Effect of Customizable Interactive Online Learning Tools on Students' Engagement in the Learning Process: Flow and Utilitarian/Hedonic Values

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Background Research and Hypotheses

Today, technology has changed the mode of teaching and learning in higher education. Between 2015 and 2016, U.S. public colleges and universities experienced the largest growth in online course enrollment (Friedman, 2018) and global e-learning market is predicted to surpass $325 billion by 2025 (McCue, 2018). With the increasing popularity of e-learning, understanding how to develop effective visual e-learning tools is critical because well-developed e-learning tools can improve students' engagement and facilitate their motivation to learn. Based on the flow theory, the current study proposes a customizable e-learning tool can enhance student learning. Although previous research investigated the role of interactivity and flow in learning, the studies mostly examined human-human interaction (e.g., discussion board, feedback from others) rather than human-technology interaction (i.e., interactive learning tool), and the findings have been inconsistent. Therefore, there is a need to understand the impact of technology, particularly with customizable option, on students' flow experience and positive outcome in the context of e-learning environment.

The flow theory (Csikszentmihaly, 1990) provides the theoretical framework explaining why interactive learning tools help students actively engage in the learning process. Flow, defined as a momentary feeling of complete engagement (Meyer et al., 2016), is often characterized by simultaneous experience of several dimensions: attention focus (or concentration), curiosity, interest, sense of control, and reduced awareness of physical surroundings (e.g., Rossin, Ro, Klein, & Guo, 2009). Previous research has emphasized the role of flow as an important antecedent of student learning in a virtual learning environment (Hoffman & Novak, 2009). Researchers (Csikszentmihaly et al., 2005) also highlighted that students only experience flow when their skill level matches the level of challenge in learning. When the challenge level of the given task does not match their skill level, students may feel negative emotions such as anxiety, boredom, and apathy if. Therefore, interactive e-learning tools with customizable challenge level options could help students find the balance between their skill level and the task challenge, which, in turn, maximizes their flow experience in learning. In addition, when the balance is achieved, the positive outcomes of flow such as student emotion (e.g., pleasure, arousal) and perceived hedonic/utilitarian value about an activity are expected to be also enhanced (Hoffman & Novak, 1996).

Following hypotheses were developed based on the above justifications. Hypothesis 1: Customizable online activity will have a greater impact on students' flow experience (H1a: attention focus, H1b: curiosity, H1c: control, H1d: interest) than non-customizable online activity. Hypothesis 2: Students' flow experience (H2a: attention focus, H2b: curiosity, H2c:

control, H2d: interest) will positively influence students' pleasure and arousal during the learning process. Hypothesis 3: Students' flow experience (H3a: attention focus, H3b: curiosity, H3c: control, H3d: interest) will positively influence students' perceived utilitarian (i.e., usefulness) and hedonic (i.e., enjoyable) value about an online activity.

Method

To test the hypotheses, a single factor (customizable vs. non-customizable) between-subject experiment was designed. For the manipulation, two online learning tools, one with three customizable challenge options and the other with a fixed challenge level, were developed using Adobe Flash. Both tools covered the same contents and contained the same interactive visual learning activities that enable students to click, move, and rearrange contents based on given tasks. Two learning tools differed in the availability of challenge level options in the activities. The customizable tool allowed students to select one level out of 3 (i.e., easy, medium, and hard) using a drop-down menu. The non-customizable tool offered the medium level challenge only. One hundred forty students were recruited from two universities. Students were randomly assigned to one of two experimental conditions and asked to learn the given material during the given time by reading the basic information and completing the interactive activity. After completing the activity, students were directed to a survey questionnaire, containing items measuring three flow constructs, perceived utilitarian and hedonic values of using an interactive online activity, emotion, prior experience, and demographic information. All items were adopted from previous research to ensure reliability and validity (Cronbach's $\alpha > .740$) and measured using 5-point Likert-type scales.

Results

Multivariate analysis of variance (MANOVA) was used to test H1. The results showed a significant multivariate main effect of customizability on flow experience (F (4, 131) = 3.868, $p<.005$). Further univariate analysis of variance (ANOVA) showed a significant main effect of customizability on curiosity (H1b: F (1, 134 = 5.054, $p<.05$) and interest (H1d: F (1, 134 =10.128, $p<.01$). Students in the group with three challenge options showed significantly higher means for curiosity (customizable: M=4.02, SD=.636 vs. non-customizable: M=3.74, SD=.804) and interest (customizable: M=4.13, SD=.615 vs. non-customizable: M=3.75, SD=.761) than their counterpart. However, there was no group difference in control and attention focus, rejecting H1a and H1c. To test H2 and H3, multiple regression analyses were conducted. Results showed that flow constructs such as attention focus (pleasure: β=.23, t=2.50, $p<.05$, arousal: β=.44, t=5.00, $p<.001$) and curiosity (pleasure: β=.24, t=2.05, $p<.05$, arousal: β=.37, t=3.27, $p<.001$) positively influenced student pleasure and arousal but effect of curiosity and control on pleasure and arousal were not significant, partially supporting H2. Results also revealed that interest positively influenced both perceived utilitarian (β=.32, t=2.55, $p<.05$) and hedonic values (β=.42, t=4.56, $p<.001$) about the activity, supporting H3d. In addition, attention focus (β=.24, t=3.69, $p<.001$) and sense of control (β=.16, t=2.54, $p<.05$) showed significant impact on the perceived hedonic value but not on the utilitarian value, partially supporting H3a and H3c. Curiosity had no significant effect on both perceived utilitarian and hedonic values, rejecting H3b.

Discussion

The findings of the study together provides a moderate support for the effectiveness of customizable learning objects. As expected, students tend to experience higher level of flow elicited by higher curiosity and interest once the balance between students' skill level and task challenge is achieved. Results also emphasized the critical role of flow in increasing students' positive emotion such as pleasure and arousal while working on the online activity. In addition, students' flow experience during the e-learning process had a significant impact on students' perceived values of the interactive online learning tool, particularly on perceived hedonic value. This indicates that students who experienced higher level of attention focus, sense of control, and interest, tend to perceive the online activity more enjoyable and fun. Therefore, providing customizable challenge options that could help students match their skill levels in online learning activities is essential to increase students' flow experience during the e-learning process, which will play a critical role in engaging students in an activity and encouraging positive e-learning experience.

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