

# The Untapped Potential of Extended Reality for Indigenous Medicinal Knowledge: A Review of Cross-Disciplinary XR Applications

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**Abstract**—Many sectors are quickly moving toward XR for education and professional training. These technologies, which include Virtual, Augmented, and Mixed Reality, are not being applied equally across different types of knowledge preservation. This study aims to review how effective these technologies are and whether they have overlooked the preservation of Indigenous Medicinal Knowledge. Following the PRISMA 2020 guidelines, relevant literature from 2019 to 2026 was gathered from major academic databases, including IEEE Xplore, Scopus, and ScienceDirect. After removing duplicates and non-English papers, 23 out of 39 publications met the selection criteria. The findings show that while XR is a proven technology in many sectors, it remains underused for documenting the medicinal knowledge of communities such as the Kayan and Kenyah. This lack of progress is not caused by technical limitations, but by internal organizational barriers and weak project planning. The evidence, therefore, points to a procedural problem rather than a technological one.

**Keywords**—*Extended Reality; Indigenous Medicinal Knowledge; Virtual Reality; Augmented Reality; Mixed Reality; gamification; cultural heritage preservation; Task-Technology Fit; PRISMA*

## I. INTRODUCTION

Indigenous medicinal knowledge is considered an important foundation for cultural history and community well-being. It includes traditional healing methods and plant knowledge that have been passed down orally across many generations [1]. In this system, medicinal uses are combined with the ecological and cultural values that shape Indigenous worldviews. One example of this can be seen in the Kenyah and Kayan communities of Sarawak, Malaysia, where plant identification and preparation are part of traditional healing practices that have long supported community health. However, this continuity is now under threat.

Traditional ways of passing down this knowledge have been disrupted by modernization, putting these practices at risk of being lost [1]. As younger generations adopt digital lifestyles and attend formal schools that are disconnected from their ancestral roots, these oral traditions face the danger of disappearing permanently.

Extended Reality (XR) is a technology that combines Virtual Reality (VR), Augmented Reality (AR), and Mixed Reality (MR), and it can be proposed as a way to document and preserve

this intangible cultural heritage. XR is an umbrella term that covers AR, which can be accessed through smartphones, tablets, or wearable devices such as the Microsoft HoloLens 2. AR layers images and text onto the user's real physical environment. VR, on the other hand, covers the user's entire field of vision through a headset and places them in a fully virtual space. Mixed Reality sits between AR, VR, and the real world [2].

XR technologies have been shown to create more immersive and effective learning experiences [2], [5]. They have been linked to better learning motivation, interest, creativity, and academic performance, while also being a more time-efficient option compared to traditional methods. XR is already being used as a training tool in medicine, the military, and sports education.

A notable gap exists: although XR is a well-established tool across many high-stakes fields such as chemistry, aviation, mental health, and medical training, it has rarely been applied to preserving Indigenous Medicinal Knowledge. In medicine, XR is used for neurosurgery and dental training [2], [7], [8], [9]. In chemistry education, it supports 3D molecular visualization [21]. Aviation uses it for flight simulation [5], and mental health practitioners apply it in cognitive rehabilitation and exposure therapy [13], [18]. The fact that XR is technically mature in these areas but largely absent from cultural preservation efforts suggests that the main obstacles are not technological, but procedural.

This review addresses the following research questions: 1) How is XR currently used for training in advanced professional fields such as medicine and aviation? 2) What are the main barriers to adopting XR, and how can inclusive design help address them? 3) How can XR technologies be adapted to preserve Indigenous Medicinal Knowledge in community settings?

## II. RESEARCH METHODOLOGY

This systematic literature review was carried out using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 framework [3], which ensures that the process is transparent, reproducible, and methodologically sound. The review comprised four stages: identification, screening, eligibility, and inclusion.