

Study of the Effectiveness of Biochemistry Education Through the Gamification Driven by Virtual Reality Technology

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Abstract

Virtual reality (VR) is a technology for users to experience an immersive artificial environment, such as virtual laboratory (VL) that is highly realistic to real world setting. For biochemistry education (BE), VL allows students to practise and acquire various subject knowledge (SK) and laboratory skills. Since 2017, we have conducted a series of studies focusing on the effectiveness of VL games (VLGs) on BE by integrating game-based design, such as guided play (GP) and competitive games, into our VLGs. Quantitative studies consistently indicated 1) increased level of user perception of VLGs, 2) improved SK, and 3) improved test performance. Qualitatively, VLGs were frequently described by the users as ‘fun’, ‘interesting’, ‘informative’, ‘realistic’, and ‘satisfying’; yet, comments of VLGs, such as ‘too few’ and ‘too short’ were also received. Moreover, biochemistry teachers rated our VLGs positively in terms of 1) capturing student attention, 2) fun VLGs, and 3) overall satisfaction of VLGs. Focus group study offered some technical feedbacks regarding VLG user experience improvement. In addition, our results suggested that the VLGs were best used for the practice of experimental procedures, and it was also identified that students with little background knowledge were the most likely to get benefits from the VLGs. Taken together, GP in the VL was observed to be a promising way of learning experimental procedures; where the major limitation was the production of suitable educational VLGs and VR hardware availability. Given the strengths of VLGs, further pedagogical study shall be performed for biosafety and bioethics education.

Keywords: constructivism; experiential learning; pedagogical study; science education; virtual lab