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BEYOND FLOW EXPERIENCE: LEARNERS’ POSITIVE AND NEGATIVE EMOTIONS RELATED TO COMPUTER-BASED INSTRUCTION

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Abstract

In computer-based instruction learning environments, learners can be easily distracted due to the attraction of the enormous amount of interesting Internet content. If learners feel negative emotions during computer-based instruction, they may discontinue their learning. Thus, finding ways to keep learners feeling positive is an important part of computer-based instruction. Flow theory proposed by Csikszentmihalyi in 1975 argues that the challenge-skill balance is a precondition for flow experience. When the challenge of learning is higher than the learners’ ability, the learners will feel anxiety, and when it is lower than learners’ ability, the learners will feel boredom. When the challenge of learning matches the learners’ ability, a flow experience will appear. Enjoyment emotion will be in company with flow experience. However the current empirical study of 151 participants reveals that emotions related to enjoyment may appear when the learners’ skill is equal to or higher than the learning challenge. Nevertheless, boredom may appear when the learning is difficult but unimportant. When the learning content is difficult, learners may feel boredom as well as anxiety. If learners regard the learning as unimportant, they may feel boredom when the learning content is difficult. In this situation, there may be a trend for learners to discontinue their learning, since they cannot complete the learning contents and feel that the learning content is unimportant. However, if learners regard the learning as important, they will feel anxiety when the learning content is difficult. In this situation, learners may try, but fail, to complete the learning content. Anxiety and frustration may appear in this situation. Based on the results of the empirical survey, we suggest that computer-based instruction development should avoid developing learning material that is beyond the learners’ ability, especially when some learners regard the learning as unimportant.

Keywords: Computer-based Instruction, Flow theory, Emotion, E-learning, Challenge-skill balance.
1 INTRODUCTION

The use of computer technology in education can provide a suitable and learning centred-atmosphere to help increase learners’ motivation (Serin, 2011). Due to the rapid development of computer and multimedia technology, computers are now commonly used to assist learning.

In traditional face-to-face instruction methods, instructors may observe learners’ reactions to learning materials instantaneously. In computer-based instruction, however, it is not easy to track learners’ reactions in real time. In addition, in online environments, learners can be easily distracted due to the enormous amount of attractive content, such as shopping websites, social networking, online games, and video sharing. It is therefore important to explore the learners’ engagement and reaction to learning activities in computer-based instruction environments.

Emotions are a major part of the reaction of learners to learning materials. During learning, learners may experience a rich diversity of emotions which will determine their focus and will in turn influence their learning activities (Sylwester, 1994). Emotions may result in selective information processing (Pekrun, 1992), which will affect learning achievements (Ozel, Caglak, & Erdogan, 2013).

Instructors usually hope to maintain learners’ curiosity and keep them feeling positive. Learners may, experience positive emotions when learning tasks are completed, insights are unveiled, and major discoveries are made during learning (D’Mello & Graesser, 2012). Nevertheless, learners may also have a lack of interest in the learning materials and present boredom, anxiety, and frustration during learning. Negative emotions may also appear when learners regard learning contents as difficult, and when they struggle with the problems and experience failure during learning.

Flow theory by Csikszentmihalyi (1975) to subjectively explore the well-being of people during engagement in an activity, may be used to explore the generation of positive emotions during such activities. Flow is a metaphorical term (Kawabata & Mallett, 2011) that refers to an optimal experience resulting in intense engagement, distorted sense of time, and heightened motivation (Chen, 2006; Csikszentmihalyi, 1990). People fully engage in what they are doing and experience enjoyment when they are in the flow state (Donna L Hoffman & Novak, 2009).

The concept of flow is widely used in learning with respect to the appearance of flow experience in learning environments and the impact of flow experience on learning outcomes. People experiencing flow have complete focus and a sense of control, passion and fulfilment during their particular activity.

Achieving a challenge-skill balance is one of the preconditions for flow experience (Csikszentmihalyi, 1975; Csikszentmihalyi & Larson, 1987; Csikszentmihalyi, 1990). The original flow theory revealed that the flow state occurs when there is a challenge-skill balance: If one’s skill cannot meet the challenge, the overwhelming activity generates anxiety; on the other hand, if the challenge decreases and one’s skill exceeds the challenge, one might come to a state of boredom. Only if the perceived challenge and perceived skill are equal or approximately equal, will a flow state appear.

According to flow theory, a challenge-skill balance is essential in learning materials in order to attract learners’ attention. When learners perceive a challenge-skill balance in learning materials, they are in the flow state, which will generate positive emotions. However, learners may feel anxiety if they perceive the learning materials as too difficult; and boredom if the learning materials are too easy, according to flow theory.

Nevertheless, in educational practice, some learners may feel boredom rather than anxiety when they perceive learning materials as more difficult than their ability; this does not match the prediction of the flow theory. Task importance may be a possible moderator of the relationship between the challenge-skill balance and learning emotion. Learners who consider the learning activity as difficult but unimportant may feel boredom rather than anxiety. In this case, they do not feel anxiety since they perceive the task as having a low value for their learning. To our knowledge, however, no previous
study has focused on the moderating effect of task importance on the influence of the challenge-skill balance on learning emotion.

In addition, flow theory advocates that learners will feel boredom when the challenge of the learning material is lower than the learners’ ability. However, in practice, learning materials with a low difficulty level may provide learners with a sense of achievement.

The present paper aims to explore the associations between challenge-skill balance, task importance, and learning emotions in a computer-based learning environment. We investigated whether the difficulty of learning materials and perception of task importance can lead to different learning emotions, which were correlated to learning performance.

2 LITERATURE REVIEW

2.1 Flow in Learning

According to flow theory proposed by Csikszentmihalyi (1975), people will be fully engaged in what they are doing and feel enjoyment when they are in the flow state (Donna L Hoffman & Novak, 2009). They will have complete focus and a feeling of control, passion and fulfilment during the activity. Csikszentmihalyi (1975) proposed the three channel model of flow to discriminate between human affective states (flow, anxiety, and boredom) during activities they involved in. As Figure 1 shows, the task challenges and skills that people perceive will influence their current affective states. If the challenge is perceived as beyond the individual’s skill, the activity generates anxiety; on the other hand, if the individual’s skill is beyond the challenge, the person might fall into a state of boredom. Only if the perceived challenge and perceived skill are equivalent or similar, will a flow state appear. The flow state occurs when the challenge and skill are balanced.

The concept of flow is widely used in learning. For example, Hwang, Wu, and Chen (2012) designed an effective learning system to promote students’ flow experiences during web-based problem-solving activities. Pearce, Ainley, and Howard (2005) used flow to explore learning activities in an online learning environment. Ho and Kuo (2010) indicated that flow experience has a positive effect on learning outcomes.

2.2 Emotion in Learning

Emotion is a key element in learning that attracts attention from both educational researchers and practitioners. Learners’ emotion will influence their attention and cognition, which in turn will influence their learning activities (Sylwester, 1994). However, previous studies on learning emotions have typically focused on test anxiety and emotions following successes and failures (Weiner, 1985; Zeidner, 2007). Few previous studies have focused on emotions during learning (Pekrun, Goetz, Titz, & Perry, 2002). Scholars have recently advocated the need to conduct research into the role of emotions in education (Artino Jr, 2012).

Learners may experience a rich diversity of emotions during learning. A learner participating in learning activities may experience a variety of emotions including enjoyment, frustration, anxiety, and boredom. Learners may enjoy learning when they are interested in the learning contents, but become frustrated when they cannot understand the learning contents, feel anxious about the post learning quiz, or feel bored when they feel the learning contents are trivial or unimportant. Emotions may result in selective information processing (Pekrun, 1992) that can influence learners’ learning activities, and achievements (Ozel et al., 2013). Noteborn, Bohle Carbonell, Dailey-Hebert, and Gijseelaers (2012) investigated the influence of learners’ enjoyment and boredom on their achievements in a virtual learning environment. They reported a positive association between enjoyment and exam performance. Nummenmäa and Nummenmäa (2008) also revealed that emotions were associated with learning activities in web based instruction; college students with more negative emotions were not actively participating in the collaborative learning activities during the courses than other students.
Learning comprises cognitive and affective processes (D’Mello & Graesser, 2012). Cognition is used to comprehend learning material. Learning emotion may affect cognition. Artino Jr and Jones II (2012) demonstrated that the positive emotion of enjoyment in learning was positively associated with elaboration and metacognition, defined as knowledge about cognition and control of cognition (Flavell, 1979); while the negative emotion of boredom was negatively associated with elaboration and metacognition. Frustration and metacognition are also significantly positively associated.

Flow theory can be used to explain learners’ emotions. Csikszentmihalyi (1975) proposed that a learning activity might produce a gradual progression into the flow channel as new skills are learned and greater challenges are sought on which to exercise those skills. Researchers have discussed the challenge-skill balance in learning. Custodero (2002) argued that the first criterion for flow experience in learning is that skill and challenge must match. D. L. Hoffman and Novak (1996) argued that challenge-skill pairing was an antecedent of flow. Shin (2006) argued that learners achieve a flow experience when they perceive a balance between challenge and skill. Gute and Gute (2008) advocated that when learners perceive their skill as surpassing the challenge of the learning, they experience boredom and when they perceive a challenge as too great for their skill, they experience anxiety. The original idea of flow revealed that a challenge-skill balance is a precondition for flow. If the challenge is beyond the skill, it can generate anxiety. In contrast, if the skill is higher than the challenge, then one might come to a state of boredom. The control-value theory of achievement emotion proposed by Pekrun (2006) provides another approach to explain learners’ emotions during learning. According to this theory, a challenge higher than an individual’s skill would lead to low perceived controllability for learners, which would induce negative emotions such as anxiety, hopelessness, or shame. For example, a student failing an important exam who feels that they cannot pass it will experience failure-related anxiety (Pekrun, 1992).

Both flow theory and the control-value theory of achievement emotion argue that a high level of difficulty (the challenge is beyond the skill) would lead to anxiety. Nevertheless, some learners may feel boredom rather than anxiety when they perceive the learning is difficult. Moreover, according to flow theory, boredom will occur when learners find that the learning is easy (the skill is beyond the challenge). However, learners may enjoy the learning when they find that they can comprehend the learning materials; the ease of learning materials will not always lead to boredom emotion.
Task value may be a confounding factor for the impact of challenge-skill balance on learning emotions. Wigfield and Eccles (2000) argued that task value is determined by the individuals’ perceptions of the usefulness of the task for them. For example, the importance of task value may include beliefs that it would be useful for them immediately or that students will need this information for higher level courses. Artino Jr (2009) advocated that learners with greater task value beliefs also had fewer negative emotions. Learners’ emotions change according to learning task value perception (Pintrich, 1991; Pintrich, Smith, García, & McKeachie, 1993). Learners may not feel anxiety if they perceive that the task has a low value.

Based on the above discussion, we argue that enjoyment may appear when learning is easy and that boredom may appear when learning is unimportant. Anxiety and frustration appear when the learning is difficult. Thus, we propose the following hypotheses:

Hypothesis 1: Learning emotion will be influenced by the challenge-skill balance, and confounded by the perception of the importance of the learning task.

H1a: When learners’ skill is higher than the challenge of learning the lesson, learners will feel enjoyment.

H1b: When the challenge of learning the lesson is higher than the learners’ skill, learners will exhibit anxiety and frustration.

H1c: When the challenge of learning the lesson is higher than the learners’ skill and the importance of the lesson is perceived as low, learners will feel boredom.

2.3 Emotion and Learning Performance

To enhance learning, instructors often try to keep learners feeling positive. Tempelaar, Niculescu, Rienties, Gijselaers, and Giesbers (2012) demonstrated that learning emotions are key to the acceptance of online learning. They revealed that students with positive learning emotions, such as enjoyment related to online learning would become more intensive learners than those with negative emotions, such as boredom.

The experience of enjoyment may be characterized as a positive, activity-related emotion. In contrast, anxiety when facing an exam is considered a negative, outcome-related emotion. During learning, learners represent both activity-related emotions (enjoyment and boredom) and outcome-related emotions (anxiety), and both positive (enjoyment) and negative emotions (boredom and anxiety) (Lichtenfeld, Pekrun, Stupnisky, Reiss, & Murayama, 2012).

Pekrun, Elliot, and Maier (2006) suggested that positive emotions improve performance by promoting task-related attention; strengthening motivation. Enjoying a particular subject will direct attention which consequently leads to a better learning performance. In contrast, negative emotions such as boredom have been found to impair motivation for learning, leading to poor student performance (Helmke, 1993; Pekrun et al., 2002). Pekrun (2011) also found positive relation between enjoyment and mathematics achievement, and negative relations between mathematics achievement and negative emotions of boredom and anxiety.

In addition, learners appeared frustrated when they failed to achieve their academic goals (Pekrun et al., 2006). For example, if the learning is valued, but learners cannot complete the learning successfully, frustration will occur. Thus, frustration appears along with low learning performance.

Based on the above discussion, we propose the following hypothesis:

Hypothesis 2: Learning performance is associated with learning emotion. High performance learners feel a higher level of enjoyment than others: Low performance learners feel a higher level of anxiety, boredom, and frustration than others.
3 METHOD

3.1 Participants

Participants of the study were college students that already had essential knowledge and experience of using Microsoft Office software enrolled into classes titled “An introduction to computers”. All subjects voluntarily joined the study and were informed of their right to leave at any time. Subjects were required to spend about one hour. Among the 166 respondents who voluntarily participated in the survey, 15 were eliminated because of incomplete responses. The study analysis was based on the remaining 151 usable responses (47.7% male and 52.3% female). 93.3% subjects were aged between nineteen and twenty-one years old. The average age of respondents was 19.64 years with a standard deviation of 0.96.

3.2 Procedure

The subjects were asked to take a pre-learning quiz which comprised the four multiple choice questions before starting the computer-assisted instruction learning lesson. The lesson included learning material about the operation of Microsoft Excel. Subjects were requested to operate on the spot and complete an exercise related to Microsoft Excel after the computer-assisted instruction learning lesson.

Then, participants were asked to fill out an online questionnaire on the challenge-skill balance, task value, and learning emotions. The subjects were then given a post-learning quiz, which comprised the same four multiple choice questions as the pre-learning quiz. All answers could be learned from the e-learning lesson. The improvement in quiz scores was used to represent subjects’ learning performance.

After finishing the study, a small gift was given to each respondent as incentive.

3.3 Measures

3.3.1 Task Value

The study measured learning task value perception using a validated task value scale (6 items) from the Motivated Strategies for Learning Questionnaire (MSLQ) (García & Pintrich, 1995; Pintrich, 1991; Pintrich et al., 1993). The MSLQ is an instrument used to measure students’ motivation for studying and asks students to describe how important, interesting, and useful a task is to them. The MSLQ also includes measures for student self-efficacy on an 8 item scale. The self-efficacy scale represents students’ judgments about their capability of learning. It consists of eight items regarding perceived competence and confidence in the performance of learning.

3.3.2 Learning Emotions

There are a variety of positive and negative emotions associated with learning activities. The original Achievement Emotions Questionnaire (AEQ) consists of nine emotions: enjoyment, hope, pride, anger, anxiety, shame, hopelessness, and boredom(Pekrun, Goetz, Frenzel, Barchfeld, & Perry, 2011). However, Pekrun et al. (2011) found that not all emotions appear frequently during learning. Lichtenfeld et al. (2012) used only three major emotions of enjoyment, boredom, and anxiety in their research. The present research focused on examining four learning emotions; enjoyment, anxiety, boredom, and frustration. The four emotions were selected since they are frequently experienced in achievement settings (Csikszentmihalyi & Larson, 1987; Pekrun et al., 2011).

We adapted the AEQ learning emotion scale developed by Pekrun et al. (2011) and Lichtenfeld et al. (2012) to measure enjoyment, anxiety, and boredom. For frustration, we used the measurement scale developed by Artino Jr (2009).
The study used 13 items (three for enjoyment, three for anxiety, three for boredom and four for frustration) to measure learning emotions. Participants were guided to report how they felt when learning. All of the items were measured on a 7-point Likert scale, from 1 (Strongly Disagree) to 7 (Strongly Agree).

3.3.3 Challenge-Skill Balance

Participants were asked to present their challenge-skill balance perception of the computer-based instruction learning using a 7-point scale from -3 (too easy) to 3 (too difficult). The positive or negative scores were regarded as an unbalance state, and the neutral score (0 point) was seen as a challenge-skill balance state.

3.3.4 Reliabilities

Cronbach’s alphas were calculated to measure the reliability of the scales. The Cronbach’s alphas of enjoyment, anxiety, boredom, frustration and task value were .88, .91, .93, .93, and .95, respectively. All of the reliability values exceeded 0.70, and were well within the acceptable range. Table 1 shows the measurement scales used in the study, including sample items and sources.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Sample item</th>
<th>Items</th>
<th>Source</th>
<th>Cronbach alpha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Task Value</td>
<td>Understanding the subject matter of this course is very important to me.</td>
<td>6</td>
<td>García &amp; Pintrich (1995); Pintrich (1991); Pintrich, Smith, García, &amp; McKeachie (1993)</td>
<td>0.95</td>
</tr>
<tr>
<td>Enjoyment</td>
<td>For me the learning is a challenge that is enjoyable.</td>
<td>3</td>
<td>Pekrun, Goetz, Frenzel, Barchfeld, and Perry (2011)</td>
<td>0.88</td>
</tr>
<tr>
<td>Anxiety</td>
<td>I get tense and nervous while learning.</td>
<td>3</td>
<td>Pekrun, Goetz, Frenzel, Barchfeld, and Perry (2011)</td>
<td>0.91</td>
</tr>
<tr>
<td>Boredom</td>
<td>I find math class so boring that I would rather do something else.</td>
<td>3</td>
<td>Pekrun, Goetz, Frenzel, Barchfeld, and Perry (2011); Lichtenfeld, Pekrun, Stupnisky, Reiss, and Murayama (2012)</td>
<td>0.93</td>
</tr>
<tr>
<td>Frustration</td>
<td>I felt frustrated.</td>
<td>4</td>
<td>Artino, Anthony(2009)</td>
<td>0.93</td>
</tr>
<tr>
<td>Challenge-skill balance</td>
<td>How did you feel about the challenge-skill balance of this learning content?</td>
<td>1</td>
<td>One item developed by this study</td>
<td></td>
</tr>
</tbody>
</table>

Table 1. Measurement of this study

4 DATA ANALYSIS

4.1 Emotion and Challenge-Skill Balance

All participants were requested to complete a computer-assisted instruction learning lesson for Microsoft Excel operation. To explore the impact of challenge-skill balance on learning emotions in a computer-based learning environment, we divided the participants into two groups based on their perceived challenge-skill balance. If participants felt that the level of learning challenge was higher than their skill, they were placed into the hard level of difficulty group; if their perceived challenge level was lower than or equal to their ability, they were placed into the easy level of difficulty group.

Table 2 reveals that enjoyment, anxiety and frustration scores were significantly different between the easy and hard level of difficulty groups. When participants regarded the learning materials as easy, the subjects’ average enjoyment level was 4.99 (SD=1.04) on the 7-point scale. The average score of enjoyment was 4.45 (SD=1.11) when the participants regarded the material as hard. Participants felt
enjoyment when they perceived that learning was easy. The average scores of anxiety on the seven point scales were 2.99 (SD=1.29) for participants who felt that the learning was easy and 4.11 (SD=1.29) for those who felt it was hard. The average score of frustration was 2.46 (SD=1.21) for participants who regarded the learning materials as easy, and 3.00 (SD=1.22) for those who regarded the learning materials as hard. The more difficult the perception of the lesson, the more anxiety, frustration, and boredom the participants felt. Moreover, the less difficult the perception of the lesson, the more enjoyment the participants felt.

<table>
<thead>
<tr>
<th></th>
<th>Easy (N=46)</th>
<th>Hard (N=105)</th>
<th>t-test results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enjoyment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>5.01</td>
<td>4.44</td>
<td>t=2.818</td>
</tr>
<tr>
<td>S.D.</td>
<td>1.04</td>
<td>1.19</td>
<td>p&lt;.01*</td>
</tr>
<tr>
<td>Anxiety</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>2.98</td>
<td>4.08</td>
<td>t=5.0132</td>
</tr>
<tr>
<td>S.D.</td>
<td>1.27</td>
<td>1.19</td>
<td>p&lt;.01*</td>
</tr>
<tr>
<td>Boredom</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>2.60</td>
<td>3.24</td>
<td>t=2.929</td>
</tr>
<tr>
<td>S.D.</td>
<td>1.17</td>
<td>1.27</td>
<td>p&lt;.01*</td>
</tr>
<tr>
<td>Frustration</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>2.43</td>
<td>3.00</td>
<td>t=2.632</td>
</tr>
<tr>
<td>S.D.</td>
<td>1.23</td>
<td>1.22</td>
<td>p&lt;.01*</td>
</tr>
</tbody>
</table>

*p<0.05

Table 2. Emotion and level of difficulty

4.2 Emotion and Task Value

To reveal the impact of learning task value on learning emotion, we divided the participants into two groups of high and low importance perception based on the participants’ task value score. Since a seven point Likert type scale was used to measure task value, we used a mean score of 4 as the cut off point for high and low importance perception.

Table 3 reveals that those in the high importance group showed a higher level of enjoyment (Mean=4.72, SD=1.11) than those in the low importance group (Mean=3.97, SD=1.41). Furthermore, the low importance group showed a higher level of boredom (Mean=3.73, SD=1.35) than the high importance group (Mean=2.94, SD=1.23). Participants who regarded the learning as highly important experienced enjoyment during the learning and participants who regarded the learning as of low importance felt boredom. There was no significant difference in anxiety and frustration levels between the high and low importance perception groups. Task value is a significant determinant of enjoyment and boredom. However, frustration and anxiety were not significantly influenced by task value perception.

<table>
<thead>
<tr>
<th></th>
<th>Low (N=21)</th>
<th>High (N=130)</th>
<th>t-test results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enjoyment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>3.97</td>
<td>4.72</td>
<td>t=2.805</td>
</tr>
<tr>
<td>S.D.</td>
<td>1.41</td>
<td>1.10</td>
<td>p=.00**</td>
</tr>
<tr>
<td>Anxiety</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>3.61</td>
<td>3.76</td>
<td>t=0.476</td>
</tr>
<tr>
<td>S.D.</td>
<td>1.26</td>
<td>1.33</td>
<td>p=.63</td>
</tr>
<tr>
<td>Boredom</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>3.73</td>
<td>2.94</td>
<td>t=2.700</td>
</tr>
<tr>
<td>S.D.</td>
<td>1.35</td>
<td>1.23</td>
<td>p=.00**</td>
</tr>
<tr>
<td>Frustration</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>3.17</td>
<td>2.78</td>
<td>t=1.343</td>
</tr>
<tr>
<td>S.D.</td>
<td>1.17</td>
<td>1.25</td>
<td>p=.18</td>
</tr>
</tbody>
</table>

Table 3. Emotion and task value importance perception.
4.3 Major Emotion during Learning

When individuals engage in activities, they will exhibit different levels of emotions for a variety of emotion dimensions. In other words, people get a score for each dimension of emotions. Among all the emotion dimensions, the major emotion could be used to describe individuals’ current emotion status. For instance, individuals may exhibit different levels of emotion for each emotion dimension. They report themselves in enjoyment status since that enjoyment is the major or dominate emotion when engaging the activities. The Figure 3 reveals the distribution of the major emotions of participants with different levels of importance and difficulty perception. The major emotion was the emotion with highest average score of the four emotions of enjoyment, boredom, anxiety, and frustration. This scatter diagram reveals that the learners’ major emotion was enjoyment when the learning was perceived as easy (learning challenge was lower than learners’ skill). When the learning was perceived as hard (learning challenge was higher than learners’ skill) and importance perception was high, the learners’ major emotion were anxiety and frustration. The learners’ major emotion was boredom when the learning was hard (learning challenge was higher than learners’ skill) and importance was low.

Figure 3. Major emotions, learning difficulty, and learning importance

4.4 Emotion and Learning Performance

To reveal the association between emotion and learning performance, we tested the difference in emotion experienced between high and low learning performance participants. During the study, four multiple choice items were used in the pre-learning and post-learning quizzes. The learning
performance was measured by the increase in quiz score. We used the median of increase in quiz score as the cut off point for low and high performance groups.

Table 4 reveals the emotions of high and low learning performance groups. The t-test results show that the high learning performance group had a significantly higher enjoyment level and lower anxiety, boredom, and frustration levels than the low learning performance group. The average score of enjoyment was 4.88 (SD=1.07) for the high performance group and 4.35 (SD=1.21) for the low performance group (t=2.850; p<.01). The average score of anxiety was 3.96 (SD=1.17) for the low performance group and 3.53 (SD=1.42) for the high performance group (t=1.964; p=0.05). The average score of boredom was 3.42 (SD=1.09) for the low performance group and 2.67 (SD=1.33) for the high performance group (t=3.789; p<0.01). The average score of frustration was 3.18 (SD=1.05) for the low performance group and 2.48 (SD=1.33) for the high performance group (t=3.542; p<0.01). The difference in emotions is shown in Figure 4, which shows that high learning performance participants experienced a higher level of the positive emotion of enjoyment. Low learning performance participants experienced a higher level of the negative emotions of boredom, anxiety, and frustration.

Base on the t-test analysis mentioned above, learning performance is associated with learning emotion. We argue that high performance learners feel a higher level of enjoyment than others and that low performance learners feel a higher level of anxiety, boredom, and frustration emotion than others.

The t-test results only report the association rather than a cause-and-effect relationship between learning performance and learning emotion. We do not know whether negative emotions will lead to poor learning performance, or that poor learning performance will lead to negative emotions. Further research should be carried out to confirm the cause-and-effect relationship between learning performance and learning emotion.

<table>
<thead>
<tr>
<th></th>
<th>Learning Performance</th>
<th>t-test</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low (n=75)</td>
<td>High (n=76)</td>
<td>T</td>
<td>P</td>
</tr>
<tr>
<td>Enjoyment</td>
<td>Mean S.D.</td>
<td>Mean S.D.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4.35 1.21</td>
<td>4.88 1.07</td>
<td>2.850</td>
<td>p&lt;.01*</td>
</tr>
<tr>
<td>Anxiety</td>
<td>Mean S.D.</td>
<td>Mean S.D.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3.96 1.17</td>
<td>3.53 1.42</td>
<td>-1.964</td>
<td>p=.05*</td>
</tr>
<tr>
<td>Boredom</td>
<td>Mean S.D.</td>
<td>Mean S.D.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3.42 1.09</td>
<td>2.67 1.33</td>
<td>-3.789</td>
<td>p&lt;.01*</td>
</tr>
<tr>
<td>Frustration</td>
<td>Mean S.D.</td>
<td>Mean S.D.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3.18 1.05</td>
<td>2.48 1.33</td>
<td>-3.542</td>
<td>p&lt;.01*</td>
</tr>
</tbody>
</table>

*p<0.05

Table 4. Emotion and learning performance
5 DISCUSSION

Computers are now commonly used to assist learning. In computer-based instruction, learners can be easily distracted by the Internet or other attractive online content. It is important to keep learners feeling positive emotions during computer-based instruction.

Flow theory is widely used in learning to discuss the impact of flow experience on learning outcomes. A challenge-skill balance is essential for flow experience (Csikszentmihalyi, 1975; Csikszentmihalyi & Larson, 1987; Csikszentmihalyi, 1990). Flow theory argues that boredom occurs when learners perceive the learning materials as too easy. Nevertheless, in educational practice, some learners may feel boredom rather than anxiety when they perceive learning materials as too difficult for their ability, which contradicts the forecast of the flow theory. The current study aimed to determine learners’ positive and negative emotions in computer-based instruction and the conditions required for the appearance of enjoyment, anxiety, boredom, and frustration.

According to statistical analysis, the study showed that a challenge-skill balance and the perceived importance of the lesson are correlated with learning emotion, and that positive learning emotions are associated with better learning outcomes. We found that when learners perceived the learning as easy, a positive feeling of enjoyment may occur. Students could learn the lesson easily since they perceive the challenge of the learning content was below their original skill level. If the challenge of learning content was beyond the learners’ skill, they might experience negative emotions like anxiety, boredom or frustration, because the student would detect an impasse or need more attention and more time to understand the learning material. These results are consistent with the suggestion by D’Mello, Lehman, Pekrun, and Graesser (2012) that learners would experience negative emotions when the learning material is too hard to understand. Thus, the negative emotions of boredom, anxiety, and frustration may occur when learners perceive the material as difficult.

Flow theory forecasts that anxiety will occur when the learning challenge is beyond the learners’ skill. Statistical analysis of the results of the present study confirms this argument. However, flow theory forecasts that boredom will occur when the learning is too easy. However, this study argues that
boredom may also appear when the learning is perceived as unimportant but difficult. In addition to examining the relationship between learning emotion and challenge-skill balance, this study examined the impact of task value perception on the learning emotion. When the learning challenge was higher than the learners' skill and the importance of lesson was perceived as high, learners experience anxiety. When facing a high difficulty lesson, learners may experience boredom rather than anxiety when the importance perception of the lesson is low. The result is inconsistent with the thoughts of flow theory. Here, we found that boredom is not fully associated with the challenge being lower than the learner's skill level. Boredom did not only appear when the challenge level was lower than the skill level, but also when the challenge level was higher than the learners' skill level and the importance of the lesson is perceived as low.

In addition, this study examined the relationship between learning emotion and learning outcome, revealing that high performance learners also have a higher level of enjoyment and a lower level of anxiety, boredom, and frustration than low performance learners. This result is consistent with the suggestion of Lichtenfeld et al. (2012) that enjoyment is positively related to learning performance.

The current study found that boredom may occur when the learning material is difficult but perceived as unimportant. However, the present study does not oppose the possibility that boredom will occur when the learning content is too easy as flow theory forecast. In this paper, we conducted only one empirical survey. If multiple experimental design studies were used, it would be possible to determine the real situation that occurs when the learning content is significantly easier than the learners’ skill. One possible result may be that a lesson that is perceived as too easy will result in learner boredom.

Reference


