

Students' intention to use high-immersion virtual reality systems for learning paragraph structure: a PLS-SEM exploratory study

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Abstract. This short paper reports the findings of a study exploring English for Academic Purposes (EAP) students' behavioral intention to use a high-immersion Virtual Reality (VR) system for learning paragraph structure. The study measured relationships between variables that may lead to learners' intention to use the high-immersion VR Reality system through leveraging a hypothesized theoretical framework based upon a widely used technology acceptance model. Quantitative data were collected from 134 Sino-British English as a medium of instruction by university undergraduate students enrolled in EAP classes by means of a post-participation questionnaire. A Partial Least Squares - Structural Equation Modeling (PLS-SEM) exploratory analysis was executed. Results suggested that students' intention to use the high-immersion VR learning environment was primarily determined by its usefulness for learning and not how easy it was to use. Furthermore, the degree to which the learners felt confident in their ability to operate the system had a large impact on how easy they perceived it was to use. And finally, the antecedent conditions of learners had little impact on the students' perceived usefulness of the VR system.

Keywords: virtual reality, high-immersion, technology acceptance model, paragraph writing.

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1. Introduction

Leveraging VR technology for language learning remains one of the least published topics in the field of computer assisted language learning, yet it is posited that utilizing virtual reality has an array of benefits which include reducing learners' affective filter, and increasing their engagement and motivation to learn content (Huang, Liaw, & Lai, 2016). This paper reports a study investigating students' behavioral intention to use a high-immersion VR system for the purpose of learning paragraph structure through an adapted version of Davis's (1989) technology acceptance model.

2. Background

Davis's (1989) Technology Acceptance Model (TAM) has perhaps been the most widely used base model that has been adapted for determining learners' intention to use VR systems.

Huang et al.'s (2016) analysis of their adapted TAM model found that students' Perceived Usefulness (PU) of the low-immersion VR system for learning, strongly and significantly determined their Intention To Use (INTU) it; whereas students' Perceived Ease of Use (PEU) of the VR system did not. However, these relationships have not been studied in learners' use of high-immersion VR systems to date, and therefore their applicability is uncertain.

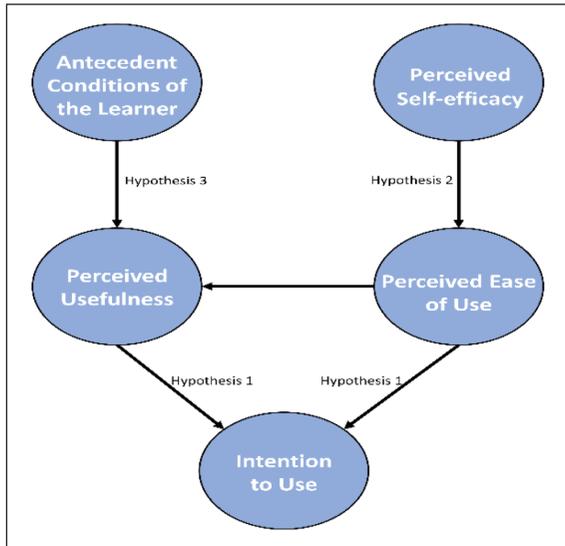
A frequently assimilated exogenous TAM model variable is Perceived Self-Efficacy (PSE) which is the degree to which a user feels confident in their ability to operate the technology. Venkatesh, Morris, Davis, and Davis (2003) consider PSE an indirect determinant of students' INTU, mediated by PEU, because the virtual literacy level of users is considered likely to impact their ease of VR system operation, although this relationship requires validation for high-immersion VR systems.

Pack, Barrett, Liang, and Monteiro (2020) have suggested that the Antecedent Conditions of the Learner (ACL), which include attitudes toward, and perceived value of, the subject matter being learned, might determine a student's PU of high-immersion VR technology for learning. However, the relatively small-scale study cited necessitates that the relationship is tested further; hence the inclusion of ACL as a predictor of PU for this present study.

Figure 1 illustrates the adapted exploratory TAM that was used in this current study according to the background presented in this section. To test the research findings outlined in the previous section and the resulting theorized exploratory model (see Figure 1) for their applicability to learners' INTU a high-immersion VR system, the following three hypotheses were formed.

- H_1 Learners' INTU will be more strongly determined by the VR system's PU than its PEU
- H_2 Learners' PSE will be a medium to high strength predictor for their PEU of the VR system
- H_3 The ACL will be a medium strength predictor for the learners' PU of the VR system

Figure 1. Exploratory TAM model



3. Method

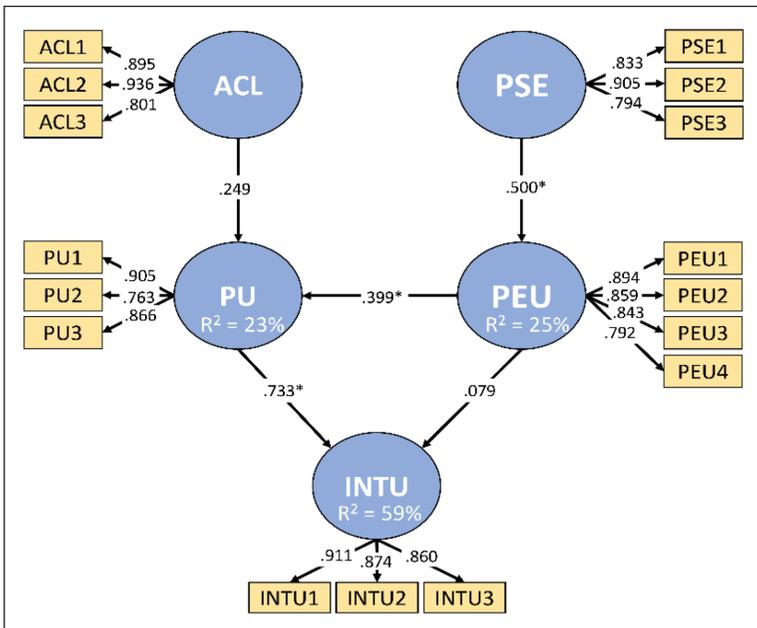
One hundred and thirty-four undergraduate year-one students at a Sino-British EMI university responded to a call for participation through non-probability voluntary

response self-selection sampling. Standard ethical procedures were undertaken to ensure participant consent and anonymity. Pack et al.'s (2020) in-house developed paragraph writing structure learning program was used in combination with an Oculus Rift high-immersion VR system. The mean length of participants' data collection sessions was 12 minutes. Data collection sessions were divided into the following stages: (1) system and program orientation; (2) supervised controlled practice; and (3) freer practice. A 16 item paper and pen questionnaire, which had been subjected to a content validity study (Rubio et al., 2003), was used for post-session data collection.

4. Analysis and assessment

PLS-SEM was chosen for the method of analysis because of its suitability for testing a theoretical model from an exploratory perspective. The PLS-SEM analysis was executed by using SmartPLS 3 (Ringle, Wende, & Becker, 2015) with resulting output presented in Figure 2. Hair, Hult, Ringle, and Sarstedt's (2017) procedural recommendations and measurement value thresholds were applied in the following measurement and structural model assessments.

Figure 2. Exploratory TAM model results (* $p < .001$)



4.1. Measurement model assessment

The outer measurement model was assessed for the validity and reliability of the questionnaire items representing each construct in the adapted model (see [Table 1](#)). Discriminant validity was also found to be acceptable through examination of the heterotrait-monotrait ratio of correlations whereby all construct values were <1 at the 95% confidence level through completion of a 5,000 sample bootstrap procedure.

Table 1. Internal consistency (α), Composite Reliability (CR), and convergent validity (AVE) results

	ACL	PSE	PEU	PU	INTU	Benchmark*
α	0.851	0.815	0.869	0.801	0.858	>0.7
CR	0.911	0.882	0.911	0.883	0.913	>0.7
AVE	0.773	0.715	0.719	0.717	0.778	>0.5

*Hair et al. (2017)

4.2. Structural model assessment

Collinearity was examined through the use of variance inflation factor values of relationships between constructs in the inner structural model, and ranged from 1.000 to 1.199 which met the recommended criterion of being <5.

[Figure 2](#) contains a visual representation of the following results testing this study's hypotheses. H_1 was confirmed because the PU-INTU path coefficient exhibited a large and significant positive influence ($\beta=0.733, p<0.01$); while the PEU-INTU path was weak and nonsignificant ($\beta=0.079, p<0.322$). The coefficient of determination of INTU ($R^2=0.590$) indicated medium effect from the two exogenous variables of PU and PEU. H_2 was also supported in that PSE was found to be a strong and significant predictor for PEU ($\beta=0.500, p<0.01$). However, H_3 was rejected due to the path coefficient for ACL-PU ($\beta=0.249, p=0.080$) being weak and nonsignificant, and PU's coefficient of determination ($R^2=0.250$) exhibiting small effect from ACL and PEU.

Additional insights into the path model's results and subsequent confirmation and rejection of this study's hypotheses can be found in the f^2 effect sizes, the Q2 predictive relevance, and q^2 effect sizes obtained through a blindfolding procedure ($D=7$), which are presented in the [supplementary materials](#).

5. Implications and conclusion

Huang et al.'s (2016) results were found to be transferable to the high-immersion VR system used in this study, because participants' PU of the VR system for learning paragraph structure was a greater determiner of their INTU than the perception of how easy it was to use. Interpretation of these results leads to the possibility that teachers introducing high-immersion VR systems into their learning spaces should perhaps consider prioritizing their usefulness for learning over how easy they are to use to some degree.

Venkatesh et al.'s (2003) assertion that PSE is an indirect determiner of users' INTU, mediated by their PEU of the system, was indicative of the learners and high-immersion VR system used in this study. A likely explanation for this finding is that newer populations of students are today more likely to be exposed to both low- and high-immersion VR systems prior to them being introduced in learning spaces.

Pack et al.'s (2020) construct of ACL was found not to be a significant predictor for students' PU of the system. One reason for this may be that students' attitudes toward their EAP class are negligible in comparison to other variables unobserved in this study, such as the wider educational merits afforded by VR learning environments.

6. Supplementary materials

<https://research-publishing.box.com/s/xwv2d8qor95vqm1e4bjcr4k302f8pc05>

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