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Evaluating Privacy and Safety Measures for Children in VR-Aided Education: Gaps and Recommendations

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Abstract

The school education system has long adopted emerging technologies to enhance student learning and engagement. This progression spans early e-learning platforms and smart classrooms to today's immersive environments (del Campo et al., 2012). Virtual Reality (VR) and Augmented Reality (AR) technologies are increasingly being introduced into classrooms to offer rich, interactive, and personalised learning experiences (Zizza et al., 2018). These tools can accommodate students from diverse educational, cognitive, and socio-cultural backgrounds through adaptable instructional designs (Romero-Ayuso et al., 2021; Shadiev et al., 2021). However, despite their pedagogical potential, adopting immersive technologies in schools raises serious concerns, especially regarding underage learners' physical health, psychological well-being, and data privacy (Kaimara et al., 2021; Skulmowski, 2023). This paper establishes a position statement by critically examining these risks and proposes key recommendations to support VR's responsible and effective implementation in school settings.

Although research on this matter is limited, physical risks are the most frequently studied (Bexson et al., 2024). Common side effects of VR use in children include visual fatigue (Fan et al., 2023) and cybersickness (Oh & Lee, 2021). Even though these effects are generally considered temporary, research on prolonged exposure is limited, particularly for young users whose visual and neurological systems are still developing. However, the psychological effects are more concerning and less understood. During critical stages of identity formation, excessive or unsupervised VR use may contribute to identity confusion (Segovia & and, 2009), cognitive overstimulation (Juliano et al., 2022), and potentially addictive behaviours (Das et al., 2017). The immersive nature of VR, which blurs the boundaries between real and virtual environments (Segovia & and, 2009), intensifies these risks. Additionally, social VR learning platforms create opportunities for bullying and harassment through masked identities like avatar interactions (Fiani et al., 2024), which are often beyond current legal protections (Prakhar & Rawat, 2024). Such experiences can lead to anxiety, reduced self-esteem, and social withdrawal (Copeland et al., 2013; Pontillo et al., 2019; Sourander et al., 2007), highlighting the need for caution and further study before widespread integration into the educational curriculum.

Equally critical concerns are related to privacy and data security. VR applications can capture thousands of behavioural data points within minutes, including eye gaze, body movements, and facial expressions (Giaretta, 2024; Miller et al., 2020; Pfeuffer et al., 2019). These data can identify users with over 90% accuracy across different sessions and may be used to train predictive models (Kumarapeli et al., 2024). While these applications have potential benefits, collecting and retaining sensitive information from children who cannot legally provide informed consent raises serious ethical and legal questions. With the rapid growth of generative AI, the misuse of such data, including identity theft (Nair, Miller et al., 2024) or unauthorised profiling (Nair, Rack et al., 2024), becomes an increasingly plausible threat.

Despite these concerns, suspending immersive technologies is neither practical nor educationally beneficial. Instead, their integration should be guided by evidence-based research findings. In the meantime, supervised exposure, adherence to guidelines like the 20-20-20 rule, careful content curation, and limited usage time are essential (Meta Platforms, Inc., 2025; Steinberg, 2025). Given that risks vary by age group, content type, and educational context, the implementation of VR should be evaluated on a case-by-case basis rather than through a universal model. A subtle, cautious approach will help ensure immersive technologies serve as inclusive, safe, and effective educational

tools.

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