The Impact of Kinesiology XR-Immersive Labs for Motor Control Learning Attitudes

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Introduction

Extended Reality (XR) refers to all real-and-virtual combined environments generated by computer technology and wearables, and includes Augmented Reality (AR), Virtual Reality (VR), and Mixed Reality (MR).

Compared with traditional education, XR immersive education has obvious advantages in teaching theoretical knowledge as well as practical skills training. Despite some efforts of utilizing XR immersion in K-12 education, research on XR immersion in the postsecondary environment is very limited [1]. The Movement in eXtended Reality Lab was developed at California State University San Marcos to help motivate students and experience hands-on scenarios otherwise limited or impossible in a traditional learning environment.

John Keller's ARCS model [2] asserts that motivation to learn is comprised of the degree to which the learner becomes engaged in the learning experience through elements of attention, relevance, confidence, and satisfaction. The aim of the study was to determine attention, satisfaction, relevance, and confidence of the undergraduate students using the XR-immersive labs in a Motor Control and Leaning course.

Methods

Participants

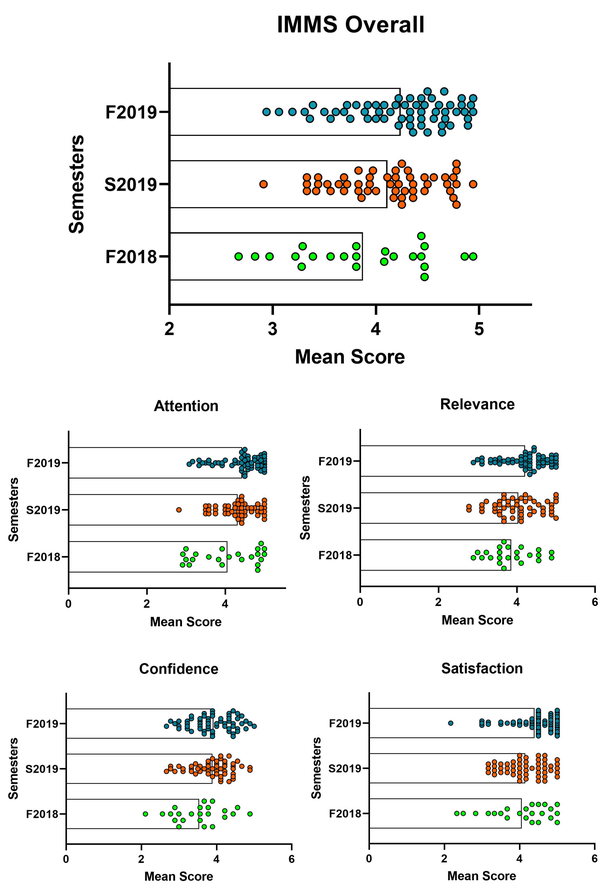
A total of 148 participants, composed of juniors and seniors, were solicited from an upper division undergraduate course entitled Kinesiology 301: Motor Control and Learning at California State University San Marcos across three semesters.

Data Analyses

For the IMMS, question ratings in each construct were averaged for a construct score. Mean of four construct scores was used for the overall score. Kruskal-Wallis test was used to compare IMMS scores across semesters. Post-hoc analysis was completed using Dunn's multiple comparisons test, and $p < 0.05$ was considered significant.

Regarding the reflexive analysis of the qualitative data, provenances were used to track the source location of each datum. A quasi-inductive approach was used, which allowed the selection of IMMS constructs as pre-determined themes before the sampling and coding process. The data analysis consisted of open and selective coding.

Instructional Materials Motivation Survey



Student Reflections

Attention

"Many of the XR labs have been engaging… I'm excited to learn from our next XR labs and develop a better understanding of how XR technology improves motor performance and skills." (Q5, S6)

XR-immersive labs were able to stimulate and sustain students' curiosities and interests.

Relevance

"I really enjoy having this integration to the labs because it gives a different perspective on learning concepts such as center of pressure, where it would not have been understood as well [in traditional labs]. The roller coaster XR showed how our brain will basically trick our body..." (Q1, S31)

Students believed that the XR-immersion was related to important personal and professional goals or motives.

Confidence

"The material that we are learning is very complex and it is beneficial to have such an active experience compared to the typical passive experience…Using VR helps me remember lab better because it was such an exciting visual that it is hard to forget." (Q2, S15)

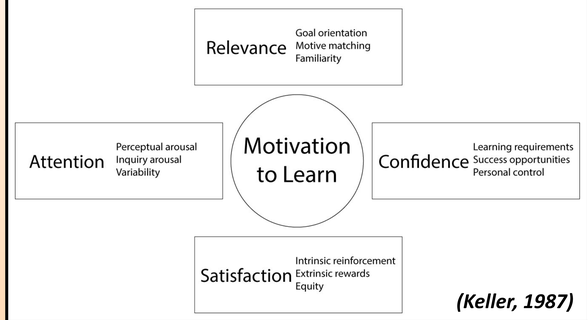
As student understanding of the course material increased so did their overall level of perceived self-efficacy using VR.

Satisfaction

"I can remember every lab we have done…and I enjoyed every single lab. Every lab gave me a greater appreciation for XR, and now when I hear we are doing XR labs, I look forward to our lab days." (Q4, S1)

XR was perceived by the students as an enjoyable teaching method for lab which was a motivating factor.

The ARCS Model



(Keller, 1987)

Discussion & Conclusions

We found overall increase in students' motivation to learn in the Fall 2019 compared to Fall 2018.

Three of four individual construct scores (attention, relevance, and satisfaction) and the overall score from the final semester were higher than 4.0 indicating that the XR-immersive labs are motivating students to learn kinesiology.

Students' reflections supported the survey findings.

One limitation of this study is the lack of data on student motivation for kinesiology learning in Kinesiology 301 course without the XR immersion.

Our study demonstrates the effectiveness of XR-immersive labs on student motivation, especially when a high number of XR-immersive activities are used, in comparison to limited XR-immersive activities. This demonstration of successful implementation of XR-immersive labs creates basis for future research.

Future studies should investigate the differences in student motivation to learn in traditional and XR-immersive labs for KINE 301 course.

Study Design

XR Immersion	*Spring 2018 (N=33)*	*Fall 2018 (N=32)*	*Spring 2019 (N=52)*	*Fall 2019 (N=64)*
Addition of XR-immersive labs	1.Intro to VR 2.Balance	1.Intro to VR 2.Balance 3.Upper-body mobility	1.Intro to VR 2.Balance I 3.Balance II 4.Upper-body mobility I 5.Upper-body mobility II	1.Intro to VR 2.Balance I 3.Balance II 4.Upper-body mobility I 5.Upper-body mobility II 6. Learning and memory
Modification to existing XR labs	N/A	N/A	1.Added additional experimental VR conditions to balance lab 2.Added AR/VR comparison in the upper-body mobility lab 3.Increased the activity time for each student 4.Included additional parameters	1.Added additional experimental VR conditions balance lab 2.Added new experimental VR group to upper-body mobility lab
Instructional Materials Motivation Survey	N/A	Collected (N=23)	Collected (N=52)	Collected (N=60)
Student Reflection	N/A	Collected (N=31)	N/A	N/A

References

[1] J. A. Bennett and C. P. Saunders, "A virtual tour of the cell: Impact of virtual reality on student learning and engagement in the STEM classroom," J. Microbiol. Biol. Educ., vol. 20, 2019, doi: 10.1128/jmbe.v20i2.1658.
[2] J. M. Keller, "Development and use of the ARCS model of instructional design," J. of Instruct. Dev., vol. 10, 1987, pp. 2–10.