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A Discourse Analysis of the Emotional Experiences of Engineering Students in an Upper-level Signal Processing Course

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Investigating the Emotional Experiences of Engineering Students in an Upper-level Signal Processing Course

Abstract

The purpose of this preliminary study was to investigate the emotional experiences of engineering students matriculating in a mathematically rigorous upper-division signal processing course. An assessment instrument was designed to capture brief snapshots of students' emotions at strategic time intervals throughout the semester. The instrument was distributed to students at the beginning of the semester, mid-semester and the end of the semester. The responses were mapped to a circumplex model of affective emotions and an emotion trajectory was determined based on the responses. Preliminary results indicate that as students matriculate through the semester, their emotional spectrum spanned from positive to negative to more-negative. Further analytical analyses must be conducted to determine the source of these findings; however, these results may contribute to the design of instructional interventions that seek to enhance positive emotions in strenuous engineering courses and ultimately improve student achievement.

Introduction

Educational psychology research suggests that emotional experiences along with cognitive and motivational approaches to teaching and learning may improve the quality of instruction and enhance positive emotions in learning (Gläser-Zikuda, Fub, Laukenmann, Metz, Randler 2005; Astleitner, 2000; Pekrun et al., 2002). Traditionally, the range of emotional experiences in college students during the course of the semester has been neglected in scholarship until recent years (Reigeluth, 2013). It is thought that since emotions are subjective experiences they may hinder or disrupt information processing (Pekrun et al, 2002; Kleinginna & Kleinginna, 1981). However, research has shown that emotions do have an effect on learning and achievement manifested by self-regulation and motivation strategies (Pekrun et al.,2002; Boekaerts, M., Pintrich, PR & Zeidner, 2000; Carver, 1990). Emotions may direct a person towards learning, as a result of positive emotions, or away from learning. Boekaerts, M., Pintrich, PR & Zeidner (2000) show that positive emotions promote self-regulated learning strategies, whereas negative emotions correlate with external regulation strategies. This study aims to objectify the emotional experiences of students in an upper-level engineering course that is considered a bottleneck course for students primarily because of its high level of mathematical rigor and abstract concepts. It is not uncommon for students to repeat this course two or three times before matriculating to subsequent courses, which ultimately delays their graduation. As a result, students typically delay registration in this course until their senior year. Understanding the emotional state of students throughout the semester may provide insight to designing instructional interventions that seek to enhance positive emotions, improve quality of instruction and cultivate a learning environment that facilitates self-regulation and increased student achievement.

The Emotional Design of Instruction is one theory that uses instructional strategies to influence the emotional experiences of students (Astleitner, 2000). The primary research areas that are influenced by this type of instruction include test-anxiety and quality of instruction (Gläser-Zikuda, Fub, Laukenmann, Metz, Randler, 2005). Research suggests that different aspects of

instruction may promote test anxiety including lack of timely feedback and unstructured learning material (Sarason, 1984). In addition, studies on the quality of instruction indicated that student-centered instructional approaches with clear and concise guidelines will promote autonomous learning, increased achievement and higher enjoyment; as opposed to teacher-centered learning which was shown to promote student achievement, but hindered emotional and motivational learning (Brophy & Good, 1986). Therefore, the results of this study can contribute to research on the emotional design of instruction for mathematically-rigorous courses in engineering and help decrease attrition and promote enhanced learning.

Research Questions

The main purpose of the study is to reveal specific beliefs about students' experiences in a Signal Processing course which may influence their learning, achievement and motivation to pursue engineering as a career. In particular, the study seeks to answer the following research questions:

(1) What specific emotions do students have about this course upon entering it?
(2) Do their emotions change positively or negatively throughout the duration of the course?

Other related research questions that may offer significant implications for understanding the complete emotional experience of engineering students in this course include:

(3) *How much do students' emotions correlate with their academic performance in the course?*
(4) *Does their emotion trajectory influence their motivation for pursuing engineering as a career?*

This study focuses on the first two research questions. Since this paper describes a work-in-progress, research questions (3) and (4) are beyond the scope of this paper. Future research in this area will explore the extent to which students' emotional experiences in this course influence their motivation to pursue their chosen career path.

Research Method

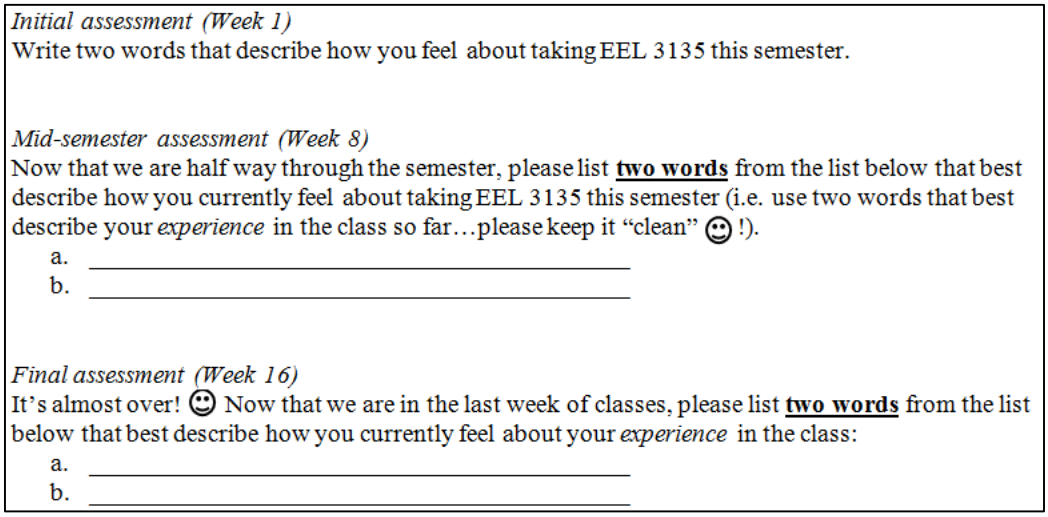
As mentioned previously, the aim of this study is to investigate the emotional experiences of engineering students matriculating in a mathematically rigorous upper-division signal processing course. The research was conducted in a junior-level Electrical and Computer Engineering (ECE) signal-processing course. The students were given a brief emotion survey (ES) at three different time intervals throughout the semester; once at the beginning of the semester, in the middle of the semester and at the end of the semester. The data was coded using the basic 28 human emotions as characterized by the Valence-Arousal Circumplex model. Using the circumplex mapping, positive or negative trajectories were determined and used as a measure of the students' emotional experience.

Participants

A sample of 58 ECE students participated in the study. The demographics of the sample were 19% ($N = 11$) female, 81% ($N = 47$) male and 36% ($N = 21$) African-Americans or black. All participants signed a consent form and approval to administer the questionnaire was obtained from the FAMU and FSU Institutional Review Board. Participants were assured that their answers would remain confidential. The Emotion Survey was administered in pencil-and-paper format. Most of the participants completed the ES instrument in less than 5 minutes.

Data Collection

The instrument that was used for this study was a brief emotion survey. At the first time interval in the beginning of the semester, no attempt was made to categorize the emotions that students felt upon entering the course. The expectation was that students would reveal their genuine emotions with no bias or coercion. Students were simply asked to "list two words that describe how they feel about taking this course this semester". The range of responses were varied, however, the majority of responses aligned well with the circumplex model of emotions. There were a few responses such as "acquiring knowledge", "really unsure" and "pass me" that did not code into basic emotions and were not included in the analysis. During the second and third intervals, the ES survey included a list of emotion adjectives and students selected two emotions from the list. Figure 1 shows the questions asked at each time interval.



Initial assessment (Week 1)
Write two words that describe how you feel about taking EEL 3135 this semester.

Mid-semester assessment (Week 8)
Now that we are half way through the semester, please list **two words** from the list below that best describe how you currently feel about taking EEL 3135 this semester (i.e. use two words that best describe your *experience* in the class so far…please keep it "clean" ☺ !).

a. _____
b. _____

Final assessment (Week 16)
It's almost over! ☺ Now that we are in the last week of classes, please list **two words** from the list below that best describe how you currently feel about your *experience* in the class:

a. _____
b. _____

Figure 1-Emotion Survey Instrument

Data Analysis

The initial words that described the students' emotions were coded using the emotional categories described in the Valence-Arousal Circumplex model. A codebook was created that mapped initial responses to the circumplex categories using an online dictionary and thesaurus to translate a response into one of the 28 basic emotion categories. For example, the category "Excited" included adjectives such as *interested, intrigued, curious, thrilled* and *motivated.* Another category that included many code words is "Depressed". This category mapped adjectives such as *unsure, abandoned, lost, confused, misled, bewildered, unprepared* and *convoluted*. Lastly, the "Tired" category warrants mention since it contains several code words including *exhausted, overworked, laborious, overwhelmed, difficult* and *worked.* Word

frequency analyses were conducted on the coded word. The emotions were then mapped to the circumplex model. The range of emotions were generated for each time interval and interpreted.

Results and Discussion

The responses were collected and the results of each emotion survey are shown in Figures (2)-(4). At the first data point, the highest frequency emotion was by far "excited" and "afraid" was the second. During the second data point, after the first exam, the highest frequency emotion was "depressed" with "tired" as a close second. By the last data point, "frustrated" and "tired" dominated students' emotions, which indicate that most students never again reached a point of positive emotion after the first exam.

Ideally, for students to have a positive emotional experience in a course, it would advantageous to have a learning experience (cognitive, emotional and motivational) that provides challenging and enriching teaching and learning. Therefore, an experience as the one shown in figure 5 is ideal, tracking emotions from "pleasant-to-activation-to-unpleasant-to-deactivation-to-pleasant". However for this study, the emotion track flows from "pleasant-to-activation-to-unpleasant-to-deactivation-to-unpleasant". Figure 6 illustrates this emotion trajectory.

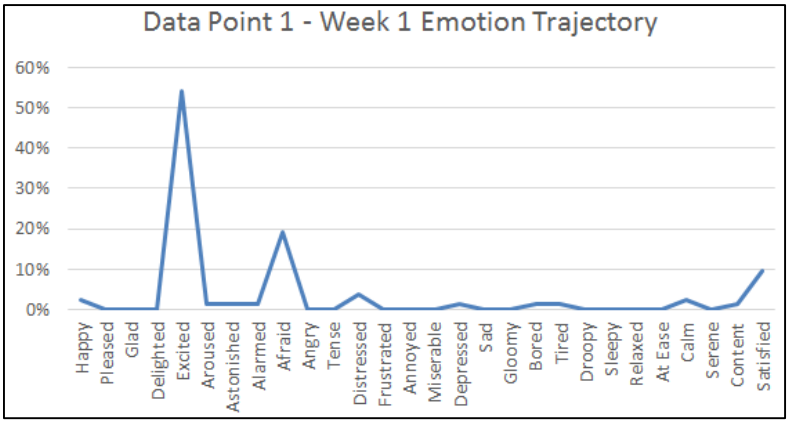


Figure 2-Week 1 Emotion Trajectory

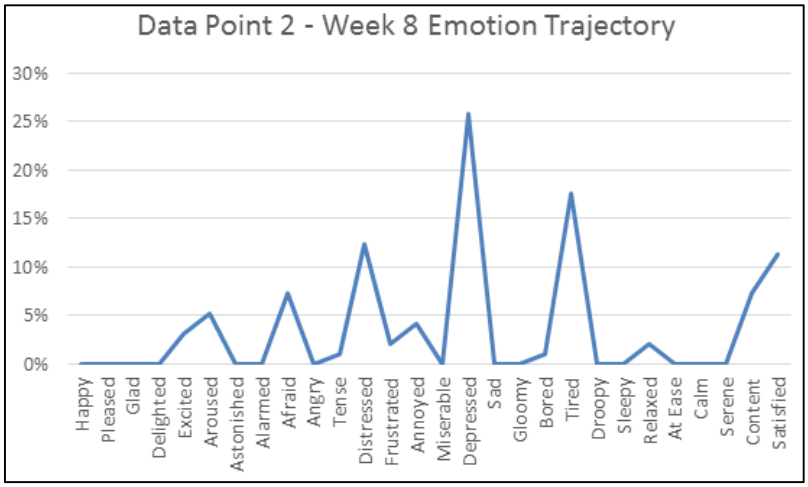


Figure 3-Week 2 Emotion Trajectory

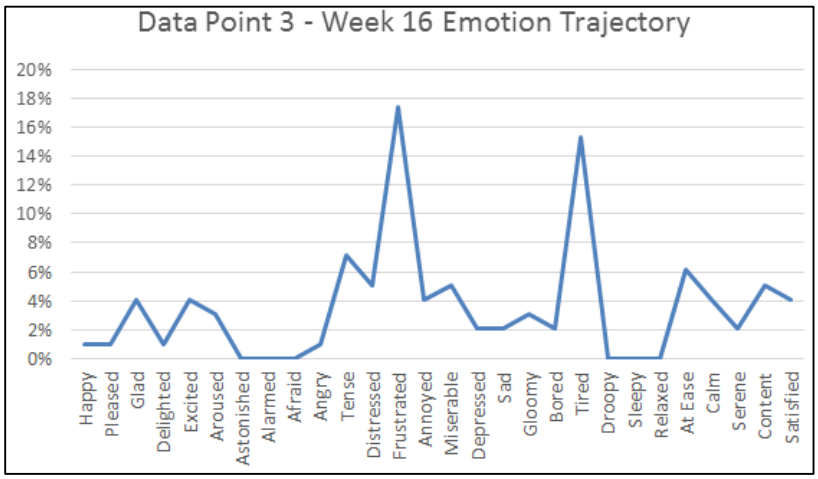


Figure 4-Week 3 Emotion Trajectory

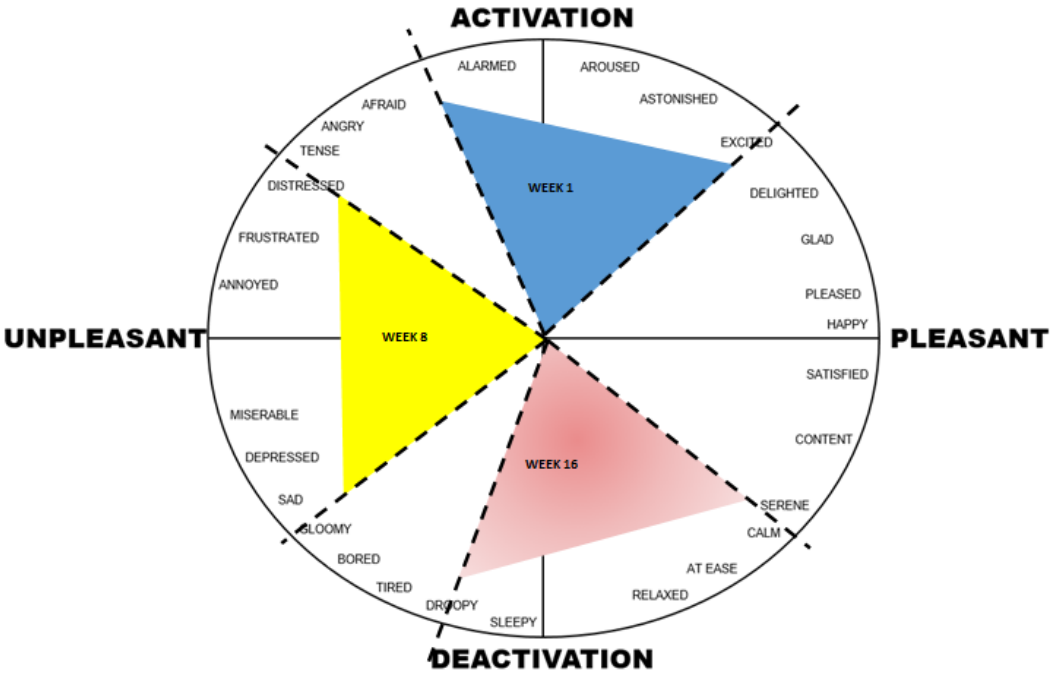


Figure 5-Emotion Trajectory based on hypothesis

Limitations of Study

Some of the limitations of the study included not having the 28 categories of emotions defined at the beginning of the semester. Coding each emotion proved challenging when only a few degrees of emotional categories are used in the Valence-Arousal mode. Another limitation was that some students who took the survey during week 1 may have missed another data collection time interval which yielded incomplete results. Coding of some responses were subjective and may not have captured a student's true emotional experience. Also, external sources of emotional experiences such as whether or not the student was having a "bad day", etc were not considered as part of this study.

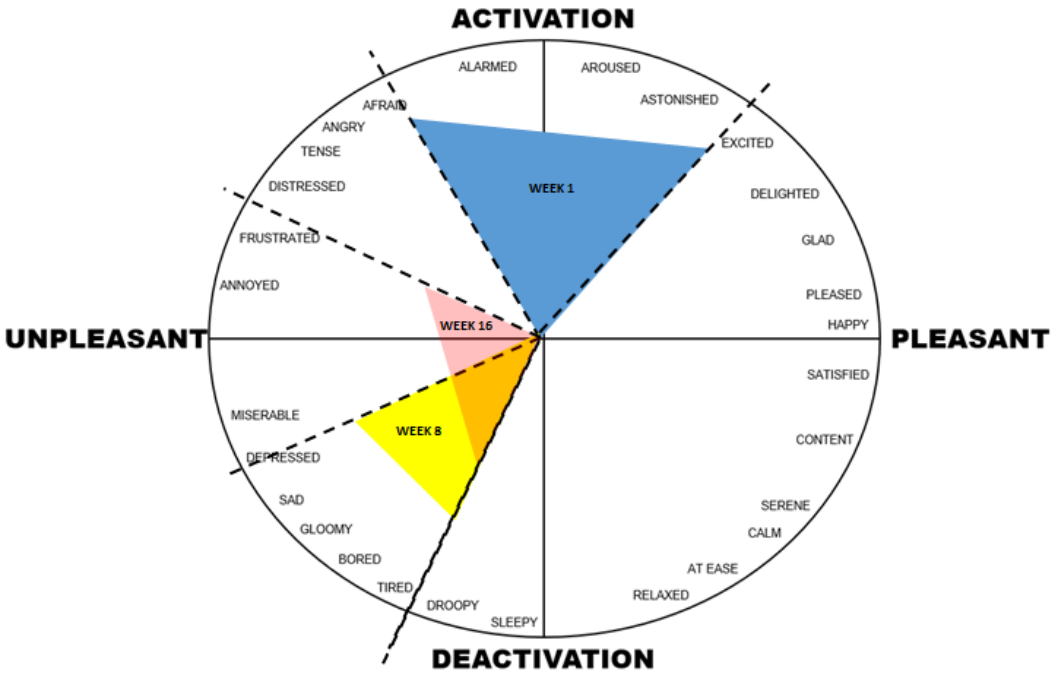


Figure 6-Actual trajectory of emotions

Conclusions and Future Work

This research contributes to the discovery of knowledge about the emotional experiences of engineering students and whether these experiences influence their pursuit of engineering as a career. In addition, the results of this study can inform other engineering programs in which certain courses may operate as intentional or unintentional bottleneck courses that may prolong students' matriculation through an engineering program. Future work will explore the sources of emotional stress experienced by students in this course as well as instructional intervention strategies that may positively influence the emotional experience of students in this course and increase achievement and motivation.

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