Computers & Education 60 (2013) 254–263

Contents lists available at SciVerse ScienceDirect

Computers & Education

journal homepage: www.elsevier.com/locate/compedu

Gender differences in cognitive load and competition anxiety affect 6th grade students' attitude toward playing and intention to play at a sequential or synchronous game

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ARTICLE INFO

Article history:
Received 12 October 2011
Received in revised form
21 May 2012
Accepted 10 June 2012

Keywords:
Evaluation of CAL systems
Gender studies
Media in education
Cooperative/collaborative learning

ABSTRACT

Do girls have more competition anxiety and exogenous cognitive load than equally able boys during the playing of stressful competitive on-line games? This question led to the adoption of a technology acceptance model to compare the influence factors of competitors in sequential and synchronous games. Confirmatory factor analysis of the data on 220 students in the 6th grade indicated that girls did have a higher cognitive load and more competition anxiety from synchronous types of competitive games, but they showed beliefs in technology acceptance constructs that were similar to that of boys. Even with high cognitive load and competition anxiety, the boys and girls didn't show a decrease in their perceived ease of playing and sense of usefulness in using this game to learning Chinese characters for two types of competitive games, and they both showed a positive attitude and intentions to play the game. This study implied that the game designers should consider reducing the competition anxiety and cognitive load by extending the time-frames for sequential competition.

1. Introduction

High-pressure contests, such as games with cognitive tasks that are usually related to competition with time or with people, stimulate player interest in strategic decision making (Law, Lee, & Yu, 2010). From the viewpoint of competition for resources and rewards, competition causes various emotional reactions among participants such as competition anxiety (CA). Salvador and Costa (2009) found that competitive interactions emerge as critical situations shed light on the effects and consequences of stress on health. Eysenck, Derakshan, Santos, and Calvo (2007) stated that competition anxiety can elicit a shift in attention from goal-directed to stimulus-driven, thereby increasing the distribution of attentional resources toward threat-related stimuli at the expense of attention allocated to the task. Moreover, Eysenck, Payne, and Derakshan (2005) state the emotional responses will differ with an individual's cognitive load (CL) and will affect performance and result in different levels of anxiety and performance of individual players under different types of competition (Jones, 1995). The ongoing competition invokes a different level of cognitive processes, from the primary cognitive function to the immediate emotional reaction, and, thus, the present study took two mental factors, competition anxiety and cognitive load, into account in documenting the effect on different types of game playing.

From a pedagogical perspective, technology acceptance is very important in a digital learning environment. The technology acceptance model (TAM) has been validated over a wide range of systems (Karahanna & Limayem, 2000), and is routinely used to explain a considerable portion of usage intentions in various contexts (Lee, Kim, & Kim, 2007). As mentioned in TAM, exposing the intentions to play and the intermittent factors, in particular the attitude toward playing, has been associated with different perceptions of usefulness and ease of play. Furthermore, Venkatesh and Davis (2000) suggested that external variables, such as computer self-efficacy, enjoyment and individual

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http://dx.doi.org/10.1016/j.compedu.2012.06.014

difference, should be considered when determining the system characteristics. This paper provides evidence to the impact of CA and CL as it relates to computer game playing acceptance, which focuses mainly on system acceptance by the students.

Gender is also considered a possible moderator of the relationship between online games and anxiety (Wang, Jackson, & Zhang, 2011). Females were reported to have higher levels of performance anxiety, concentration disruption and somatic anxiety when compared with males in highly competitive situations (Abrahamsen, Roberts, & Pensgaard, 2008). Given that many computer games are highly competitive for students, it is easy for them to become anxious and experience an increased CL (Keller & Bless, 2008; Kiili, 2005). In this sense, the present study examines the gender differences related to competition anxiety and cognitive load while the players are involved in different competitive situations.

However, computer games tend to have an effect on the technology attitudes and experiences of females (Chang & Yang, 2010; Lowrie & Jorgensen, 2011). Thus, the purpose of this study, based on the Chinese radical assembly game, was to determine the extent to which the external variables CA and CL influenced user beliefs, and influenced computer game players' intentions to play. The effect of gender differences on the interconnection between the two external variables and behavioral intentions was also assessed in this study.

2. About the game

2.1. The Chinese radical assembly game

Chinese characters are ideophonetic compounds, each composed of a semantic component and a phonetic component (also known as *radicals*) (Ho, Chan, Chung, Lee, & Tsang, 2007). As a logographic language system, Chinese characters are ideal examples of perceptual chunks (Perfetti, Liu, & Tan, 2005; Siok, Perfetti, Jin, & Tan, 2004). Radicals convey information about the meaning and pronunciation of the character. They usually consist of several strokes and can be thought of as sub-chunks of a character. Thus, radicals are meaningful chunks, whereas strokes are not meaningful in isolation. According to the chunk decomposition hypothesis, it should be much easier to separate a character by its radicals than to separate a character by its strokes, because particular strokes are tightly embedded in a perceptual chunk (Luo, Niki, & Knoblich, 2006). Therefore, the present study used the radical assembly activity of composing Chinese characters as the basis of a game.

An interactive constituency model has provided a radical assembly framework for Chinese radical recognition and assembly. The "Radical Assembly Game" developed by National Taiwan Normal University was used. The game required participants to click on the radicals in a plate to make up a word, and then click "send" to submit their answers. If the selected radicals were correct, the word was shown in a 3×3 box next to it. Each radical in the plate could be used only once, and the used radical was highlighted, indicating it was unavailable for the next word or competition. The scoring scheme was designed based on exponential order, e.g., assemble 3 radicals into a word and the player will get 9 points, 4 radicals will get 16 points, and so on. For both types of competition, in a given time, the player who used the most radicals to make a Chinese character and accumulated the highest number of words was the winner. The more radicals they used, the higher scores they got.

2.2. Designing synchronous and sequential competition

Competition, implying that one or more individuals carry out some actions directed toward achieving a goal by confronting another individual or group of the same species motivated by the same goal, is a quite frequent situation in human communities (Salvador & Costa, 2009). The Radical Assembly Game competition included multiple players competing simultaneously. Participants were paired to compete against each other, and pairs of participants took turns every 30 s to compete with each other.

For the purpose of this study, the competition was divided into two types: sequential and synchronous. In sequential competition, each competitor takes turns to play the game sequentially in order to reach the final goal; whereas, in synchronous competition, competitors simultaneously compete for the final goal. From the perspective of a cognitive process, Dual process theories (DPT) illustrate mental reasoning and decision-making in two different types (see Evans, 2003). Type 1 is characterized as fast and automatic, and Type 2 as slow and deliberate. Dual process theory can account for differences in different types of competition, therefore sequential games appear to weigh in favor of Type 2. On the other hand, a synchronous game display weighs in favor of Type 1. Heathcote (2003) observed that as the strength of the rate of Type 2 responding increases, the recognition accuracy of task operation increases. In Yonelinas' (1994) dual-process framework, if the mental process is highly accurate, it will contribute to individual high-confidence development. This assertion implies that the competitive anxiety of a sequential type of competition would be less compared with that of the synchronous type, thus the research framework of this study was proposed across sequential or synchronous games.

The Chinese radical assembly game is a type of constraint game. If a radical has been selected, the players cannot use it again, which may interrupt their original idea to make up a character and force them to think of another. In the course of game-playing, the worrisome aspect of radicals being taken away could be another cause of competitive anxiety. The details of the two different types of competition are shown in Table 1.

3. Research contents and hypotheses

3.1. Technology acceptance model (TAM)

According to Ajzen and Fishbein (1980), the forming of an attitude involves the combination of elements of beliefs and affectively laden evaluations concerning a particular situation. The theory of reasoned action sought to address the link between this concept of attitudes and actions, where actions were considered a particular subset of behavior by virtue of their existence (Fraser & Burchell, 2001, p. 246). In this way, actions might be predicted fairly, accurately and supposition regarding underlying attitudes, in some form, will appear to lie behind all reasoned action (Chapman, 2001). Gauging the apparent strength of such reasoned action might be a simple matter of seeking a response to the acceptance of the courses of action. Davis (1993) proposed the technology acceptance model (TAM) to examine perceptions and