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Using the saliency-based model to design a digital archaeological game to motivate players' intention to visit the digital archives of Taiwan's natural science museum

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ABSTRACT

Museums in Taiwan have developed various digital archives, but few people have visited these digital archives. Therefore, this study designed a digital archaeology game for high school students to play. Based on the concept of "learning for playing" (i.e., players who want to win will study more), the digital archaeology game contest aims at attracting students to visit the natural science digital museum. In the game, researchers (players) reorient the artifacts, structures and architectures through excavation and assemblages to understand the world of natural science based on the saliency-based model. To examine whether this game prompts learners to visit the natural science digital museum to acquire knowledge, 80 students from three high schools were recruited and grouped into 40 pairs to compete against each other. After the contest, questionnaires were collected and analyzed using confirmatory factor analysis with structural equation modeling. The results indicated that the research participants' gameplay self-efficacy affected their perceived hedonic values and was mediated by the perceived ease of playing the game increased their intention to visit the digital archives of the natural science museum. The implications of this study could be used for promotion of digital archives or other digital museums.

1. Introduction

Perception refers to the detection and interpretation of sensory stimuli or "environmental cues" (Solso, 1979). Perceptual learning is a process of discovering how to transform previously overlooked sensory stimulation into effective information (Gibson, 1969; Lu, Yuc, Watanabed, Sagie, & Levi, 2009). Today, more than 50 laboratories around the world are conducting research about perceptual learning. They are using techniques ranging from single-unit recording to human psychophysics and brain imaging (Lu et al., 2009). It is rare to study perceptual learning as it relates to a game-based approach and to take into account other relevant and dependent cognitive processes such as learning, decision making, and action selection.

A visual-cognitive system known as the saliency-based model, which was introduced by Koch and Ullman (1985) and Itti, Koch, and Niebur (1998), is based on the saliency concept. This model mimics the overall structure of the early visual system, which detects locations that convey visual signals from its surroundings (Peters & Itti, 2008). Thus, the saliency-based model has pattern recognition abilities for a variety of tasks that can be improved by learning or training (Dahmen & King, 2007). The present study proposed that the digital archaeological game be built upon the saliency-based model so that the game player would interact with relevant objects in a scene through object recognition, creating situational interest in playing the digital archaeology game and intention to visit the digital archives.

Regarding the determinants of behavioral intention, the study adapted the theory of reasoned action (TRA) (Ajzen & Fishbein, 1980) to examine game players' favorable perception of hedonic values. In addition to TRA, Davis' (1989) proposed technology acceptance model (TAM) identifies two user beliefs–perceived usefulness and perceived ease of use–as the main determinants for individuals' behavioral intention to use information systems. Turel, Serenko, and Bontis (2010) note that technology may influence individuals either utilitarian or

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hedonic value to determine his or her behavior adoption, that is, perceived usefulness, which is affected by perceived ease of use (Davis, 1989), mainly includes utilitarian and hedonic values. As Hassenzahl and Tractinsky (2006) describe how an interactive product is made valuable: the pragmatic and hedonic aspects are required, the present study then observed utilitarian values as pragmatic in the game performance, in terms of competition score, and explored its correlation to hedonic values.

In addition to those internal constructs of TAM, Venkatesh (1999) proposes self-efficacy as the key external construct used in task-specific self-efficacy, such as computer self-efficacy and Internet self-efficacy. This study examines gameplay self-efficacy. Accordingly, identifying the mechanism of perceived ease of play and the hedonic value of the digital archaeology game is needed to prompt high school students' intention to visit the digital archives. Therefore, the purpose of this study is to examine how gameplay efficacy and perceived hedonic values mediated by perceived ease of play and game performance can influence visitation to the digital archives of the science museum.

2. Research background

According to Taiwan's 2008 "National Science and Technology Program for e-Learning (ELNP)" summary report, indicated there has been a considerable amount of government support for Digital application programs. To add perceived value to the digital archives, this study has designed a digital archaeology game. Two modes of interaction between computer games and learning are "learning for playing" and "learning from playing." Amory (2010) defines learning from playing, such as drill and practice games and tutoring games, as play for cognitive outcomes; a result of gameplay includes descriptive knowledge and declarative knowledge. In contrast, learning for playing is learning with a game as a cognitive tool for construction of new knowledge. Kim, Park, and Baek (2009) argued learning with playing can invoke the meta-cognitive strategies mediated between gameplay and cognition and support self-regulated learning. In yet another mode, "learning for playing," the emphasis is on learning. Gee (2007) states that games almost always give information either "just in time" (right before players need and can use it), or "on demand" (when the player feels a need for it); that is learning to prepare for play. Jehiel and Samet (2005) suggest that, in a win–lose game, if the player has learned the game related content and is learning a winning strategy in the game, there is almost surely a time she/he always wins. To promote the usage of the digital archives, the present study used the concept of "learning for playing" as the basis for designing the contest game of digital archaeological interaction with online competition.

2.1. Intention to visit digital archives

According to Ajzen and Fishbein (1980), the theory of reasoned action sought to address the link between attitudes and actions. Actions were considered a particular subset of behavior by virtue of their being thoughtful, intentional behaviors. Ajzen and Fishbein considered "intention" as the immediate determinant to action. The first consideration of the theory of reasoned action suggested that a person's attitude influenced their intention, which led to a particular action. In this way, actions and attitudes might be predicted accurately because some form of attitude (e.g., interest) would appear to lie behind all reasoned action (Chapman, 2001). The theory of reasoned action (TRA) suggests courses of action represent a supposed underlying attitude. This would become an efficient way to tap into the intention of a research sample, in this study examining the players' intentions to visit the science museum's digital archives.

2.2. Perceived ease of play

The Technology Acceptance Model (TAM) is derived from TRA and explains types of human behavior on the basis of beliefs and intentions (Fishbein & Ajzen, 1975). The TAM concentrates exclusively on the analysis of information technology and establishes a priori knowledge of two key perceptions: ease of use (PEOU) and usefulness (PU) (Davis, 1989; Featherman & Pavlov, 2003). Despite its simplicity, this type of model has been employed in a wide range of research and has been shown to offer significant explanatory power (Hernandez, Jimenez, & Jose Martin, 2009; Lee, Kozar, & Larsen, 2003). In online technologies, several studies have noted that factors relating to the ease with which information can be used on a website and the ease with which information can be understood affect the website's perceived ease of use (Lederer, Maupin, Sens, & Zhuang, 2000). This implies that the easier the system, the greater the user's perceived self-efficacy in using the system. The present study has identified the antecedent construct of gameplay self-efficacy related to ease of playing that significantly predicts intention to visit the digital archive of a science museum.

2.3. Perceived hedonic value in playing digital games

Previous research suggests that interactivity influences perceived quality, resulting in consumers' value creation (e.g., Yoo, Lee, & Park, 2010). Value creation is related to a person's expectations and goals; the object of interest is of value to the person. Schiefele (2009) argues that the meaningfulness of subject content and active involvement may facilitate positive value creation related cognitions that may turn into more stable beliefs, which are characteristics of personal interest. Amory (2012) suggests that education technology is used in the classroom as the object of instruction to support fundamentalist values. As such, it would be interesting to investigate how interactivity affects game players' perceived value creation in the process of online behavior. Moreover, interactivity value stems from the overall assessment of the perceived utility of learning based on the comparison between what is received and what is expected (Zeithaml, 1988). Specifically, Hirschman and Holbrook (1982) state that human seek fun, fantasy, arousal, sensory stimulation, and enjoyment in undertaking any mission. Accordingly, the present study examined students' perception of hedonic values in playing online contest games to ensure the quality of interactivity in the playing tasks would contribute to game players' intention to visit the digital archive.

2.4. Gameplay self-efficacy

Bandura (1997) stated that efficacy is crucial in determining the manner by which people approach novel tasks as well as tasks with which they are more accustomed. Due to its importance, people are continuously seeking ways to build efficacy. Self-efficacy pertains to a specific task that individuals encounter and the amount of control they believe they have over the task (Bandura, 2001). Task-specific