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Research Article

Students' perceptions of physical magnetic models and immersive virtual reality for chemistry learning

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ABSTRACT

Physical magnetic models and immersive virtual reality (iVR) both support students' grasp of abstract chemistry concepts, yet the distinct affordances of each remain underexplored. In this qualitative study, forty undergraduate chemistry students (twenty pairs) completed learning activities on hydrogen bonds using both magnetic models and iVR. Pre/post semi-structured interviews were transcribed and analysed using a cross-case thematic analysis, beginning with inductive coding and followed by

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interactivity, narrative (task design), and social features – highlighting the features of magnetic models and iVR that shape students' learning experiences. Students reported that the magnetic model activity supported tactile exploration that helped them understand basic molecular concepts like attraction and repulsion. While it offers opportunities to test hypotheses, the magnetic model activity felt individualistic. In contrast, students saw iVR as a collaborative environment where complex tasks, advanced 3D visualisation, and interactivity deepened their understanding of hydrogen bonds. These findings highlight students' distinct perceptions of each tool – magnetic models are effective for tactile, individual explorations, and iVR is valuable for collaboration, problem-solving, and visualising complex structures. Educators should leverage these differing affordances when designing learning experiences to support students' understanding of scientific concepts.

KEYWORDS:[Immersive virtual reality \(iVR\)](#) [students' perceptions](#) [molecular visualisation](#)[physical molecular models](#)**Disclosure statement**

No potential conflict of interest was reported by the author(s).

Data availability statement

The data supporting the findings of this study are not publicly available to protect the confidentiality and privacy of the participants. Access to the data is restricted in accordance with ethical guidelines and institutional policies.

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