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Expert Validation of an Extended Reality Framework for Outcome-based Education: A Proposed Validation Protocol

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Dr. Aidrina Sofiadin§*

*Corresponding Author

§ Kulliyyah of Information and Communication Technology, International Islamic University Malaysia (IIUM), Kuala Lumpur, Malaysia

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Extended Reality (XR) | Outcome-Based Education (OBE) | Expert Validation | Delphi Method | Content Validity Index | Higher Education | Immersive Learning

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Abstract

Extended Reality (XR) technologies, encompassing Virtual Reality (VR), Augmented Reality (AR), and Mixed Reality (MR), hold transformative potential for Outcome-Based Education (OBE), yet frameworks to guide their systematic, outcomes-aligned integration into higher education remain scarce and insufficiently validated. Existing XR instructional design frameworks specify general pedagogical planning procedures without explicit alignment with graduate outcome accreditation regimes, such as those governing ASEAN higher education. This paper proposes an expert validation protocol for an eight-step XR-OBE integration framework spanning learning outcome identification, technology assessment, curriculum integration, pilot programme development, experiential implementation, data collection, iterative refinement, and continuous quality improvement. The proposed validation employs a mixed-methods design that combines Content Validity Index (CVI) scoring, an interrater reliability check using a modified kappa statistic, structured expert rubrics, focus group discussions, and a two-round Delphi consensus technique with seven purposively selected academic and industry experts. The paper specifies expert selection criteria, validation instruments, a six-phase protocol with explicit entry and exit criteria, and a convergent mixed-methods analytical plan grounded in established trustworthiness criteria. Anticipated outcomes include a content-validated, evidence-based framework suitable for adoption across higher education institutions (HEIs) and scalable within Malaysia's MySTIE Education and Ekonomi MADANI policy agendas, together with a reusable validation protocol transferable to other emerging educational technology frameworks.

Keywords: *Extended Reality (XR), Outcome-Based Education (OBE), Expert Validation, Delphi Method, Content Validity Index, Higher Education, Immersive Learning, Curriculum Design*

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1. Introduction

The rapid proliferation of immersive technologies in educational settings has prompted educators and policymakers to seek structured guidance for their adoption. Extended Reality (XR) is a superset of VR, AR, and MR that has demonstrated significant promise in facilitating experiential learning, enhancing engagement, and supporting the acquisition of complex skills. A systematic review of 295 XR studies in higher education across 48 countries (Burke, Crompton, & Nickel, 2025) confirms that adoption has accelerated markedly since 2020, with a concentration in professional training, STEM education, soft skills development, general education, and assessment. Theoretically, Dede (2009) frames immersion as the subjective sense of participating in a comprehensive, realistic experience that supports multiple perspectives, situated learning, and transfer, while the Cognitive Affective Model of Immersive Learning (CAMIL; Makransky & Petersen, 2021) specifies the psychological mechanisms, such as presence, agency, and six cognitive-affective factors, through which immersive virtual reality produces knowledge acquisition and transfer. In the context of Outcome-Based Education (OBE), which foregrounds the alignment of teaching, learning, and assessment with predefined graduate competencies, integrating XR is a compelling yet methodologically complex endeavour.

Despite this growing evidence base, a notable gap persists: a few frameworks offer practitioner-ready, step-by-step guidance that is simultaneously grounded in OBE principles and empirically validated by domain experts. Even the most recent general-purpose XR instructional-design frameworks illustrate this gap. XR2Learn (Karachristos et al., 2026), for instance, extends established models such as ADDIE and ASSURE to address the spatial, embodied, and interactive characteristics of immersive environments, and was itself subjected to a thorough multi-round Delphi evaluation involving twenty specialists. However, its validation identified persistent gaps in practical performance, accessibility, and the explicit usage of XR-specific constructs such as presence and social interaction and, notably, it does not address alignment with formal graduate-outcome accreditation requirements. The eight-step XR-OBE integration framework shown in Figure 1 addresses this compound gap by providing a cyclical, continuous quality-improvement model that spans the full lifecycle of XR adoption, from identifying learning outcomes to scaling and refining the XR experience and is explicitly mapped onto OBE curriculum design logic.

However, the credibility and transferability of any educational framework rest on the rigour of its validation. Without systematic expert review, a framework risks being theoretically sound but practically unfit for diverse institutional contexts. This paper therefore proposes a structured expert validation protocol that will focus on the XR-OBE framework to be validated by scholars and practitioners across XR technology, OBE curriculum design, educational technology, instructional design, and industry practice.

The objectives of this study are to: (1) design a expert validation protocol for the XR-OBE integration framework; (2) identify appropriate instruments and criteria for assessing content validity, OBE alignment, pedagogical soundness, feasibility, and usability, including an inter-rater reliability check that corrects for chance agreement; and (3) outline an analytical plan such as quantitative, qualitative, and trustworthiness-oriented that yields defensible evidence of the framework's validity for publication and institutional adoption.

The remainder of this paper is organised as follows. Section 2 reviews related work on XR in higher education, OBE principles, and framework-validation methodology, and positions the proposed framework relative to comparable recent work. Section 3 presents the XR-OBE framework itself. Section 4 details the proposed validation protocol, including expert panel composition, instruments, and phased procedure. Section 5 outlines the data analysis plan. Sections 6 through 9 address ethical considerations, expected outcomes and contributions, limitations and future directions, and concluding remarks, respectively.

2. Background and Related Work

2.1. XR in Higher Education

XR technologies have been studied extensively across medical education (Pottle, 2019), engineering training (Hamilton et al., 2021), and humanities learning environments (Southgate, 2020). The systematic review by Burke et al. (2025) confirms that XR adoption in higher education has grown rapidly since 2020, while a complementary review of 95 studies (Sümer & Vančeček, 2024) reports that medical and health-science courses remain the dominant application context, with simulation-based pedagogy the most frequently deployed instructional strategy. Meta-analytic and narrative review evidence converges on moderate-to-large effect sizes for VR-enhanced learning on knowledge retention and engagement. At the same time, AR overlays support spatial reasoning in STEM disciplines and MR environments enable real-time collaborative problem-solving.

Beyond effect-size evidence, theoretical models increasingly explain why XR supports learning. CAMIL (Makransky & Petersen, 2021) specifies presence and agency as the core psychological affordances of immersive virtual reality, mediating six cognitive-affective factors: interest, motivation, self-efficacy, embodiment, cognitive load, and self-regulation that jointly determine knowledge acquisition and transfer. Extending this line of enquiry to adoption behaviour, Al-Adwan et al. (2023) apply an extended Technology Acceptance Model to show that perceived usefulness, personal innovativeness, and perceived enjoyment, rather than ease of use, drive students' intentions to adopt metaverse-based learning platforms, underscoring that pedagogical design, not technological novelty alone, determines uptake. The XR-OBE framework draws on this theoretical base: Step 1 (Identify Learning Outcomes) and Step 3 (Curriculum Integration) operationalise CAMIL's emphasis on aligning XR affordances with intended cognitive outcomes. In contrast, Step 4 (Pilot Programme and Training) addresses the adoption-related barriers identified in the technology-acceptance literature.

Within Malaysian higher education, initiatives aligned with MySTIE Education and the national Ekonomi MADANI agenda signal increasing institutional receptiveness to technology-enhanced learning. Nevertheless, the gap between awareness of XR's potential and systematic, outcome-aligned deployment remains wide, and practitioners continue to lack actionable frameworks validated within educational contexts.

2.2. Outcome-Based Education Principles

OBE, as conceptualised by Spady (1994) and operationalised by ASEAN higher education accreditation bodies, including the Malaysian Qualifications Agency (MQA), mandates that curriculum design begin with clearly articulated graduate attributes and work backwards through instruction and assessment. The second edition of the Malaysian Qualifications Framework (MQA, 2024) reaffirms this outcomes-first orientation, consolidating learning-outcome domains across the Academic and TVET sectors and strengthening institutional accountability for demonstrable graduate competencies. The Constructive Alignment model (Biggs & Tang, 2011) is foundational to OBE and provides the theoretical bridge between learning activities, including XR experiences and measurable learning outcomes.

Integrating XR into OBE therefore demands more than technological deployment. It requires deliberate curriculum mapping, outcome specification, and evidence-based evaluation of whether immersive experiences produce the intended competencies, a requirement that existing XR instructional-design literature rarely operationalises against formal accreditation frameworks (see Section 2.4).

2.3. Framework validation in Education research

Expert validation is an established methodology for ensuring that educational frameworks, instruments, and models have content validity prior to empirical testing. The Content Validity Index (CVI), introduced by Lawshe (1975) and refined by Lynn (1986) and Polit and Beck (2006), provides a quantitative measure of expert consensus on the relevance of each framework component. CVI scores at the item level (I-CVI ≥ 0.78) and at the scale level (S-CVI/Ave ≥ 0.90) are widely accepted thresholds in educational and health sciences research (Zamanzadeh et al., 2015). Polit, Beck, and Owen (2007), however, note that the raw CVI does not adjust for chance agreement among experts; they recommend supplementing CVI with a modified kappa statistic, a refinement adopted in the present protocol (Section 5.1).

The Delphi technique (Linstone & Turoff, 1975) complements CVI by iteratively polling experts until consensus is reached on the items under review, making it particularly well suited to new frameworks as existing evidence grows. Diamond et al.'s (2014) systematic review of Delphi reporting practice highlights substantial inconsistency in how consensus is defined across published studies and recommends that Delphi protocols pre-register explicit stopping rules and consensus thresholds, a recommendation incorporated into the phased protocol described in Section 4.5. Together, CVI and Delphi provide a robust, mixed-methods foundation for establishing content validity prior to empirical field trials.

2.4. Positioning Relative to Existing XR Instructional Frameworks

The most directly comparable recent work is XR2Learn (Karachristos et al., 2026), a hybrid instructional-design framework for XR-based education validated through a multi-round Delphi study involving twenty specialists in instructional design and

Table 1. Positioning of the XR-OBE Framework Relative to Comparable XR Instructional Frameworks

Framework	Primary Focus	Validation Approach	OBE / Accreditation Alignment	Panel Size
XR-OBE Framework (this paper)	Full-lifecycle XR integration mapped to graduate outcomes	CVI + modified kappa + Delphi + focus group discussion (triangulated)	Explicit (MQA/OBE-aligned)	7 experts
XR2Learn Hybrid Instructional Design Framework (Karachristos et al., 2026)	XR-specific instructional design procedure (extends ADDIE/ASSURE)	Multi-round Delphi	Not addressed	20 experts
CAMIL (Makransky & Petersen, 2021)	Theoretical model of cognitive-affective mechanisms in immersive VR learning	Conceptual synthesis of empirical literature (not an empirical validation protocol)	Not addressed	N/A

XR-enhanced education. XR2Learn extends established models such as ADDIE and ASSURE to address the spatial, embodied, and interactive characteristics of immersive environments; its validation identified persistent gaps in practical enactment, accessibility, and the explicit treatment of XR-specific constructs such as presence and social interaction. While methodologically rigorous, XR2Learn, like ADDIE- and ASSURE-derived models generally, is discipline- and outcome-agnostic: it specifies how to design XR instruction but not how that instruction maps onto predefined, accreditation-bound graduate competencies. Table 1 situates the proposed XR-OBE framework relative to XR2Learn and to CAMIL, the dominant theoretical (rather than procedural) account of XR-based learning.

This positioning clarifies the paper's contribution: rather than proposing a new theory of XR-based learning or a generic XR instructional-design procedure, the XR-OBE framework operationalises existing theoretical and procedural knowledge into an OBE-accreditation-aligned, cyclically self-improving protocol, validated through a triangulated CVI–Delphi–focus-group design that additionally corrects for chance agreement via modified kappa, a methodological refinement absent from the single-method Delphi validation reported for XR2Learn.

3. The Proposed XR-OBE Integration framework

The framework under validation comprises eight sequential, cyclical steps designed to guide higher education practitioners through the full lifecycle of XR integration within an OBE context, illustrated in Figure 1. Grounded in the theoretical constructs reviewed in Section 2.1, the framework treats learning-outcome specification (Step 1) and outcome-mapped content selection (Step 3) as prerequisites for meaningful immersion, consistent with CAMIL's emphasis on aligning technological affordances with intended cognitive outcomes rather than deploying XR for novelty alone. The steps are:

1. Identify Learning Outcomes: Define pedagogical objectives and target engagement levels, ensuring alignment with programme-level graduate attributes.
2. Assess Available XR Technologies: Evaluate the spectrum of XR options (VR, AR, MR) against institutional budget and infrastructure resources.
3. Curriculum Integration: Map selected XR experiences to existing curriculum units, selecting content most appropriately delivered through immersive modalities.
4. Develop a Pilot Programme and Training: Select a student cohort, co-design realistic scenarios, establish resource-sharing protocols, and provide professional development for educators.
5. Implement the XR Experience: Schedule and facilitate XR sessions with attention to safety, inclusivity, and technical contingency.
6. Data Collection and Analysis: Systematically collect engagement data, learner feedback, and performance metrics to identify areas for improvement.
7. Refine and Scale: Adjust content and delivery based on evidence, then scale successful interventions across cohorts or disciplines.
8. Continuous Quality Improvement: Institute updates and long-term evaluation cycles to ensure sustained effectiveness and relevance.

The cyclical design of the framework reflects the iterative nature of OBE quality assurance and mirrors established continuous-improvement cycles such as Plan-Do-Study-Act (PDSA) and Deming's PDCA. Each step interlocks with adjacent steps through feedback mechanisms, ensuring that insights from data collection (Step 6) inform both immediate refinement (Step 7) and long-term quality improvement (Step 8), which in turn re-triggers outcome identification (Step 1) for subsequent cohorts or disciplines.

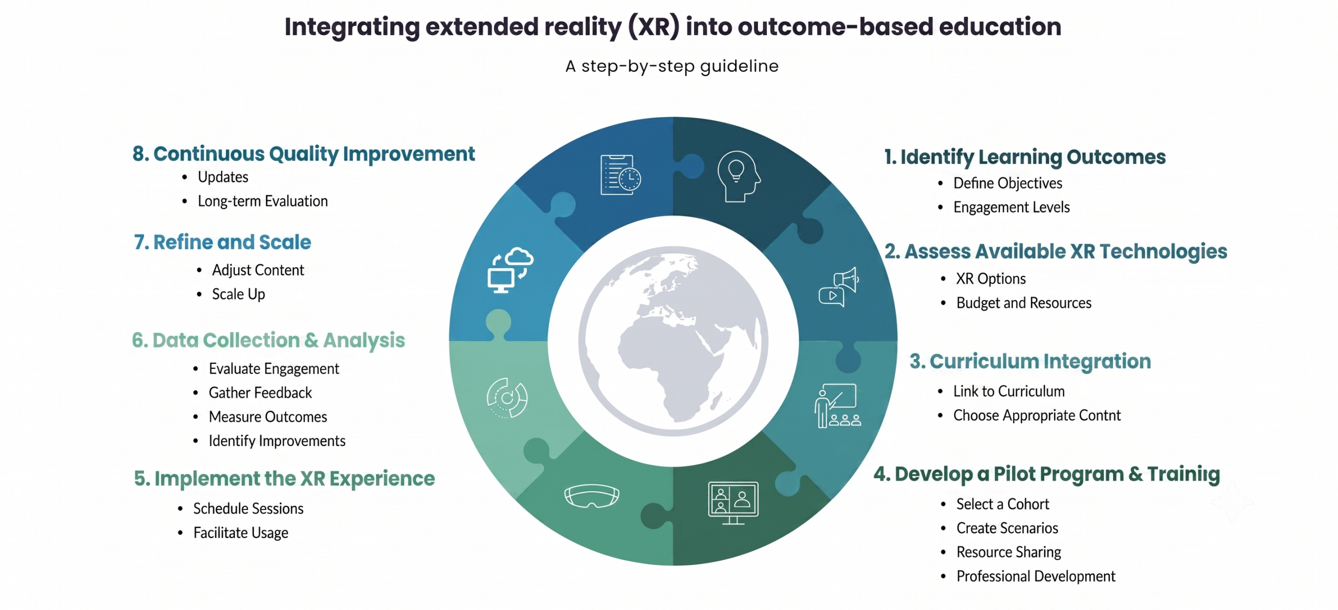

Figure 1. The Eight-Step XR-OBE Integration Framework (Sofiadin, 2025)

Table 2. Expert Panel Profile and Qualification Criteria

Expert	Designation	Institution	Domain	Years Exp.
E1	Professor / XR Researcher	Public University	XR & Immersive Learning	18
E2	Associate Professor	Public University	OBE & Curriculum Design	14
E3	Senior Lecturer	Public University	Educational Technology	7
E4	Instructional Designer	Higher Ed Institution	VR/AR Content Design	16
E5	Curriculum Specialist	Public University	OBE Policy & Quality	8
E6	XR Solutions Architect	Industry (XR Technology Firm)	XR Product Development & Deployment	10
E7	Professor	Public University	Instructional Design & Curriculum Evaluation	20

4. Proposed Expert validation Protocol

4.1. Research design

A mixed-methods validation design is proposed that combines quantitative CVI scoring with qualitative expert feedback and Delphi consensus rounds. This approach reflects best practices in educational framework validation (Grant & Davis, 1997; Yusoff, 2019) and ensures that both the statistical rigour of content validity measurement and the rich contextual insight of expert judgement are captured. To address a recognised weakness of CVI — its failure to adjust for chance agreement (Polit, Beck, & Owen, 2007), the design additionally incorporates a modified kappa statistic as a secondary reliability check (Section 5.1).

4.2. Expert Panel Composition

A panel of seven experts will be recruited through purposive sampling to ensure representation across the key domains relevant to the framework: XR technology, OBE curriculum design, educational technology, instructional design, and industry practice. The recommended expert profile is described in Table 2. Seven experts are consistent with Polit and Beck's (2006) recommendation for novel frameworks and provide statistical adequacy for CVI calculation; recruitment will draw on professional networks, relevant conference communities, and industry partners to ensure the panel spans both academic and applied XR expertise.

4.3. Inclusion Criteria for Expert Selection

To be included in the expert panel, candidates must satisfy a minimum of three of the following criteria:

- Holds a doctoral degree in a relevant field (Educational Technology, Computer Science, Curriculum Studies, or a related discipline)
- Has a minimum of five years of experience in XR development, XR research, or OBE implementation
- Has published at least two peer-reviewed articles in XR, immersive learning, or OBE within the past five years
- Has held a leadership role in curriculum design or technology integration at a recognised higher education institution
- Has demonstrable industry experience in XR product development for educational applications

Candidates with an unresolved conflict of interest with the research team (e.g., direct supervisory or co-authorship relationships within the preceding two years) will be excluded, consistent with the independence requirements typically expected of content-validity expert panels.

Table 3. Validation Instruments and Their Purposes

Instrument	Purpose	Key Criteria
Content Validity Index (CVI)	Measure relevance and clarity of each framework component	Item-CVI ≥ 0.78; Scale-CVI/Ave ≥ 0.90; modified kappa ≥ 0.74 (excellent)
Expert Judgement Rubric	Assess completeness and coherence of the 8-step guideline	Accuracy, Comprehensiveness, Feasibility, Alignment
Open-Ended Feedback Form	Capture qualitative suggestions and improvements	Thematic analysis via NVivo
Delphi Consensus Round	Achieve consensus on ambiguous or debated items	Consensus ≥ 70%; IQR < 1.5

Table 4. Expert Validation Protocol Phases

Phase	Activity	Description	Output
Phase 1	Expert Recruitment	Purposive sampling of 7 experts across XR, OBE, and EdTech domains	Expert Panel Confirmed
Phase 2	Document Review	Experts review framework document, background literature, and visual guideline (Figure 1)	Annotated Feedback
Phase 3	Structured Validation Survey	Likert-scale rating (1–5) on content validity, clarity, feasibility, and OBE alignment	CVI Scores, Modified Kappa, and Ratings
Phase 4	Focus Group Discussion	Online FGD to discuss findings, resolve ambiguities, and refine components	Consensus Minutes
Phase 5	Delphi Round (if needed)	Second-round survey for items with low consensus (< 70%)	Final Consensus Data
Phase 6	Framework Refinement	Revise framework based on expert input; produce validated version	Validated XR-OBE Framework

4.4. Validation Instruments

Four complementary instruments will be deployed across the validation phases to ensure comprehensive triangulation of expert judgement. These are summarised in Table 3.

The primary instrument is a structured validation survey comprising: (a) a five-point Likert scale rating each framework component on relevance, clarity, completeness, and feasibility; (b) a CVI rating question (relevant / not relevant) for each of the 8 steps and their sub-components; and (c) open-ended fields for elaborative comments and suggestions. Prior to full deployment, the survey will be piloted with two experts outside the main panel to assess item clarity and completion time, consistent with recommended instrument development practices (Grant & Davis, 1997). The survey will be administered digitally via a secure, purpose-built form and, if Delphi iteration is required, in two rounds.

4.5. Validation Phases

The validation process is structured across six phases to ensure systematic, traceable, and defensible evidence generation, with an indicative overall duration of four to six months. The phased protocol is outlined in Table 4.

Each phase is designed with explicit entry and exit criteria, following Diamond et al.'s (2014) recommendation that Delphi protocols pre-register stopping rules. For instance, Phase 3 proceeds only after all seven experts have confirmed receipt of the framework document; Phase 5 (Delphi) is triggered only if any item achieves fewer than 70% expert agreement in Phase 3. This conditional logic minimises unnecessary burden on experts while ensuring rigour.

4.6. Evaluation Criteria and Dimensions

The validation process will assess the framework across six core dimensions, as detailed in Table 5. These dimensions collectively address the intellectual rigour, practical applicability, and pedagogical grounding of the XR-OBE framework.

Table 5. Validation Dimensions, Indicators, and Methods

Dimension	Indicators	Validation Method
Content Validity	Relevance, accuracy, and completeness of each step	CVI rating per item
OBE Alignment	Mapping of XR activities to learning outcomes and competencies	Expert rubric scoring
Technological Feasibility	Practicability of XR options given typical HEI resource constraints	Open-ended feedback + FGD
Pedagogical Soundness	Grounding in constructivist, experiential, and cognitive-affective (CAMIL) learning theory	Expert judgement rubric
Scalability & Sustainability	Potential for long-term adoption across disciplines	Delphi consensus
Clarity & Usability	Comprehensibility of the step-by-step guideline for practitioners	Cognitive walkthrough + FGD

5. Data Analysis Plan

5.1. Quantitative analysis

Item-level CVI (I-CVI) scores will be computed for each of the 8 framework steps and their constituent sub-components by dividing the number of experts rating an item as relevant (4 or 5 on the Likert scale) by the total number of experts. Items with I-CVI below 0.78 will be flagged for revision or elimination. The Scale-level CVI averaging method (S-CVI/Ave) will be computed as the mean of all I-CVI scores; a threshold of ≥ 0.90 will be required for the overall framework to be considered content-valid (Polit & Beck, 2006). Because raw CVI does not correct for the probability that experts agree by chance, each I-CVI will additionally be converted to a modified kappa statistic (κ^*) following Polit, Beck, and Owen (2007), with $\kappa^* \geq 0.74$ interpreted as excellent agreement, 0.60–0.73 as good, and 0.40–0.59 as fair.

Descriptive statistics (mean, standard deviation, interquartile range) will be reported for all Likert-scale ratings across the six validation dimensions. Where Delphi rounds are conducted, convergence will be assessed using the interquartile range (IQR); consensus is defined as IQR < 1.5 with $\geq$ 70% of experts in agreement, consistent with the stopping-rule pre-registration recommended by Diamond et al. (2014).

5.2. Qualitative analysis

Open-ended feedback from the expert survey and FGD transcript data will be subjected to thematic analysis following Braun and Clarke's (2006) six-phase framework, facilitated by NVivo software. Initial codes will be generated inductively, then organised into themes that map to the six validation dimensions. Member-checking will be conducted by sharing thematic summaries with expert panellists before finalisation.

The integration of quantitative CVI/kappa scores and qualitative thematic findings will follow a convergent mixed-methods design (Creswell & Plano Clark, 2018), with quantitative results prioritised for decisions on framework retention, revision, or elimination of components, and qualitative findings used to contextualise and enrich the rationale for revisions.

5.3. Trustworthiness and Rigour

Because the protocol combines quantitative content-validity indices with qualitative expert judgement, trustworthiness will also be assessed against Lincoln and Guba's (1985) four naturalistic inquiry criteria. Credibility is addressed through methodological triangulation across CVI, Delphi, and FGD data sources, as well as through member checking of thematic summaries. Transferability is supported by a thick description of the Malaysian HEI, MQA accreditation, and the MySTIE/Ekonomi MADANI policy context in which the framework is situated, enabling readers in other jurisdictions to assess its applicability to their own settings. Dependability is established through an auditable trail of Delphi-round data, survey versions, and a documented revision log linking each framework change to its supporting evidence. Confirmability is supported by involving researchers not directly engaged in framework development in the coding of open-ended responses, reducing the risk that thematic interpretation is shaped solely by the framework's original authors.

6. Ethical Considerations

All expert participants will provide written informed consent before participation. Participation is voluntary, with the right to withdraw at any stage without consequence. Expert identities will be anonymised in publications, and individual responses will be reported only in aggregate; identifiable data will be stored on access-controlled institutional servers for the duration required by IIUM data-retention policy and then securely destroyed. The study will seek ethical clearance from the IIUM Institutional Research Ethics Committee (IREC) before data collection. Expert panel members with prior working relationships with the research team will be identified through a conflict-of-interest declaration, and their data will be analysed separately to assess any influence on the results.

7. Expected Outcomes and Contributions

Upon completion of the validation protocol, the study anticipates the following outcomes:

- A validated, eight-step XR-OBE integration framework with documented CVI and modified-kappa scores, expert consensus data, and a detailed revision log.
- A reusable, open-access expert validation protocol that can be adapted for validation of other educational-technology frameworks in the Malaysian and broader ASEAN higher education context.
- A peer-reviewed publication presenting validation evidence to the academic community, contributing to the nascent literature on XR framework development and validation, and to the emerging comparative literature exemplified by XR2Learn (Karachristos et al., 2026).
- Practical guidelines for higher education practitioners seeking to adopt the framework, informed by expert-identified implementation considerations and feasibility caveats.

Theoretically, this study contributes to the field of Educational Technology by demonstrating how triangulated, chance-corrected expert validation can be applied systematically to immersive learning frameworks, and by explicitly connecting procedural framework design to cognitive-affective learning theory (CAMIL) and outcomes-based accreditation logic (MQA, 2024). In practice, it provides IIUM's FRGS-EC research project (Reference: FRGS-EC/1/2024/ICT09/UIAM/03/1) with a validated instrument, ready for subsequent empirical field trials in collaboration with industry partners such as GamesMy.

8. Limitations and Future Directions

The proposed validation protocol has several acknowledged limitations. First, the expert panel of seven, while statistically adequate for CVI computation, limits the breadth of perspectives that may be captured compared with larger panels, such as XR2Learn's 20 specialists (Karachristos et al., 2026); future work may employ a larger, internationally representative panel. Second, content validity, while necessary, is not sufficient to establish construct or predictive validity; this paper therefore positions expert validation as a precursor to a full empirical field trial with student participants, mirroring the transitional conceptual-to-classroom trajectory that XR2Learn itself is only beginning to undertake. Third, the cultural and institutional specificity of the Malaysian HEI context, including MQA accreditation requirements and MySTIE Education mandates, means that direct transferability to other national contexts must be approached with caution, notwithstanding the transferability safeguards outlined in Section 5.3.

Future research directions include: (1) empirical field testing of the validated framework in multiple IIUM faculties; (2) co-development of XR content aligned with the framework in partnership with GamesMy; (3) longitudinal evaluation of the framework's impact on graduate-attribute achievement; and (4) adaptation of the framework for secondary education and vocational training contexts under the Ekonomi MADANI human-capital development agenda.

9. Conclusion

This paper has presented a structured expert validation protocol for an eight-step XR-OBE integration framework, addressing a critical methodological gap in the literature on immersive technologies in higher education, a gap that persists even in the most recent general-purpose XR instructional-design frameworks such as XR2Learn. By combining Content Validity Index measurement with a chance-corrected modified kappa check, expert judgement rubrics, focus group discussions, and Delphi consensus methodology, and by grounding the analytical plan in established trustworthiness criteria, the proposed protocol offers a rigorous, transparent, and reproducible approach to framework validation. The resulting validated framework will provide higher education institutions with an evidence-based, practitioner-ready roadmap for systematically integrating XR technologies into OBE curricula, with the potential to enhance graduate competency attainment in the digital era meaningfully.

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