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Assessing of Physiological Arousal and Cognitive Anxiety toward Academic Performance: The Application of Catastrophe Model

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Abstract

The Catastrophe model in which the theory attempts to explain the interaction of physiological arousal cognitive anxiety affect on sport's performance. The model is important to understand the influence of anxiety upon performance. This research proposes a model to understand the effect of anxiety upon academic performance. The research consists with finding on the Catastrophe model of anxiety upon sport's performance. A total 135 students were participated in this study conducted during 2nd semester. The physiological arousal was measured using heart rate sensor and respiration sensor. Meanwhile, cognitive anxiety was measure using State Trait Anxiety Inventory (STAI) and Study Anxiety Scale (SAS). Furthermore, Grade Point Average (GPA) is employed to predict students' academic performance. For assessment, the Pearson correlation was used to assess the physiological arousal and cognitive anxiety toward academic performance. The finding shows that high level of physiological arousal and cognitive anxiety is a significant factor that creates low academic performance. Based on the finding, it is concluded that the model can be use to comprehend of relationship between anxiety toward academic performance.

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1. Introduction

Several of studies have been acknowledged about factors allied with academic performance. Researchers have found an indication that high level of anxiety affects academic performance (Soler, 2005; McCraty, 2007; and Vitasari *et al.*, 2010a). Researchers have also demonstrated that students with higher level of anxiety obtain lower marks in of examination (Sena *et al.*, 2007). Others expressed the opinion that the high level of anxiety will be associated with low academic performance (Luigi *et al.*, 2007). Anxiety is an occurrence that human beings normally encounter within their daily experiences. It is considered to be one of the most widespread and persistent human emotions, with affected a physiological arousal and cognitive functions. In addition to being subjectively unpleasant, anxiety has overheads in contend for bodily (physiology) and cognitive resources (Kalisch *et al.*, 2005). Previous studies found that anxiety affects sport performance (Abenza *et al.*, 2009), music performance (Thurber,

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2006), as well student performance (McCraty, 2005; and Vitasari *et al.*, 2010a). McCraty (2005) stated that cognitive and physical performance help understand how emotions affect the nervous system. However, the general conclusion is that high anxiety score is one of the obstacles to low academic performance.

Anxiety according to Catastrophe model has two dimensions to predict anxiety includes physiological arousal and cognitive anxiety. The model is important in understanding the influence of anxiety upon performance. Other opinion supporting the theory, Robb (2005) proposed that cognitive anxiety would have negative correlation with performance and physiological anxiety have curvilinear relationship with performance. Cognitive anxiety is the component that most strongly affects performance (Ingugiro, 1999 and Robb, 2005). Cognitive anxiety is considered to deal with negative concern and self-doubt in relation to performance, whereas, physiological arousal associated with anxiety such heart beat has been shown to fluctuate continuously during performance (Fazey and Hardy, 1988). In the other hand, the cognitive anxiety among students can be explain as feeling nervous before class, lack of confident, fail in examinations, feeling powerless doing the task, or learning difficulties. The physiological arousal describes as symptoms such headache, rapidly breathing, fast of heart beating, and sweaty palms.

Many theories have been advanced to explain the relationship between anxiety and performance. Based on the differences in opinion, the Catastrophe model is developed to predict the relationship of cognitive anxiety and physiological arousal on performance (Hardy and Parfitt, 1991). The model is the most prominent theory accepted, advanced and evaluated to define the relationship of anxiety on performance (Ingugiro, 1999).

This paper proposes an application of Catastrophe model to find out the relationship of physiological arousal and cognitive anxiety toward academic performance. Where, physiological arousal and cognitive anxiety are used to predict study anxiety, then Grade Point Average (GPA) is used to predict students' academic performance. The rest of this paper is organized as follows. Section 2 describes the catastrophe model. Section 3 describes the research method. Section 4 describes the result and discussion. Finally, section 5 describes the conclusion of this work.

1.2 The Catastrophe Model

The Catastrophe model, in which the theory attempts to explain the interaction of cognitive anxiety and physiological arousal affect on performance (Hardy and Fazey, 1987). The three dimensions model and is used to predict the interactive effects of cognitive anxiety and physiological arousal upon performance as follows:

- a. Cognitive anxiety has a positive relationship with performance when physiological arousal is low.
- b. Cognitive anxiety will have a negative relationship with performance when physiological arousal is high.
- c. When cognitive anxiety is low, physiological arousal has an inverted U-shaped relationship with performance.
- d. When cognitive anxiety is high, increased level of physiological arousal lead to catastrophic drop in performance

Researchers have classified anxiety into cognitive (mental) and physical components (Robb, 2005). While cognitive anxiety has negative effects on human performance, physical anxiety is concerned with perception of physiological to psychological response as such sweaty palms, racing heartbeats, or butterflies in the stomach. The Catastrophe model selects cognitive anxiety as the splitting factor and physiological arousal as the normal factor. Physiological arousal, according to Robb (2005), is associated with anxiety and has been shown to continue to fluctuate during performance.

Physiological arousal is defined by the American Psychological Association Dictionary of Psychology as aspects of arousal shown by physiological responses, such as increases in blood pressure and rate of respiration and decreased activity of the gastrointestinal system (Johnson et al., 2009). Other physiological effects of anxiety according to Johnson et al (2009) include constricted blood vessels, elevated body temperature, increased dilation of the eyes, muscle spasms, raised blood flow to muscles, and decreased blood flow to the skin. Pougatchev and Pougatchev (2008) cite that physiological arousal of anxiety is related by heart rate and breathing as reaction of the body.

Cognitive anxiety is anxiety that interferes with students' performance through memory blocks, concentration, attention, resources, or mere cognitive interference from worries and fears. According to Gill et al (2004) cognitive anxiety can be caused by negative expectation and negative self expectation. Another description cognitive anxiety is considered to be the negative concerns and self-doubt in relation to performance (Fazey and Hardy, 1988). Cognitive factors are known to raise anxiety levels including one's reaction to lack of control, such as lack of confidence, shyness, lack of concentration lack concentration, and failure in examinations.

More specifically, an effectiveness theory predicts that cognitive anxiety will invest more effort in the task at hand provided they perceive themselves to have a reasonable chance of success (Hardy and Woodman, 2003). That

cognitive anxiety is addressed by STAI instrument means that high level of STAI scores determines high level in cognitive anxiety (Cassady and Johnson, 2002; and Spielberger, 1983).

2 Method

A total 135 students with low academic performance were participating in this study. For physiological arousal uses heart rate sensor and respiration sensor by Stress Sweeper. Cognitive anxiety measures by STAI and SAS. The entire instrument consists of reliability and validity test. Pearson correlation uses to examine the significant correlation of physiological arousal and cognitive anxiety toward academic performance.

2.1 Heart rate (beat per-minute)

Beat per minute is a measure of heart rate as measured by the electrocardiograph sensor, recorded for five minutes with the accumulated time of one minute (Pougatchev and Pougatchev, 2008). Mean heart rate expects around 70 beats per-minute.

2.2 Respiration (breath per-minute)

Respiration is a physiological phenomenon and is used as the basis for the training techniques in this study. Breath per minute is a measure of respiration rate and is measured using the respiratory sensor. The respiration rate was calculated by recording the breathing for five minutes with the accumulated time of one minute (Pougatchev and Pougatchev, 2008). Mean of breath per-minute expects around 6 breath per-minute.

2.3 State Trait Anxiety Inventory (STAI)

This instrument has forty items of questions with two subscales: The S-Anxiety scale (STAI Form Y-1) consists of twenty statements that evaluate how respondents' feel about anxiety currently, at this moment". The standard test form is to the write on each item-statement that best describes the intensity of their feelings: (1) not at all; (2) somewhat; (3) moderately so; (4) very much so. In responding to the T-anxiety scale (STAI Form Y-2) consists of twenty statements that assess how people "generally feel" about anxiety with four point scale: (1) almost never; (2) sometimes; (3) often; (4) almost always. The STAI is documented of reliability and validity test which had yielded .850 (Vitasari et al., 2011b).

2.4 Study Anxiety Scale (SAS)

Study Anxiety Scale (SAS) was designed to evaluate the anxiety level, to provide an overview of symptoms of anxiety and the intensity at a particular point of study anxiety. SAS has twenty items with five scales: 1 (no), 2 (somewhat), 3 (being so), 4 (a lot), and 5 (very much). A scale of five indicates of high score. Scoring of SAS was calculated from the total scores.

2.5 Grade Point Average (GPA)

Grade Point Average (GPA) is to measure students' academic performance, this was found from faculty's document. The classification found three levels to justify the academic performance level includes low is ≤ 2.50 ; moderate is within the range $2.50 < GPA < 3.67$; and high is ≥ 3.67 .

3 Results and Discussion

This part presents for results and discussion. The finding shows correlation of physiological arousal with academic performance and cognitive anxiety on academic performance. The findings display below.

3.1 Correlation of physiological arousal and academic performance

The Pearson correlation finds out significant correlation between physiological arousal and academic performance. The result proves mean and standard deviation of physiological arousal ($M=48.25$; $SD=6.817$); and GPA ($M=2.33$; $SD=.416$), a significant correlation ($p=.000$), the correlation coefficient shows $r=-.425$, and finally the sample size yield $n=135$. The result shows negative coefficient correlation that means high physiological arousal achieve low academic performance. Therefore, it can be concluded that there is a significant relationship between high level anxiety and low academic performance for students.

Table 1: Results of correlation between physiological arousal and academic performance

Measures	Mean	SD	r	p
Physio.arousal (PA)	48.25	6.817		
GPA	2.33	.416		
PA-GPA			-.425	.000

3.2 Correlation of cognitive anxiety and academic performance

Pearson correlation examines the relationship of cognitive anxiety and academic performance. The finding shows mean and standard deviation of STAI ($M=24.10$; $SD=11.805$) and GPA ($M=2.33$; $SD=.416$), a significant correlation ($p=.000$), the correlation coefficient with $r=-.328$, and finally the sample size consists $n=135$. Similar with physiological arousal, the relationship of CA-GPA found negative score. That was concludes with the aim of high cognitive anxiety effect on low academic performance. Therefore, it can be concluded that there is a significant relationship between cognitive anxiety and academic performance among students.

Table 2: Correlation cognitive anxiety and academic performance

Measures	Mean	SD	r	p
Cogn. Anxiety (CA)	24.10	11.805		
GPA	2.33	.416		
CA-GPA			-.328	.000

The findings consists with the previous studies that cognitive anxiety has negative effects on human performance, physical anxiety is concerned with perception of physiological to psychological response as racing heartbeats and rapid breathing (Pougatchev and Pougatchev, 2008). Anxiety sensitivity is the fear of anxiety related sensation such as increased heart rate and breathlessness (Stewart et al., 1999). Another judgment support the findings if breathing is the basic handling of anxiety due to physiological arousal (Lehrer and Woolfolk, 2007).

Cognitive anxiety is considered to deal with negative concern and self-doubt in relation to performance, whereas, physiological arousal associated with anxiety such heart beat has been shown to fluctuate continuously during performance (Fazey and Hardy, 1988). Related with Robb (2005), it is found that cognitive anxiety would have negative correlation with performance and physiological anxiety has curvilinear relationship with performance. Another finding of cognitive anxiety is considered to be the negative concerns and self-doubt in relation to performance (Fazey and Hardy, 1988). The Catastrophe model was suitable to examine the relationship of anxiety (physiological arousal and cognitive anxiety) on sports' performance. The Catastrophe was adopted from sports' psychology. Consistently with the prior studies that physiological arousal and cognitive anxiety can be use to understanding of relationship between study anxiety and academic performance.

4 Conclusion

The Catastrophe model in which the theory attempts to explain the interaction of physiological arousal cognitive anxiety affect on sport's performance. Cognitive anxiety is considered to deal with negative concern and self-doubt in relation to performance, whereas, physiological arousal associated with anxiety such heart beat has been shown to fluctuate continuously during performance. The model is important to understand the influence of anxiety upon performance. This paper proposes the Catastrophe model applied in education field to assessing of physiological arousal and cognitive anxiety to measure study anxiety effect on academic performance. The result shows negative coefficient correlation for both of analysis. That means high physiological arousal achieves low academic performance and high cognitive anxiety effect on low academic performance. The Catastrophe model was

successful examine the association of anxiety on sports' performance. The model was adopted from sports' psychology. Based on the finding, it is concluded that the model can be use to comprehend of relationship between anxiety toward academic performance for the similar studies.

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