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The Future is Connection:

Collaboration, Creativity and Compassion in a Digital Society

Designing XR learning scenarios with GenAI for situated judgement

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Extended reality (XR) learning environments can support situated practice where conventional teaching is risky, costly, difficult to standardise or unable to reproduce authentic decision-making conditions. However, immersive fidelity alone does not guarantee learning. The educational value of XR depends on whether learners notice meaningful cues, interpret context, make decisions, justify action, reflect on consequences and transfer judgement. This conceptual paper operationalises the Prompt to Practice XR Framework as a context-managed conversational prototyping protocol for designing XR learning scenarios with generative artificial intelligence. Design-based research (DBR) provides the methodology through which the protocol is implemented, evaluated and iteratively refined across authentic educational contexts. Each design phase produces a validated design artefact that becomes the input for the next phase. The protocol moves from learning rationale and scenario architecture through platform translation, evidence planning, evaluation and redesign. A construction safety pre-placement case demonstrates how the approach supports situated judgement rather than immersive exposure alone. The contribution is a theory-informed operational method that makes XR learning design explicit, assessable and open to evidence-informed refinement while preserving educator judgement.

Keywords: extended reality, generative artificial intelligence, learning design, situated judgement, design-based research, conversational prototyping

Introduction

Extended reality (XR) learning environments are increasingly used to support simulation, rehearsal and situated practice in higher education. Their educational appeal lies in the capacity to create practice conditions that may be dangerous, costly, difficult to standardise or impractical to reproduce through conventional teaching. Bailenson's (2018) Dangerous, Impossible, Counterproductive and Expensive (DICE) framing is useful because it identifies when XR may be educationally justified. However, DICE provides only a threshold rationale for XR use. It does not explain how learning should be designed once an immersive environment is selected.

The central design problem is that immersive fidelity can be mistaken for educational quality. A visually convincing simulation may still be pedagogically weak if learners are not positioned in meaningful roles, required to interpret relevant cues, supported to make decisions, and guided to reflect on consequences. The Cognitive Affective Model of Immersive Learning (CAMIL) identifies presence and agency as key affordances of immersive learning, mediated by embodiment, motivation, cognitive load, self-efficacy and self-regulation (Makransky & Petersen, 2021).

Recent reviews similarly caution that immersive learning effectiveness depends on active engagement, practical application, instructional design and implementation conditions rather than novelty alone (Conrad et al., 2024; Stretton et al., 2024). This issue has become more pressing as generative artificial intelligence (GenAI) and natural language production tools enter educational design workflows. GenAI can accelerate the drafting of scenarios, branching pathways, facilitator notes, rubrics and production briefs. However, faster production can also accelerate weak design when pedagogical reasoning is not made explicit, critiqued and systematically validated.

When educators begin with broad generative prompts (e.g., "write a simulation scenario"), the resulting outputs may appear coherent yet lack the pedagogical structure required to support situated judgement. This concern aligns with GenAI learning research showing that GenAI can support learning performance and self-efficacy, but that excessive reliance and cognitive outsourcing may weaken knowledge acquisition, depth and transfer (Hou et al., 2026; Pallant et

al., 2026).
This paper introduces a design-based research (DBR) informed approach for creating XR learning scenarios with GenAI while preserving educator judgement. Building on the Prompt to Practice XR Framework (Birt & Cochrane, 2026), it operationalises the framework as a context-managed conversational prototyping protocol. The Prompt to Practice XR Framework provides the conceptual design structure, the conversational prototyping protocol specifies how educators enact and validate each design stage through design artefacts, and DBR provides the methodology through which the protocol is implemented, evaluated and iteratively refined across authentic educational contexts.

Judgement-centred XR learning design

This paper positions effective XR learning design as judgement-centred. Judgement refers to the learner's capacity to notice relevant cues, interpret contextual information, make decisions under uncertainty, justify action, receive feedback, reflect on consequences and transfer reasoning to future practice. This framing shifts the focus from immersive exposure to learning conditions in which disciplinary or professional judgement can be enacted, observed and evaluated while supporting learner agency (Blaschke et al., 2021).

Situated and authentic learning theory provides the foundation for this position. Learning is strengthened when learners engage in meaningful activity within recognisable contexts of practice, rather than encountering knowledge as decontextualised content (Herrington et al., 2009; Lave & Wenger, 1991). In XR scenario design, learners should not merely view an environment or select responses to isolated questions. They should be positioned in a role that requires action within a meaningful situation. Work on embodied and mixed reality learning similarly emphasises authentic activity, learner agency and practice-oriented environments (Aguayo et al., 2018, 2020).

Cognitive apprenticeship explains why cue mapping and decision architecture are central to the proposed method. Professional judgement often depends on tacit forms of noticing, sequencing, prioritisation and interpretation that are difficult for novices to access. Collins et al. (1989) describe modelling, coaching, scaffolding, articulation, reflection and exploration as mechanisms for making expert practice visible and learnable. Applied to XR learning design, this means that environmental cues, decision points, facilitator prompts and debrief questions should surface expert reasoning and allow learners to explain not only what they noticed, but why it mattered.

Together, these theories provide the design logic underpinning the proposed protocol. DICE establishes when XR is educationally justified. Situated and authentic learning explain why role and context matter. Cognitive apprenticeship explains why expert noticing and reasoning should be made explicit. CAMIL explains why agency, embodiment, cognitive load and self-regulation must be intentionally designed rather than assumed. Finally, GenAI critical reliance research explains why conversational outputs require structured educator validation. Collectively, these perspectives support a judgement-centred approach in which XR learning scenarios are designed and evaluated according to whether learners notice, interpret, decide, justify, reflect and transfer.

Operationalising the Prompt to Practice XR Framework through DBR

The Prompt to Practice XR Framework provides the conceptual foundation for this paper (Birt & Cochrane, 2026). It comprises eight linked stages that make pedagogical reasoning explicit throughout XR learning design. This paper operationalises the framework as a conversational prototyping protocol. Whereas the framework defines the stages of good design, the protocol specifies how design work is enacted, validated and translated into evidence for evaluation and redesign. DBR provides the methodological structure through which the protocol is implemented, evaluated and iteratively refined across authentic educational contexts (Cochrane et al., 2024; McKenney & Reeves, 2019).

Figure 1 maps the Prompt to Practice XR Framework onto the phases of DBR. Early stages align with analysis and design, middle stages support iterative prototyping and implementation, and later stages emphasise evaluation, redesign and transfer. The mapping makes the protocol researchable because the outcome is not only an XR scenario but also a documented design process that preserves pedagogical reasoning, supports situated judgement and generates evidence for iterative refinement.

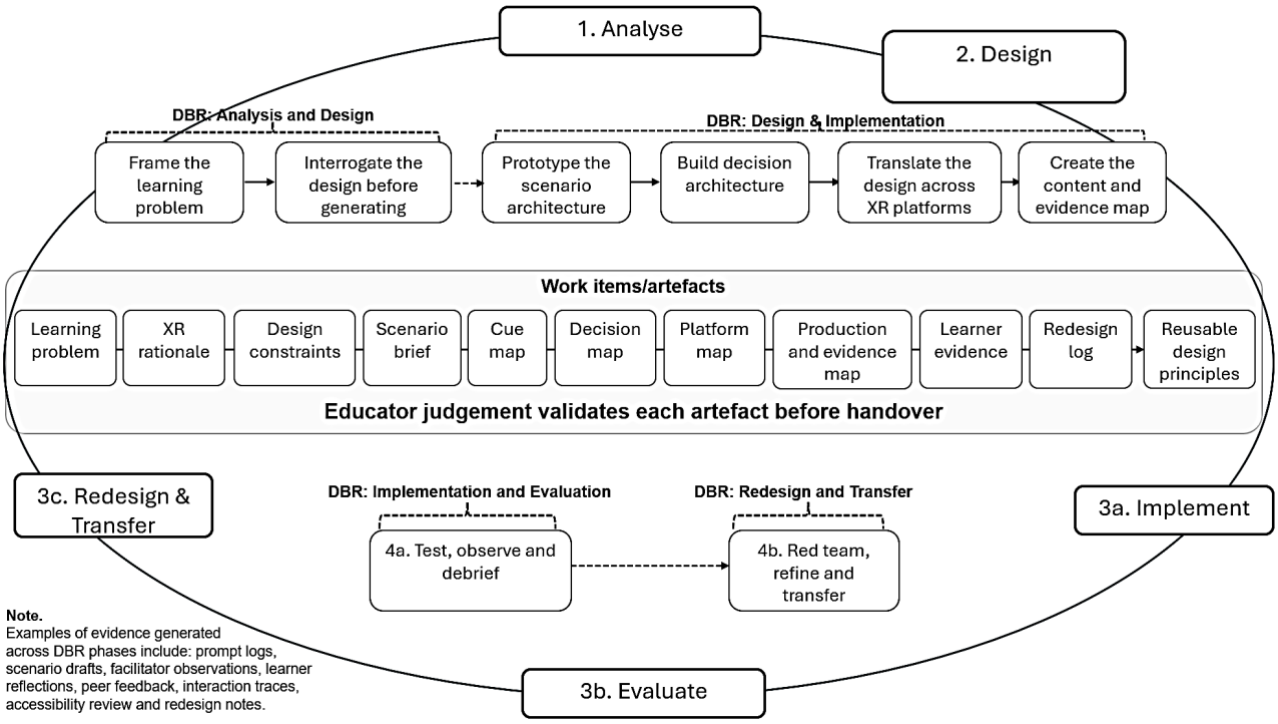


Figure 1. Operationalising the Prompt to Practice XR Framework (Birt & Cochrane, 2026) through DBR.

Vibe coding as conversational scenario prototyping

Vibe coding is not treated as informal software generation or as a replacement for design expertise. Instead, it is used to describe conversational scenario prototyping, where natural language interaction externalises, tests and refines XR learning scenarios before production. This interpretation aligns with emerging work on AI-assisted educational prototyping that emphasises human judgement, contextual educational goals and structured evaluation (Ng & Chow, 2026). The protocol in Table 1 is context-managed because conversational systems cannot be assumed to retain all prior design information across extended interactions. Each phase therefore concludes with a validated context summary that becomes the authoritative input to the next phase, reducing design drift while providing an auditable design artefact. The protocol embeds prompting within DBR as a learning design method rather than a shortcut around pedagogy (Luo et al., 2025).

Table 1
Context-managed protocol for operationalising judgement-centred XR scenario design

DBR phase	Framework work	Artefact produced	Validation focus	Evidence produced
1. Analyse and design	Frame learning problem and interrogate assumptions	XR rationale and constraints	Learner group, DICE fit, assessment purpose, access	Prompt logs, design assumptions, educator notes
2a. Design Prototype and implement	Build scenario, cue map and decision architecture	Scenario brief, cue map, decision map	Authenticity, cue relevance, decision quality, cognitive load	Scenario drafts, cue map, decision map
2b. Translate design and plan	Select the XR format and map production and evidence	Platform map and production/evidence map	Platform fit, feasibility, access and evidence capture	Production notes, accessibility review and evidence plan
3. Implement and evaluate	Test, observe and debrief	Learner activity and debrief evidence	Cue recognition, justification, escalation logic and reflection	Observations, interaction traces, reflections and peer feedback

4. Refine and transfer	Red-team, refine and transfer	Redesign log and reusable principles	Assessment validity, facilitator burden and transferability	Redesign notes, revised artefacts and transfer principles

Construction safety worked case

A safety pre-placement scenario is used to demonstrate the conversational prototyping protocol. The case is appropriate because it involves situated risk, professional judgement and practice conditions that are difficult to reproduce consistently through conventional teaching. Learners preparing for site placement must recognise hazards, prioritise risk, justify action and escalate concerns before entering live or restricted construction environments. The scenario positions learners as junior site supervisors undertaking a pre-start walkthrough of a partially completed multi-storey construction site. Subcontractors are due to enter the area within 15 minutes. The educational objective is not recall of safety rules but situated judgement. Learners must notice relevant environmental cues, interpret relationships between hazards, decide on an appropriate response, justify their reasoning and reflect on how those decisions transfer to future practice. The protocol guides the educator through successive design stages from learning rationale through scenario architecture, cue mapping, decision architecture, platform translation and production planning. At each stage, the validated artefact produced becomes the authoritative input to the next stage, preserving design intent while creating an auditable record for evaluation and redesign. A representative prototyping prompt illustrates how validated artefacts are carried forward between stages:

> *Using the validated scenario brief and cue map, generate three decision points for the construction safety scenario. For each decision point identify the environmental cue, judgement required, possible learner actions, consequences, facilitator observation prompts, evidence of decision quality and a debrief question. Avoid simple right-or-wrong quiz logic. Finish with a validated context summary to support the next design stage.*

Rather than illustrating prompting alone, the example demonstrates how validated artefacts are carried forward between protocol stages to produce a decision map and context summary for subsequent design.

Outcomes and discussion

The protocol produces outcomes at four levels: design artefacts, workflow continuity, learner judgement, and implementation evidence. Together these outcomes make pedagogical reasoning explicit, reduce design drift and support handover between educators, learning designers, facilitators and technical teams. The protocol extends the Prompt to Practice XR Framework from a conceptual design framework to an operational design method by specifying how artefacts are produced, validated, transferred and evaluated through DBR. Conversational prototyping is positioned as a learning design method rather than a substitute for educational expertise, consistent with emerging evidence that GenAI adds educational value when used through structured processes and human judgement (Hou et al., 2026; Pallant et al., 2026). The worked case demonstrates this approach while illustrating how prompt logs, context summaries, learner evidence and redesign artefacts can be examined across iterative DBR cycles. Future work should evaluate the protocol across authentic XR learning contexts.

Conclusion

This paper has presented a design-based research informed approach for designing XR learning scenarios with generative artificial intelligence while preserving educator judgement. It argues that effective XR learning design should be centred on situated judgement rather than immersive exposure alone. Building on the Prompt to Practice XR Framework, the paper operationalises this position as a context-managed conversational prototyping protocol that guides educators from learning rationale through scenario architecture, cue mapping, decision architecture, platform translation, production and evidence planning, evaluation and redesign. The contribution is an operational method that makes pedagogical reasoning explicit through validated design artefacts, enabling XR learning scenarios to be more transparent, assessable and researchable. GenAI is positioned as a design partner that supports the articulation, testing and refinement of educational reasoning rather than replacing the pedagogical judgement that gives immersive learning its educational value. Future work should evaluate the protocol across authentic XR learning

contexts to determine its impact on design quality, facilitation and learner judgement.

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