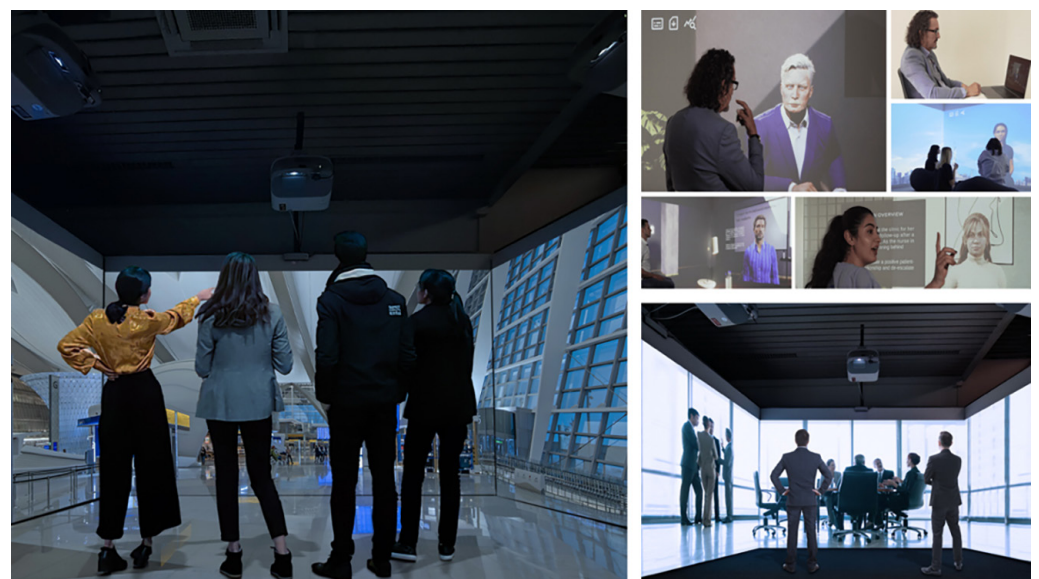


Fig. 3. e-REAL combines extended reality with AI-driven avatars to enhance professional training in decision-making, communication, and leadership. Its immersive environments, ranging from large-scale simulations to AI-powered virtual coaching, offer interactive, scenario-based learning. These solutions benefit the corporate, healthcare, and education sectors by enhancing engagement, collaboration, and real-world readiness



Fig. 4. e-REAL uses 360-degree projection technology to provide immersive training for legal, crisis response, and energy sector professionals. These simulations enhance decision-making, situational awareness, and problem-solving in real-world scenarios, from courtroom proceedings to emergency response and industrial policy discussions

e-REAL: EFFECTIVE WAYS TO USE EXTENDED REALITY (XR)

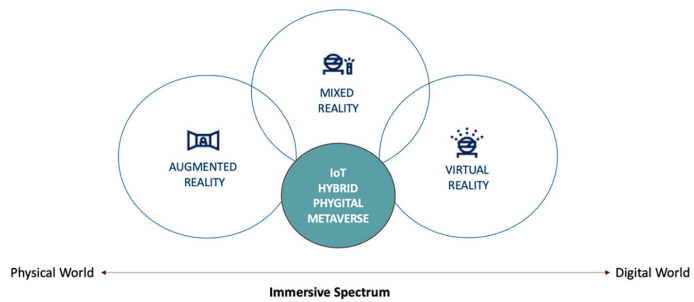


Fig. 5. Extended Reality Integration: e-REAL leverages hybrid reality, augmented reality, mixed reality, and virtual reality to create scalable and adaptable education and training solutions. By combining physical and digital environments, the platform ensures high accessibility, enabling users to engage in immersive learning regardless of their technological resources

EXTENDED REALITY CONTINUUM

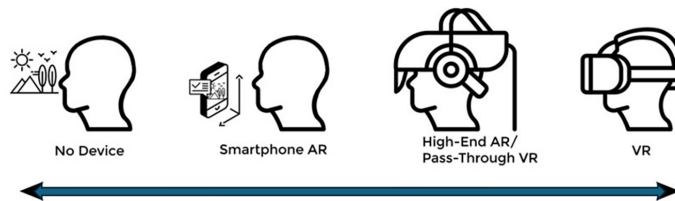


Fig. 6. XR Continuum and Data-Driven Learning: e-REAL offers a progressive learning experience that ranges from device-free interactions to fully immersive VR. This approach improves accessibility while incorporating data-driven insights to tailor learning paths, monitor user performance, and enhance decision-making in real-world situations

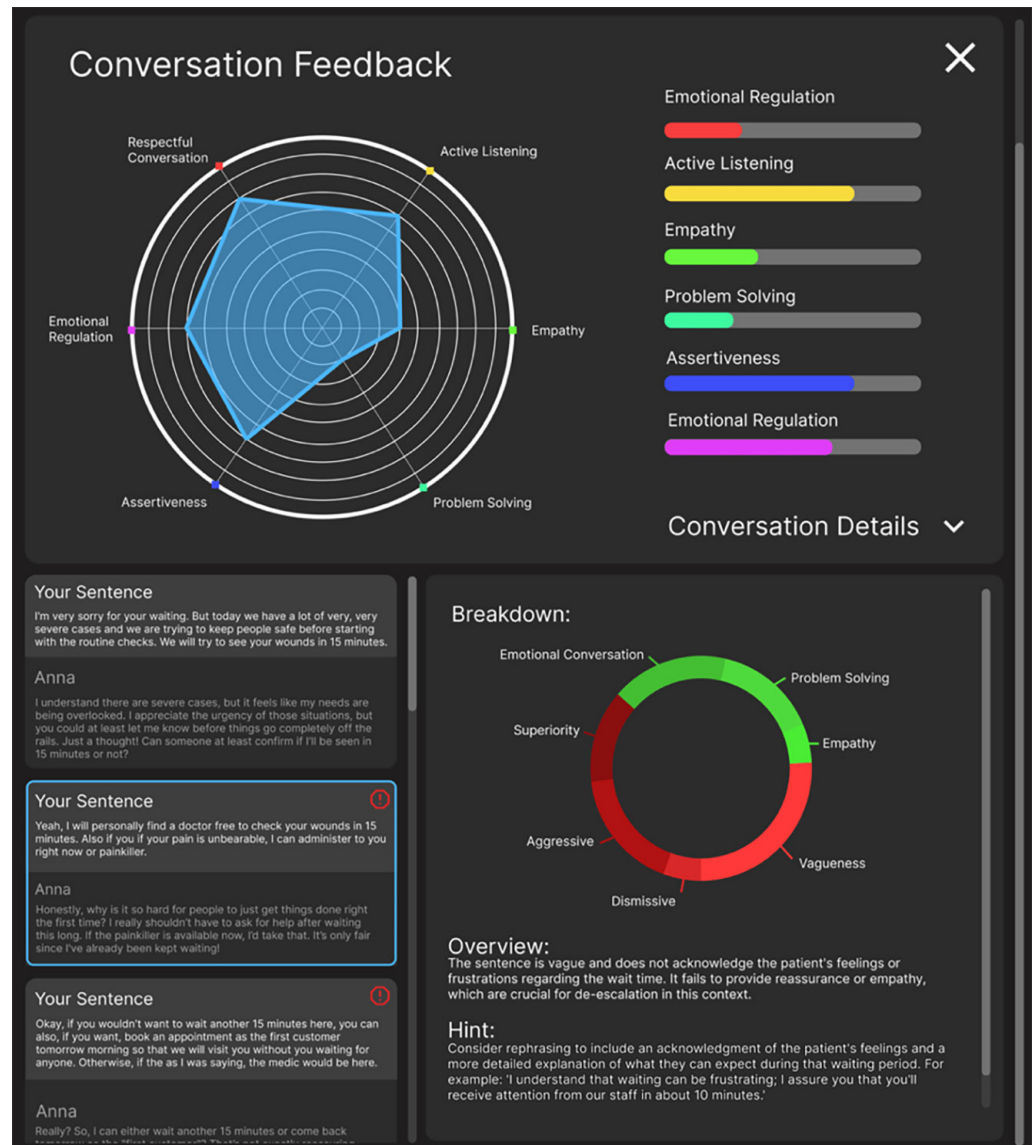


Fig. 7. The e-REAL conversation feedback system provides AI-driven analysis of communication, evaluating skills such as empathy, problem-solving, and active listening. Real-time feedback and data visualization enhance conversational strategies, making it an effective tool for de-escalation, conflict resolution, and professional communication training

5 REPRESENTATIVE CASE STUDIES ACROSS READINESS-ORIENTED DOMAINS

To illustrate how readiness-oriented, avatar-mediated learning environments function in practice, this section presents a set of representative case studies drawn from different professional domains. The cases are not intended as exhaustive evaluations or controlled experiments, but as *illustrative instances* showing how similar design principles operate under diverse contextual, organizational, and risk conditions.

Rather than emphasizing technological novelty, the analysis focuses on how immersive, conversational, and feedback-driven environments support readiness

through deliberate practice, psychological safety, and adaptive decision-making. Across all cases, AI-driven avatars function as mediating agents that structure interaction, reduce the emotional cost of error, and enable repeated exposure to complex scenarios.

5.1 Healthcare training: High-stakes clinical readiness

In healthcare education, readiness is critical due to the direct impact of decisions on patient safety and outcomes. A leading U.S. nursing school integrated avatar-mediated simulations into its training curriculum to complement traditional instruction. Learners engaged in realistic clinical scenarios requiring rapid assessment, communication with patients and families, and coordination within interdisciplinary teams.

The implementation focused on repeated scenario exposure and structured debriefing rather than one-time assessment. Observed outcomes included reductions in simulated medical errors, shorter response times in emergency scenarios, and improved interdisciplinary collaboration. These results suggest that avatar-mediated environments support clinical readiness by allowing learners to rehearse judgment and communication under pressure in a psychologically safe setting.

5.2 Financial risk training: Decision-making under uncertainty

In the financial sector, readiness involves the ability to assess risk, interpret complex information, and act decisively under time constraints. A major Swiss financial institution adopted avatar-mediated simulations to train professionals in risk management and compliance. Scenarios replicated high-pressure decision contexts involving regulatory constraints, incomplete data, and ethical considerations.

Learners reported improved confidence in risk assessment and faster adaptation to regulatory changes. Performance indicators showed increased accuracy in simulated decision-making tasks and improved detection of anomalous patterns. These outcomes highlight how readiness-oriented environments support the integration of analytical reasoning and judgment in domains characterized by uncertainty and systemic risk.

5.3 Energy sector safety training: Operational and crisis readiness

In the energy sector, safety and crisis readiness are essential due to the potential consequences of operational failures. A major Italian energy company implemented immersive, avatar-mediated training to prepare personnel for emergency response and safety-critical situations. Scenarios simulated industrial environments, infrastructure failures, and crisis coordination under time pressure.

The training emphasized situational awareness, communication, and coordinated decision-making. Reported outcomes included reductions in simulated accident rates, improvements in operational efficiency, and faster response times during crisis simulations. These findings suggest that readiness-oriented environments can enhance both individual and collective performance in safety-critical industries.

5.4 Legal training: Reasoning, communication, and ethical judgment

Legal practice requires readiness not only in legal reasoning but also in negotiation, communication, and ethical decision-making. A top-tier international law firm integrated avatar-mediated simulations into its professional development programs. Scenarios included courtroom proceedings, client interviews, negotiation settings, and intercultural interactions.

Participants practiced articulating arguments, responding to opposing positions, and managing interpersonal dynamics in high-stakes legal contexts. Observed outcomes included improved efficiency in simulated negotiations, greater accuracy in strategic decision-making, and increased awareness of diversity and inclusion issues. The case illustrates how avatars can support readiness in domains where judgment and communication are as critical as technical expertise.

5.5 Leadership and crisis management: Organizational readiness

Leadership readiness involves managing uncertainty, coordinating teams, and making strategic decisions under pressure. A multinational corporation deployed avatar-mediated simulations within its executive development programs to enhance crisis management and leadership effectiveness. Scenarios focused on organizational crises, stakeholder communication, and time-sensitive decision-making.

Leaders engaged in repeated simulations that required balancing competing priorities and managing emotional responses. Reported outcomes included improved handling of high-pressure situations, faster decision-making, and stronger team coordination. This case demonstrates how readiness-oriented environments can support leadership development beyond traditional classroom-based training.

5.6 Aviation crew training: Safety and team coordination

In aviation, readiness is closely linked to safety, communication, and procedural compliance. A major European airline adopted avatar-mediated simulations to train pilots and cabin crew in emergency response and crew resource management. Scenarios replicated in-flight emergencies, communication breakdowns, and coordination challenges.

Training outcomes indicated improvements in simulated emergency response efficiency, clearer communication among crew members, and higher safety compliance scores. These results highlight the value of avatar-mediated practice in reinforcing readiness within highly regulated, safety-critical environments.

5.7 Retail and customer service training: Interpersonal readiness

In retail and customer service contexts, readiness centers on communication, conflict resolution, and adaptability. A global retail company implemented avatar-mediated simulations to train employees in customer interactions, de-escalation, and sales conversations. Scenarios reflected common service challenges, including dissatisfied customers and high-volume environments.

Participants demonstrated improved communication strategies, higher customer satisfaction ratings in simulated assessments, and increased engagement with

training activities. The case illustrates that readiness-oriented environments are applicable not only in high-risk domains, but also in everyday professional settings where interpersonal judgment is central.

5.8 Emergency response and public services: Inter-agency readiness

Public services and emergency response require readiness at both individual and systemic levels. A European government agency deployed avatar-mediated simulations to improve coordination among emergency responders and public service teams. Scenarios involved disaster response, multi-agency coordination, and decision-making under stress.

Results indicated improvements in simulated coordination effectiveness, decision-making under pressure, and cross-agency communication. This case underscores the role of readiness-oriented environments in supporting complex, multi-actor systems where effective collaboration is essential.

5.9 Cross-case synthesis

Across all cases, several common patterns emerge. First, readiness-oriented environments support learning by reducing the emotional cost of error, enabling learners to engage with challenging scenarios without fear of negative consequences. Second, AI-driven avatars function consistently as mediating agents that structure interaction and feedback, regardless of domain. Third, improvements are most pronounced in areas involving judgment, communication, and coordination rather than rote procedural knowledge.

Taken together, these cases demonstrate that avatar-mediated, multimodal learning environments can support readiness across domains with different risk profiles, regulatory constraints, and professional cultures. The following sections build on these qualitative insights through survey-based and controlled empirical studies that further examine the relationship between immersive learning, readiness, and performance outcomes.

6 AI-DRIVEN AVATARS AND PERSONALIZATION FOR ADAPTIVE LEARNING

A defining feature of readiness-oriented, multimodal learning ecosystems is their capacity to support personalized and adaptive learning pathways through structured interaction and feedback. Among the most promising tools for achieving this vision are **AI-driven avatars**, which function not only as tutors but as **expert mentors and conversational partners**, capable of simulating complex scenarios, providing feedback, and scaffolding the learner's progress toward readiness.

Unlike traditional e-learning platforms, avatars engage in **real-time, interactive dialogue** that integrates both verbal and non-verbal cues—intonation, facial expressions, gaze, and gesture—to create a strong sense of **social presence**. This sense of presence has been shown to increase trust, motivation, and emotional engagement, thereby reinforcing both cognitive and behavioral learning outcomes. As highlighted in *Learning 4.0*, the inclusion of embodied and affective dimensions is essential to transform abstract concepts into lived experiences, where **knowledge is anchored in practice**. Personalization is achieved through **adaptive learning**

architectures that combine natural language processing with **retrieval-augmented generation (RAG)** and learner analytics. These systems enable avatars to provide context-sensitive feedback, adjust the complexity of tasks, and recommend additional resources. In this way, learning is no longer linear but **dynamic and iterative**, aligning with the principles of deliberate practice and readiness.

A crucial aspect is the role of avatars in fostering **meta-competences and empowerment**. Learners today must be able to regulate their own learning, reflect critically, and adapt knowledge across cultural and professional contexts. Avatars can support this by encouraging learners to take ownership of their progression, offering **scaffolded autonomy**—that is, guided freedom that gradually increases as mastery develops. This not only builds confidence but also equips learners with the **resilience and intercultural intelligence** required in today’s knowledge society.

Another important contribution of AI-driven avatars is **bias mitigation**. Traditional mentoring and assessment are inevitably influenced by subjective human factors such as implicit bias, fatigue, or variability in judgment. Avatars, by contrast, can provide **consistent, unbiased feedback** anchored to validated rubrics and performance metrics. When combined with structured debriefing and reflection, as suggested by Rudolph’s framework for psychological safety, this objectivity helps create a **safe container for learning**, where learners can experiment, err, and improve without fear of stigma. Avatars also contribute to inclusivity by supporting **multilingual dialogue, cultural adaptability, and accessibility standards**, making learning environments more equitable and reducing barriers to participation. This inclusivity ensures that the transformative potential of adaptive learning does not remain confined to elite institutions but becomes a resource available to diverse populations worldwide.

A key innovation of e-REAL is its implementation of **AI-driven avatars as interactive learning partners**. These avatars:

- Utilize **Natural Language Processing (NLP)** for **context-aware, realistic conversations**.
- Employ **emotional intelligence mechanisms** to analyze behavioral cues and adjust responses accordingly.
- Apply **machine learning models** to personalize training **based on user performance**.

The e-REAL AI-driven avatars and scenarios have been **successfully integrated into university curricula, professional training, leadership development, and compliance programs**. They provide **adaptive and responsive learning experiences** tailored to specific academic or professional needs. The limitations of traditional education are becoming increasingly evident. As the demand for **practical and hands-on training solutions** grows, e-REAL offers a **transformative alternative**. By incorporating **AI-driven avatars, immersive simulations, and adaptive learning**, e-REAL fosters **critical thinking, decision-making, and professional readiness** [7–9].

With empirical evidence backing its effectiveness, **e-REAL signifies the future of professional education and training**—one that emphasizes **engagement, skill mastery, and real-world applicability** over passive content consumption. As organizations and educational institutions continue to pursue **innovative, scalable training solutions**, **e-REAL emerges as a game-changer in the learning landscape**.

More universities, corporations, and training institutions should adopt e-REAL now, ensuring that learners acquire the adaptive skills necessary for the future.

7 LIMITS OF TRADITIONAL LEARNING APPROACHES: EVIDENCE FROM A CROSS-REGIONAL SURVEY

While the preceding sections have outlined a readiness-oriented theoretical and architectural framework, this section examines empirical perceptions of traditional learning approaches as reported by learners and early-career professionals. The objective is not to establish causal relationships, but to identify recurring patterns of perceived inadequacy in conventional educational models when confronted with real-world professional demands.

The data presented here derive from a survey conducted between October and November 2024 across Canada, the United States, the United Kingdom, the European Union, and Switzerland. The survey was designed to capture learners' and professionals' perceptions regarding the effectiveness of traditional education in preparing them for applied, high-pressure, and decision-intensive contexts.

7.1 Sample and methodological scope

The study involved **520 respondents**, comprising **higher education students (60%)** and **working professionals (40%)** from a range of disciplinary and professional backgrounds, including business, healthcare, engineering, finance, law, technology, and public administration. Participants were recruited through academic networks and professional training initiatives associated with the Logos Research Center, with support from interns affiliated with the University of Turin.

Data collection combined:

- A structured questionnaire focused on perceived preparedness and transferability of learning,
- Targeted focus group discussions aimed at contextualizing survey responses.

The survey did not aim to measure objective performance or learning outcomes. Instead, it focused on *self-reported readiness*, perceived gaps between education and practice, and subjective assessments of learning effectiveness. As such, the findings should be interpreted as indicative of experiential patterns rather than as statistically generalizable results.

7.2 Perceived gaps between education and practice

Across regions and professional domains, respondents consistently reported difficulties in transferring theoretical knowledge to real-world situations. A substantial majority of professionals indicated that traditional learning environments had provided a solid conceptual foundation but limited preparation for decision-making under pressure, adaptive problem-solving, and situational judgment.

Similarly, a large proportion of students expressed concern that conventional curricula offer insufficient opportunities for hands-on practice, experiential learning, and structured feedback. These perceptions were particularly pronounced among respondents engaged in fields characterized by complexity, uncertainty, or high stakes, such as healthcare, finance, and public services.

Rather than rejecting theoretical instruction per se, respondents emphasized the absence of learning formats that enable repeated application, error-based learning, and reflective debriefing. This distinction is important: the issue identified is not the presence of theory, but the lack of mechanisms that support readiness for practice.

7.3 Interpretation of survey findings

The survey results highlight a perceived disconnect between academic learning and professional readiness. Respondents frequently described traditional education as necessary but insufficient: effective for building foundational knowledge, yet inadequate for preparing individuals to act competently in dynamic and uncertain environments.

Figure 8 visualizes two dominant concerns emerging from the data:

1. Professionals' difficulty in applying theoretical knowledge in real-world situations, and
2. Students' perception that traditional education provides limited hands-on experience.

These findings align with the broader argument developed in this paper: readiness cannot be reduced to content mastery or curricular completion. Instead, it requires exposure to contextualized practice, feedback, and opportunities to engage with complexity in psychologically safe environments.

7.4 Diversity of respondents and contextual relevance

Figure 9 presents a matrix detailing the diversity of respondents by country, educational level, field of study, and professional sector. The heterogeneity of the sample reinforces the relevance of the observed patterns across different educational systems and labor markets. While perceptions naturally vary by discipline and region, the recurrence of similar concerns suggests that the readiness gap identified is not confined to a single context.

Importantly, the survey does not claim that immersive or avatar-mediated learning environments are the sole solution to these challenges. Rather, it provides empirical grounding for the need to rethink educational design beyond traditional instructional models, particularly in relation to transferability, adaptability, and decision-making readiness.

7.5 Positioning the survey within the overall framework

Within the structure of this paper, the survey serves a specific function. It does not validate the effectiveness of any particular technological solution, nor does it replace controlled empirical studies. Instead, it offers contextual evidence that motivates the shift toward readiness-oriented, experiential learning environments.

The following sections build on this perceptual evidence by examining readiness as a central educational objective and by presenting controlled empirical studies that explore how immersive, avatar-mediated environments influence engagement, learning efficiency, and applied decision-making.

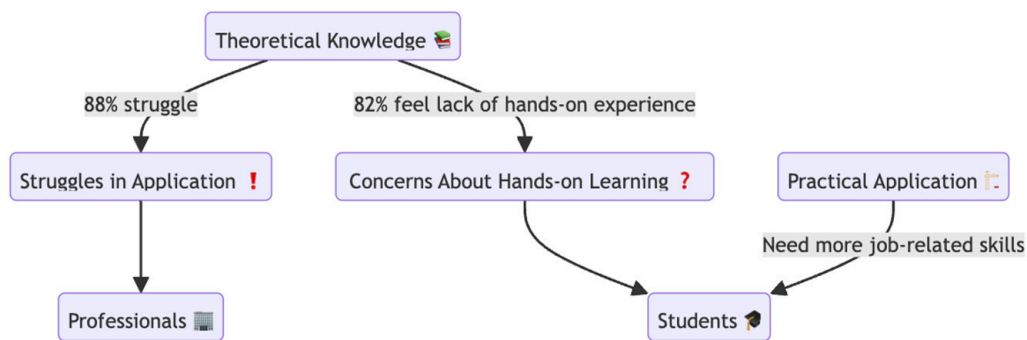


Fig. 8. This concept map visually illustrates key findings from our survey, which gathered insights from professionals and students across various regions. The results reveal two major concerns: 88% of professionals have difficulty applying theoretical knowledge in real-world situations, while 82% of students believe that traditional education falls short in providing hands-on learning opportunities. These insights highlight the disconnect between academic learning and practical application, underscoring the need for more immersive, experiential, and skill-based training solutions to better prepare individuals for professional challenges

Respondent Data Matrix (Total: 520 Respondents)

Category	Participants
United States	156 (94 students, 62 professionals)
United Kingdom	88 (53 students, 35 professionals)
Canada	78 (47 students, 31 professionals)
European Union (Germany, France, Italy, Spain, etc.)	146 (88 students, 58 professionals)
Switzerland	52 (31 students, 21 professionals)

Higher Education Students (60% of Total Respondents = 312 Students)

Category	Participants
Undergraduate students	140
Graduate students (Master's, PhD, professional programs)	172

Fields of Study

Field	Participants
Business & Management	87
Healthcare & Medical Sciences	75
Engineering & Technology	62
Social Sciences & Law	47
Natural Sciences & Mathematics	25
Other	16

Working Professionals (40% of Total Respondents = 208 Professionals)

Category	Participants
Early-career professionals (1–5 years of experience)	104
Mid-career professionals (6–15 years of experience)	73
Senior professionals (16+ years of experience)	31

Industries Represented

Industry	Participants
Healthcare & Life Sciences	62
Business & Finance	52
Technology & Engineering	42
Public Administration & Education	31
Other	21

Key Findings

Finding	Percentage
Professionals struggling to apply theoretical knowledge	88%
Students concerned about lack of hands-on learning	82%

Fig. 9. The respondent data matrix offers a detailed breakdown of the survey participants, categorizing them by country, education level, field of study, and professional industry. It emphasizes the diverse backgrounds of the 520 respondents, with 60% being higher education students and 40% working professionals. The data also reveals key trends, such as the prevalence of business, healthcare, and engineering fields among students, and healthcare, finance, and technology sectors among professionals. These insights underscore the broad applicability of the findings and the urgent need for training solutions that connect academic learning to professional readiness

8 READINESS AS A CENTRAL EDUCATIONAL OBJECTIVE

The findings presented in the previous sections underscore a recurring challenge across educational and professional contexts: the gap between knowledge acquisition and the ability to act effectively in real-world situations. This gap cannot be adequately explained by deficiencies in content quality or instructional rigor alone. Rather, it reflects a structural limitation of educational models that prioritize knowledge transmission over readiness for practice.

Readiness, as articulated in this paper, extends beyond the accumulation of information or the completion of curricular requirements. It refers to the capacity to mobilize knowledge, skills, emotional regulation, and judgment in context-sensitive situations—often under conditions of uncertainty, time pressure, and social complexity. From this perspective, readiness is not an outcome that follows learning automatically, but a property that must be intentionally cultivated through educational design.

Traditional learning environments often assume that exposure to theory will naturally translate into effective performance. However, both the survey-based evidence and the qualitative patterns emerging from practice suggest that this assumption is increasingly untenable. Learners frequently report confidence in their conceptual understanding while simultaneously expressing uncertainty when confronted with authentic professional challenges. This discrepancy highlights the need to reconceptualize educational success not in terms of content mastery alone, but in terms of preparedness for action.

A readiness-oriented approach shifts attention from *what learners know* to *how learners are prepared to act*. This shift has several implications. First, it emphasizes the importance of experiential learning formats that allow learners to rehearse decision-making, communication, and problem-solving in realistic contexts. Second, it foregrounds the role of psychological safety, recognizing that readiness develops when learners are able to experiment, err, and reflect without fear of stigma or negative evaluation. Third, it highlights the integrative nature of readiness, which encompasses cognitive, emotional, social, and ethical dimensions of professional practice.

Importantly, readiness should not be understood as a static threshold or a one-time achievement. It is a dynamic and relational process that evolves through repeated engagement with increasingly complex situations. Educational systems that aim to foster readiness must therefore support continuity between learning environments and real-world practice, enabling learners to transfer insights across contexts and over time.

Within this framework, immersive and avatar-mediated learning environments represent one possible response to the readiness challenge, not because of their technological sophistication per se, but because of their capacity to structure interaction, feedback, and reflection around authentic scenarios. Such environments make it possible to design learning experiences in which readiness is explicitly targeted as the primary objective, rather than treated as a secondary byproduct of instruction.

This reframing has consequences for curriculum design, assessment, and institutional strategy. Assessment practices aligned with readiness focus less on isolated task performance and more on patterns of judgment, adaptability, and reflective capacity. Curricula designed around readiness prioritize deliberate practice and scenario-based learning over linear content coverage. At an institutional level, readiness-oriented education requires alignment between pedagogical methods, organizational culture, and expectations of professional practice.

By positioning readiness as a central concern and objective, this paper provides a conceptual bridge between perceived shortcomings of traditional learning models and the empirical evaluation of immersive, avatar-mediated approaches. The following section builds on this foundation by examining controlled empirical evidence that explores how readiness-oriented environments influence engagement, learning efficiency, and decision-making under pressure.

9 EVALUATING READINESS-ORIENTED LEARNING THROUGH CONTROLLED COMPARATIVE STUDIES

To complement the perceptual evidence presented in the previous sections, this section reports findings from a multi-year comparative study designed to explore how readiness-oriented, immersive learning environments relate to engagement, learning efficiency, and applied decision-making. The purpose of this study is not to claim universal causality, but to examine *relative differences* observed between traditional instructional approaches and avatar-mediated, experiential learning configurations within controlled conditions.

9.1 Study design and scope

Between 2022 and 2024, a longitudinal comparative study was conducted in collaboration with multiple academic institutions and professional organizations in Europe, Switzerland, and the United States. Participating institutions included universities, polytechnic schools, colleges, and corporate training partners operating across different educational and professional domains.

Each year, the study involved approximately **100 participants**, resulting in a total sample of **300 learners** over the three-year period. Participants were distributed across educational and career stages, including undergraduate students (40%), postgraduate learners (35%), and early-career professionals (25%). This composition allowed for the observation of readiness-related patterns across varying levels of prior experience.

Participants were assigned to one of two learning conditions:

- A comparison group engaging in traditional instructional formats (lectures, standard e-learning modules, or non-interactive digital content), and
- An experimental group engaging in readiness-oriented, immersive learning environments characterized by avatar-mediated interaction, scenario-based practice, and structured feedback.

Key indicators were identified in advance to enable comparison between groups, including engagement, learning efficiency, knowledge retention, teamwork, and decision-making under pressure.

9.2 Interpretation of observed differences

Across the observed cohorts, learners participating in readiness-oriented environments consistently demonstrated higher levels of engagement relative to those in traditional formats. Engagement here refers to a composite measure

including time-on-task, self-reported involvement, and observable interaction with learning materials. The relative increase in engagement reported in this study reflects differences compared to baseline measures within the comparison group rather than absolute performance gains.

In parallel, a substantial reduction in training time was observed among participants in the immersive learning condition. This reduction should be interpreted as increased learning efficiency—that is, the ability to reach comparable or higher levels of preparedness within shorter instructional cycles—rather than as a simplification of content or learning objectives.

Improvements were also observed in areas related to collaboration and teamwork, particularly in simulations requiring coordinated decision-making under time pressure. These outcomes suggest that readiness-oriented environments may support not only individual learning, but also collective performance in complex scenarios.

9.3 Readiness-related outcomes

Several indicators associated with readiness showed notable relative differences between learning conditions. Participants trained in immersive, avatar-mediated environments demonstrated stronger performance in tasks requiring adaptive reasoning, situational awareness, and decision-making under stress. Reductions in fixation errors were observed, indicating greater flexibility in responding to evolving scenarios rather than adherence to rigid procedural patterns.

Knowledge retention outcomes should be interpreted cautiously. The reported improvements reflect enhanced recall and application of learned material in simulated contexts, rather than long-term retention measured through delayed testing. Nevertheless, these patterns align with the hypothesis that experiential and feedback-driven learning supports deeper cognitive integration than passive instruction alone.

Figure 10 illustrates the distribution of participant profiles across educational stages, highlighting the applicability of the observed patterns to learners at different points in their professional trajectories. Figure 11 summarizes participants' perceptions of learning benefits, providing a complementary perspective on engagement, efficiency, and readiness-related outcomes.

9.4 Methodological considerations and limitations

Several limitations must be acknowledged. First, while the study employed comparison groups, it was not designed as a randomized controlled trial. Assignment to learning conditions was influenced by institutional constraints and program design, which may introduce selection effects. Second, many indicators rely on self-reported measures and performance within simulated environments, limiting direct generalization to real-world outcomes.

Third, the diversity of participating institutions and domains—while a strength in terms of ecological validity—also introduces variability that complicates fine-grained statistical comparison. The results should therefore be interpreted as indicative patterns rather than definitive proof of superiority.

These limitations do not diminish the relevance of the findings, but they clarify their appropriate scope. The study provides empirical support for the plausibility and potential effectiveness of readiness-oriented, immersive learning

environments, while underscoring the need for further research using more tightly controlled designs.

9.5 Positioning within the overall argument

Within the structure of this paper, the controlled comparative study serves a specific role. Together with the survey-based evidence, it supports the argument that traditional instructional models face structural challenges in preparing learners for real-world application. At the same time, it provides preliminary empirical grounding for the claim that readiness-oriented, avatar-mediated environments can influence engagement, learning efficiency, and applied decision-making in meaningful ways.

Rather than presenting these results as conclusive endpoints, this section positions them as part of an emerging body of evidence that invites further investigation. Future research should explore longitudinal transfer to real-world practice, domain-specific validation, and the interaction between readiness-oriented design and organizational culture.

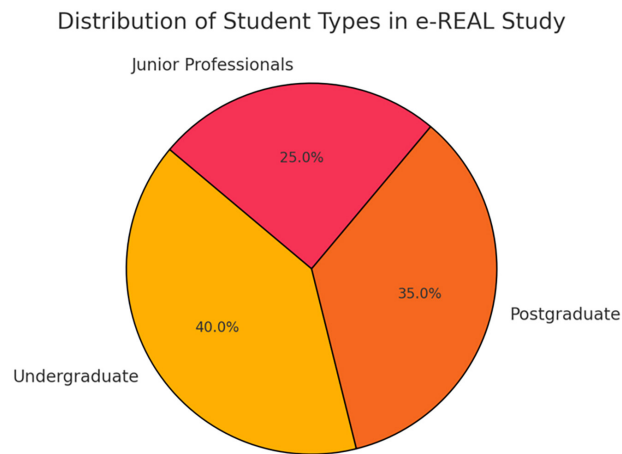


Fig. 10. The pie chart visualizes the distribution of student types in the e-REAL study, showing a balanced mix of undergraduates (40%), postgraduates (35%), and junior professionals (25%). e-REAL engages learners at different educational and career stages, reinforcing its adaptability across various learning needs

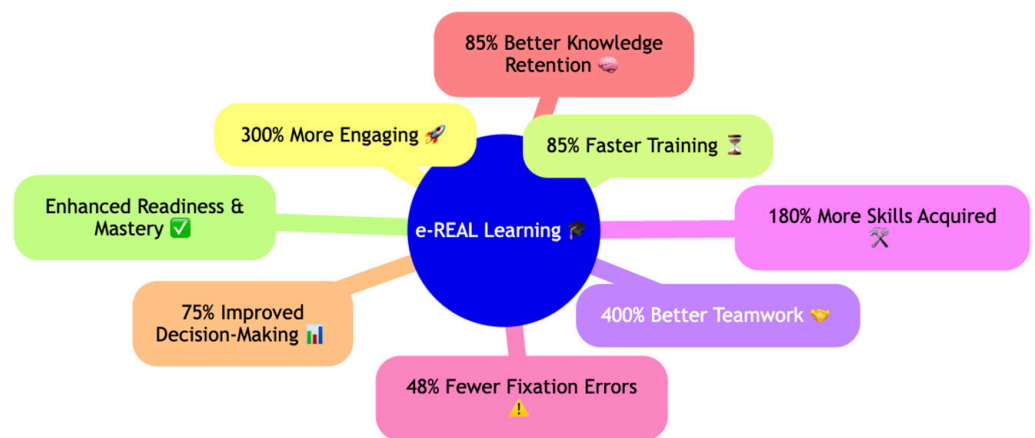


Fig. 11. This mind map is about the learners' perception of the benefits of e-REAL, highlighting key performance improvements such as **better knowledge retention (85%)**, **faster training (85%)**, and **higher engagement (300%)**

10 CONCLUSIONS

This paper has argued that one of the central challenges facing contemporary education and professional training is not the availability of advanced technologies, but the persistent gap between knowledge acquisition and readiness for practice. Across higher education and professional domains, learners frequently complete rigorous curricula yet struggle to act effectively in real-world situations characterized by uncertainty, time pressure, and social complexity. Addressing this gap requires a shift in educational focus—from content mastery as a primary objective to readiness as a central organizing principle.

By conceptualizing readiness as a dynamic, systemic, and relational construct, this study reframes learning as a process that integrates cognitive understanding, emotional regulation, social interaction, and ethical judgment. Readiness does not emerge automatically from exposure to theory, nor can it be inferred solely from isolated performance metrics. Instead, it develops through deliberate practice, structured feedback, and repeated engagement with authentic scenarios in psychologically safe environments.

Within this framework, AI-driven conversational avatars and immersive learning environments are not presented as solutions in themselves, but as enabling mechanisms that make readiness-oriented design feasible at scale. Their value lies in how they mediate interaction, reduce the emotional cost of error, and support consistent, adaptive feedback. When embedded within coherent pedagogical architectures, avatars function as boundary objects that bridge theory and practice, individual learning and organizational expectations, and human judgment and technological mediation.

The empirical components of this paper—the cross-regional survey and the multi-year comparative study—do not claim definitive causal proof. Rather, they provide converging evidence that traditional instructional models are widely perceived as insufficient for preparing learners for real-world application, and that readiness-oriented, immersive approaches are associated with higher engagement, improved learning efficiency, and stronger decision-making under pressure. These findings should be interpreted as indicative patterns that justify further investigation rather than as conclusive endpoints.

Several implications follow from this work. For curriculum design, prioritizing readiness entails moving beyond linear content coverage toward scenario-based, experiential learning that supports transfer across contexts. For assessment, it requires shifting attention from isolated task performance to patterns of judgment, adaptability, and reflective capacity. At an institutional level, readiness-oriented education demands alignment between pedagogical methods, organizational culture, and expectations of professional practice.

Importantly, this paper does not suggest that technology replaces human educators, mentors, or facilitators. On the contrary, readiness-oriented systems amplify human expertise by extending opportunities for deliberate practice, debriefing, and reflection. AI-driven avatars and immersive environments should therefore be understood as complements to human-centered education, not substitutes for it.

Finally, several limitations and avenues for future research deserve attention. Further studies should explore longitudinal transfer from simulated environments to real-world practice, domain-specific validation of readiness indicators, and the interaction between readiness-oriented design and institutional constraints. Ethical, regulatory, and governance considerations—particularly in sensitive

domains such as healthcare, law, and public services—also warrant continued examination.

In conclusion, the contribution of this paper lies not in advocating a specific technological platform, but in proposing readiness as a unifying framework for rethinking education and professional training. By aligning theory, design, and empirical inquiry around readiness, educators and institutions can move toward learning ecosystems that better prepare individuals to act competently, ethically, and adaptively when it matters most.

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