Gender Differences in Class-related Emotional Experiences: A Study of Mathematics Course

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Abstract

In education, students experience different emotions, which affect their academic performance, engagement, and achievement. In the classroom, these emotional experiences of students are called academic emotions (Lei & Cui, 2016). This paper holds two-fold aims: to inquire about class-related emotions; and to find gender differences in the emotional experiences of undergraduates of a math course. The theoretical framework was grounded in control value theory. The purpose of the study was achieved by adopting a positivist paradigm, and applying a quantitative research method. The achievement emotions questionnaire (2000) was adapted as a data collection tool for class-related emotions. The data were collected from 162 undergraduates. The descriptive analysis was run for comparing group means on SPSS v. 23. The findings reported more positive emotional experiences: pride and enjoyment, and less negative emotional experiences: anxiety, anger, hopelessness, shame, and boredom in learning math in students. Moreover, interesting differences were found in class-related emotions between males and females. Future researchers direct focus on assessing test-related, learning-related, and teacher-related emotions of students learning science courses, and uncover underlying factors of negative emotions and environmental inciters of emotions from an interpretivist's perspective.

Keywords: *class-related emotions, gender, emotional differences, mathematics subject, mathematics classroom*

Introduction

The research on test anxiety and motivation has been in the limelight since 1936 (Stengel, 1936), about 1200 researches conducted on test anxiety from the period 1974 to 2000 (Pekrun et al., 2002) whereas students' emotions were neglected for a long time until Weiner (1985), as an exception, conducted attributional research on achievement emotions, which sought the attention of researchers to explore the achievement related emotions in terms of cognitive antecedents. More recently, studies on emotions in education have gained much interest from researchers (Pekrun & Linnenbrink-Garcia, 2014). Theoretically, students experience an array of diverse emotions in academic settings. This experiential phase offers learning and achievement opportunities to enable students to excel in education, profession, and the allocation of resources efficiently. Thus, learning and achievement are prime sources of human emotions, which activate the self, task, and social emotions (cf. Scherer et al., 1986).
The emotions concerning achievement activities or outcomes produced in an academic setting deal with affective stimulation are called achievement emotions (Pekrun, 2006, pp. 121-122). There is an indication of the relationship between achievement emotions emotional experiences and students' achievement outcomes in the control-value theory (CVT) (Pekrun, 2006), which impacts academic experiences. The achievement stimulates intense emotions pertaining to student results—success or failure; and the situations around achievement yield different emotions—anger, hopelessness, shame, boredom, pride, enjoyment, and hope (Pekrun & Linnenbrink-Garcia, 2014, p. 120). The achievement emotions affect academic performance through students' self-regulation and motivation for learning (Pekrun et al., 2017), and physical and mental health (Pekrun, 2017). In addition, the literature showed a strong relationship between the emotions of students and teachers (Bieg et al., 2017). Teachers perform two roles; impart knowledge and ignite the passion for the course and excitement for learning which results in students' success; and failure, if the teacher encounters negative emotions like boredom and anxiety, students tend to weaken motivation for learning and attend the class (Pekrun & Linnenbrink-Garcia, 2014, p. 1). Moreover, the anxiousness of math teachers impairs students' performance in mathematics (Beilock et al., 2010). Conversely, when a math teacher enjoys teaching, it develops students' motivation and fosters a conducive environment for learning (Rodrigo-Ruiz, 2016, p. 76). In sum, teachers with positive emotions demonstrate high-quality instruction whereas teachers with negative emotions depict low-quality instruction (Rodrigo-Ruiz, 2016; Postareff, & Lindblom-Ylänne, 2011). So, students' experiences of emotions situate around achievement emotions (Martínez-Sierra & García González, 2014) and hold prime significance in the current literature.

Emotions in Math Classroom

The student's emotions in a math classroom received less attention (Larkin & Jorgensen, 2015). Frenzel et al. (2007) study reported some enjoyment as a positive emotion in females, and more boredom, anger, and anxiety as negative emotions in females that students experienced during math instruction. Lewis (2013) found positive emotions: first is pride which was associated with the achievement of tests or exams, or understanding or doing something in math class, and relaxation was linked with experiences like doing a task as per the requirement of the question and being able to cope. Moreover, the study of Larkin and Jorgensen (2015) reported that positive emotions yield as a result of connecting math with the real world and adding purpose while teaching math, adopting activity-based instruction, and scaffolding students during the class activities; the negative emotions associated with math subject include general difficulty level, content-specific difficulty, hatred, confusion and frustration, and feelings of boredom and sadness. Thus, experiencing emotions is a psychological capacity of an individual but subjective structure are associated with the context and social origin which indicate that specific achievement emotions are setting-bound (Martínez-Sierra, & García-González, 2016). A study on emotions necessitates unveiling math emotions taking place in daily activities in a math classroom, lessons, and courses (Hannula et al., 2010). To sum up, class-related emotions make up a set of contextual emotions students experience in a math course, and further assessment of classroom-related emotions can determine the trait and state of emotional experiences of students in math.

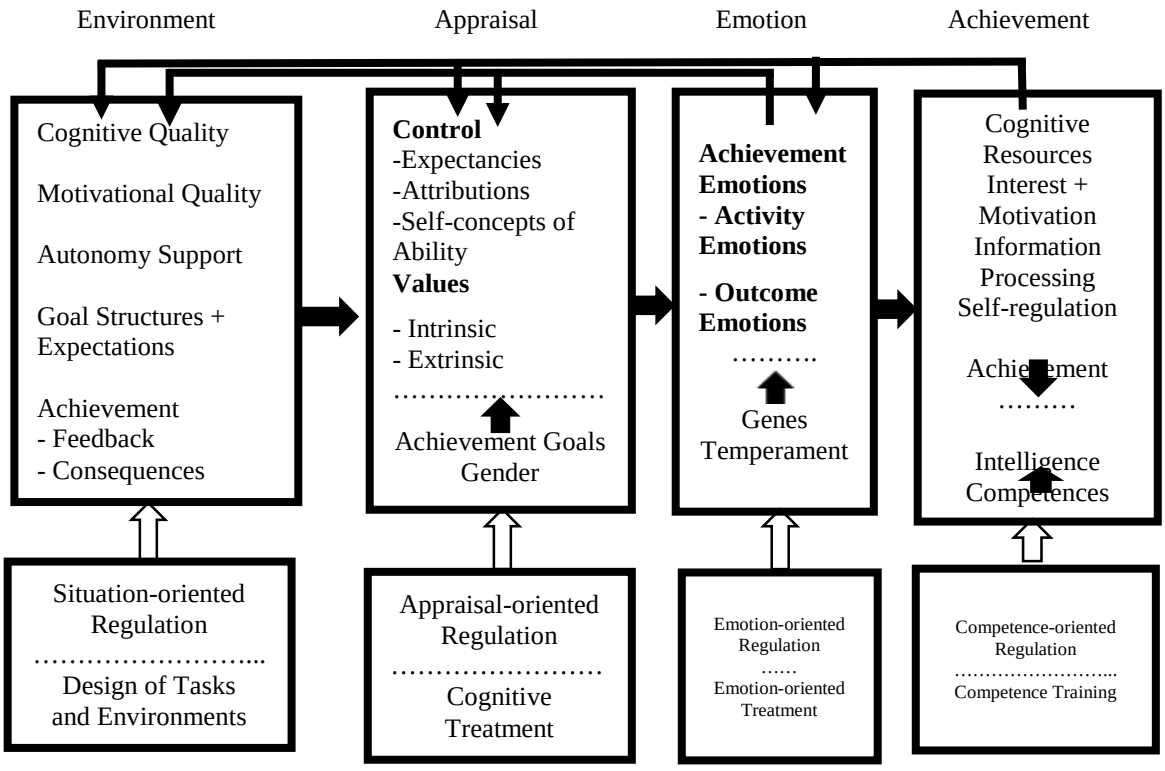
Theoretical Framework

Achievement emotions play a crucial role in learning and are not the outcomes and consequences of achievement activities (Pan et al., 2022). According to Camacho-Morles et al. (2021), the effects of achievement emotions on learning have gained significant attention among scholars. The achievement emotions may have an important influence on learners' satisfaction (Wu et al., 2021b), engagement (Luo & Luo, 2022), motivation (Feraco et al., 2022), problem-solving ability (Lee & Chei, 2020), learning persistence (Tang et al., 2021), and achievement (Putwain et al., 2022). The control value theory (CVT) sets the theoretical framework for determining emotions related to achievement (Perkun, 2006). CVT was built on expectancy-value theories of emotions (Pekrun et al., 2017), attribution-achievement-related emotions theories (Weiner, 1985); the performance-effects of emotions models (Zeidner, 2007; Pekrun et al., 2002) and transactional approaches (Lazarus & Folkman, 1984) by revising and integrating an explanation of a wider variety of emotions. The emotions reside in physiological, cognitive, affective, and motivational components of interrelated psychological

processes. This theory premises that the current approaches to achievement emotions complement in setting a common ground for sharing basic assumptions. CVT explains the reasons why learners' achievement, satisfaction, engagement, performance, and motivation are influenced by achievement emotions (Pekrun et al., 2011). Moreover, CVT advocates that achievement emotions may differ among individuals concerning varying degrees of frequency and intensity due to the culture of learners, age, and gender (Camacho-Morles et al., 2021). The central propositions of the theory relate to a value-related and control-related appraisal that precedes these emotions (Perkun, et al., 2011). The future outcomes and appraisal of achievement activities hold prime importance. The achievement is subjective by nature, which may be within or without one's control, in due course, students experience specific achievement emotions (Goetz et al., 2010). This situation indicates the close determinants of emotions that are: the control and value appraisals where appraisals have critical importance for stimulating achievement emotions. These appraisals categorize into control appraisals as action-oriented expectancies, where an individual initiates and acts (Pekrun, 2006), and action outcome expectancies (Skinner, 1996) indicate producing the desired outcome. Pekrun et al. (2001) named expectancies as "academic control", and value judgments are the subjective significance of outcomes and attainment activities (Pekrun, et al., 2011) (Figure 1).

Figure 1

The CVT of Achievement Emotions



Note. Adopted from Pekrun (2006).

As per situational specificity, teacher and student emotions are required to be domain- and subject-specific vein. The distal antecedents affect these appraisals and influence achievement emotions despite value appraisals and the subjective nature of control as proximal precursors. The CVT emphasizes the functions of achievement emotions and stipulates that cognitive and motivational mechanisms affect the learning and performance of individuals. Emotions influence intrinsic motivation like interest and curiosity for learning, and extrinsic motivation for securing good grades based on positive outcomes; moreover, emotions facilitate rigid and flexible learning techniques and rehearsal; emotions regulate students' self and external learning (Pekrun, et al., 2011). Subsequently, achievement feelings determine success and failure and affect individuals beyond achievement outcomes. Moreover, reciprocal causation exists between the interaction of attainment emotions origins and their outcomes. The outcomes either met with success or failure indicate the attainment of emotion regulation. The positive activating emotions motivate an individual for learning and self-regulation fostering positive academic performance; while the negative deactivating emotions demotivate students and leave negative effects on academic performance; moreover, the negative activating and positive deactivating emotions affect intrinsic motivation, and simultaneously, avoid failure, can induce extrinsic motivation; and the learning differences cause variations in the influence of negative activating emotions (Lane et al., 2005), however, for most students, the influence of negative activating emotions on the collective academic performance is higher than that of positive activating consequences (Pekrun, et al. 2011). CVT distinguishes appraisal, emotion, competence, and situation-oriented regulations.

Finally, the CVT states that achievement emotions are relatively universal across individuals, contexts, achievements, and genders. Though variations can be found in intensity, frequency, and contents of achievement, the operational mechanisms tying origins and outcomes of achievement emotions are general. However, the emotions theory's cognitive structure posits discrete emotions in a typology of emotional experience (Ortony et al., 1990), which is appropriate for analyzing the emotions of students and teachers (Martínez-Sierra & García González, 2016; Coppola et al., 2013).

Research on student achievement emotions in math is an understudied area. The study of Hannula et al. (2010) suggested studying students' math emotions during math activities. Further, Martínez-Sierra (2015) emphasized investigating students' emotions at different academic levels and academic settings. These studies were conducted in international contexts but a gap in the literature substantiates to conduct a study for examining the math emotions of undergraduates in the context of Pakistan.

Considering the above literature, this research study attempted to bridge the knowledge gap in the literature by examining students' emotions pertaining to math learning, math class, and math test and exams according to time. The emotions are central to this study, hence, the CVT of achievement emotions (Pekrun, 2006) is adopted. Moreover, the presumed predictive effect of emotions indicates a specific instigation toward math achievement. The review of related literature led to the formulation of research questions and a hypothesis below:

a. What are the class-related emotions of undergraduates enrolled in a math course?
b. What are the differences in the class-related emotions of male and female undergraduates enrolled in a math course?

H: There exists no difference in the class-related boredom; shame; anxiety; anger; pride; hope; and enjoyment emotions between male and female undergraduates enrolled in a math course.

Methodology

This study was an attempt to focused on exploring the emotions of undergraduates toward class-related emotions of math. The nature of inquiry necessitated positivism as philosophical stance, the approach adopted was deductive, the methodological choice was grounded in mono-method quantitative, the strategy was survey, the time-zone was cross-sectional, and the data collection involved voluntary participation of respondents (Sauders et al., 2019). Quantitative research was employed as it attempts to inquire into numbers that are used for data collection, and coding for expressions (Williams et al, 2022, p. 3), and a cross-sectional survey was conducted at one point in time (Fraenkel et al., 2012, p. 394) for exploring context-specific emotions. The sampling process involved the volunteer participation of a representative sample from the universities (Fraenkel et al., 2012, p. 91). The gathered data from the respondents were used for descriptive data analysis and inferential statistical analysis on SPSS. The mean analysis was processed using the table of mean range interpretation (Moidunny, 2009). The data stemmed from undergraduates of business administration, computer science, mathematics, and education departments of two universities. A random selection criterion was used to elicit voluntary responses. The respondents were briefed about the purpose of the study before filling out a 10-minute survey form. The information on data collection was shared with the undergraduates before data collection, and participation in the study involved no incentives, and selection was made on voluntary basis. The total sample of undergraduates who participated in the study was 162. Out of the total respondents, male 83 (51.2%) and female 79 (48.8%) with 149 undergraduates with ages ranging between 19 to 23. The department-wise response remained as business 60 (37%), education 72 (44.4%), Math 23 (14.2%), computer science 5 (3.1%),

and others 2 (1.2%). Similarly, the semester-wise response stood at 56 (34.6%) from semester five, 42 (25.9%) from semester two, 24 (14.8%) from semester six, 21 (13%) from semester eight, 13 (8%) from semester four, 5 (3.1%) from semester-seven, and 1 (0.6%) from semester-three. In addition, the number of students from one university was 122 (75.3%) and 40 students (24.7%) from other universities participated in the study. No variables related to previous education and family background were asked of the undergraduates.

Measures

Pekrun's et al. (2005) self-report survey of achievement emotions questionnaire was adapted in this study. The five-point Likert scale was used as a tool for the measurement of emotions ranging from strongly disagree=1 to strongly agree= 5 (Bhandari & Nikolopoulou, 2022). The survey was administered to measure students' typical, habitual, and individual course-specific achievement emotions. The instrument comprised three sections: emotions related to class; learning; and test, however, considering practicality and paucity of time, the achievement emotions section pertaining to class-related scales of 52 items were used, where all items retained affective, motivational, cognitive, or physiological components. The internal consistency reliability tests for the class-related emotion scales showed excellent alpha scores for hopelessness (0 .942) and boredom (0.908), and good scores for enjoyment (0.890), hope (0.848), pride (0.882), anger (0.858), anxiety (0.873), and shame (0.865) (George & Mallery, 2003, p. 231) (Table 1).

Table 1

Reliability of Class-related Emotion Scales

	Class-related Emotions	
	α	Items
Enjoyment	0.890	8
Hope	0.848	4
Pride	0.882	6
Anger	0.858	7
Anxiety	0.873	8
Shame	0.865	6
Hopelessness	0.942	8
Boredom	0.908	5
Total		52

Emotions inherently are a complex construct with varying interpretations and measurements (Sinatra et al., 2014). The achievement emotions questionnaire (AEQ) (Pekrun et al., 2005) shows the interrelated psychological process in emotions. Moreover, Pekrun's (2006) CVT sets three dimensions of emotions: activating—deactivating emotions, activity outcome-

related object focus of emotions, and positive-negative emotions. The AEQ comprises four sections: emotions that activate positivity—pride, enjoyment, and hope; emotions that activate negativity—shame, anxiety, and anger; positive deactivating emotion—relief; and negative deactivating emotions—boredom and hopelessness. The measurement of emotions is applicable in three contexts: during class while learning, and taking a test. The internal structure of these emotions rests on the interrelatedness of affective, motivational, physiological, and cognitive mechanisms. The achievement depends on the combination of negative and positive activation and deactivation of emotions (Pekrun, 2006). The sparse research on achievement emotions indicates a shift in students' emotions in education during daily activities of math (Hannula et al., 2010); for example, emotions in math classrooms including lessons, courses, and exams.

Results

In this section, the sample characteristics, tests of normality, Reliability of Class-related emotion scales, demographics of the study sample, class-related emotions, and their mean result with interpretation are presented.

Characteristics of Sample

The visual inspection of histograms, box plots, normal Q-Q plots, and Shapiro-Wilk's tests ($p > 0.05$) (Shapiro & Wilk, 1965) showed mixed results in class-related emotions of males and females (Table 2).

Table 2

Tests of Normality

Sex		Shapiro-Wilk Statistic	df	Sig.
Enjoyment	Male	.968	83	.039
	Female	.953	79	.005
Hope	Male	.925	83	.000
	Female	.946	79	.002
Pride	Male	.898	83	.000
	Female	.937	79	.001
Anger	Male	.979	83	.197
	Female	.979	79	.230
Anxiety	Male	.987	83	.572
	Female	.949	79	.003
Shame	Male	.972	83	.067
	Female	.922	79	.000
Hopelessness	Male	.953	83	.004
	Female	.895	79	.000
Boredom	Male	.961	83	.012
	Female	.949	79	.003

The analyses of descriptive statistics for the demographic dataset (Table 3) informed gender-wise participation, female 79 (48.8%), and male 83 (51.2%); the ages of 149 participants ranged between 19-23 (92%), 8 participants ages ranged between 24-25 (4.9%), 3 participants had age above 28 (1.9%), and 2 participants ages ranged (1.2%). Similarly, the analysis for semester-wise distribution of the participants informed that 56 (34.6%) participants were in the fifth semester, 42 (25.9%) in the second semester, 24 (14.8%) in the sixth semester, 21 (13%) in the eighth semester, 13 (8%) in the fourth semester, 5 (3.1%) in the seventh semester, and 01 (0.6%) in the third semester. The final demographic analysis illustrated the department of the participants. As per analysis, students (72) from the education department constituted 44.4%, the students (37) from the business department made 37%, students (23) from the math department made 14.2%, students (05) from computer science contributed 3.1% and only 02 students from other departments made 1.2%.

Table 3

Demographics of Study Sample

		n	%
Sex	Male	83	51.2
	Female	79	48.8
Age	19-23	149	92
	24-25	8	4.9
	26-28	2	1.2
	Above 28	3	1.9
Semester	Second	42	25.9
	Third	1	0.6
	Fourth	13	8
	Fifth	56	34.6
	Sixth	24	14.8
	Seventh	5	3.1
	Eighth	21	13
Department	Business	60	37
	Computer Science	5	3.1
	Math	23	14.2
	Education	72	44.4
	Others	2	1.2

The results of the analyses reported class-related positive and negative emotions. The pride, hope, and enjoyment set out as positive class-related emotions. On the contrary, boredom, hopelessness, shame, anxiety, and anger are grouped under class-related emotions. The analysis of class-related emotions toward math (Table 4) informed of participants, standard deviation, mean score, and minimum and maximum values. The positive class-related emotions on enjoyment ranked first with a mean score of 29.13, SD = 6.63, and range of 32; the mean score for the second highest scale of pride stood at 23.48, SD = 4.83, and range of 24; however, at seventh number came the class-related emotions for hope, which showed a

mean score of 15.38, SD = 3.28, and range 16. Conversely, the negative class-related emotions on anxiety stood at third position with a mean of 21.73, SD = 6.96, and range of 32; anger secured fourth place with a 20.25 mean score, SD = 6.23, and range of 28; hopelessness came fifth with 18.74 mean score, SD = 7.89, and range 32; the position of class-related emotions for shame stood sixth, 14.83, SD = 5.32, and range 24; and boredom positioned last in class-related emotions with a mean score 14.26, SD = 5.40, and range 20. In terms of mean scores, positive class-related emotions outweighed negative emotions toward math class.

Table 4

Class-related Emotions

	n	Min.	Max.	M	SD
Enjoyment	162	8	40	29.13	6.63
Hope	162	4	20	15.38	3.28
Pride	162	6	30	23.48	4.83
Anger	162	7	35	20.25	6.23
Anxiety	162	8	40	21.73	6.96
Shame	162	6	30	14.83	5.32
Hopelessness	162	8	40	18.74	7.89
Boredom	162	5	25	14.26	5.40

Note. Each scale ranged from 1 to 5 points.

The interpretation of mean values in the data analysis process was achieved through the mean score division on a five-point mean range (Table 5).

Table 5

Mean Result Interpretation

Mean Range	Interpretation
1.00 – 1.80	Very Low
1.81 – 2.60	Low
2.61 – 3.20	Moderate
3.21 – 4.20	High
4.21 – 5.00	Very High

Note. Adopted from Moidunny (2009).

Table 6 shows the item analysis report for class-related emotions between males and females. The analysis shows eight scales: boredom, hopelessness, pride, enjoyment, hope, anger, anxiety, and shame. For enjoyment, the highest mean value of the item (enjoyment of taking a class) for females is 4.18 (high mean value) with *SD* = 0.94. However, the mean value for males for the same item is 3.80 (high mean value) with *SD* = 1.00. The lowest mean value of the item (enjoyment from understanding material) for males is 3.02 (moderate mean value) with *SD* = 1.22. The mean range for the remaining six items lies between mean 4.18 and 3.02, with high and moderate mean values respectively. For hope, the highest mean value of the

item (positive self-belief in class) for females is 4.10 (high mean value) *SD* = 0.73. The lowest mean value of the item (feeling confident in class) for males is 3.64 (high mean value) with *SD* = 1.08. The item also shows a high level of mean range interpretation. The mean range for the remaining two items lies between 4.10 (high mean value) and 3.64 (moderate mean value). For pride, the highest mean value of the item (self-pride as a source of motivation) for females is 4.39 (high mean value) with *SD* = 0.61. The lowest mean value of the item (pride in moving with the material) for males is 3.63 (high) with *SD* = 0.86. The mean range for the remaining four items lies between 4.39 (very high) and 3.63 (high). For anger, the highest mean value of the item (time wastage adds to worries) for males is 3.59 (high mean value) with *SD* = 1.06. The lowest mean value for the item (frustration leads to anger) for females is 2.29 with *SD* = 1.12. The mean range for the remaining five items lies between 3.59 (high) and 2.29 (low). For anxiety, the highest mean value of the item (fear of saying wrong dominates) for males is 3.02 (moderate mean value) with *SD* = 1.33.

Table 6

Highest and Lowest Mean Analysis of Class-Related Emotions between Male and Female

	Male			Female			Total		
	M	*n*	SD	M	*n*	SD	M	*n*	SD
Enjoyment taking class	3.02	83	1.22	3.25	79	1.16	3.14	162	1.19
Enjoyment from understanding material	3.80	83	1.00	4.18	79	0.94	3.98	162	0.99
Feeling confident in class	3.64	83	1.08	3.78	79	0.86	3.71	162	0.98
Positive self-belief in class	3.69	83	1.02	4.10	79	0.73	3.89	162	0.91
Pride in moving with material	3.63	83	1.08	3.68	79	0.86	3.65	162	0.97
Self-pride is a source of motivation	4.11	83	1.04	4.39	79	0.61	4.25	162	0.86
Frustration leads to anger	2.54	83	1.06	2.29	79	1.12	2.42	162	1.10
Time wastage adds to worries	3.59	83	1.19	3.32	79	1.25	3.46	162	1.22
Nervousness leads to class skipping	2.65	83	1.27	2.20	79	1.23	2.43	162	1.27
Fear of saying wrong dominates	3.02	83	1.33	2.86	79	1.24	2.94	162	1.29
The feeling of shame under powers	2.57	83	1.19	2.32	79	1.01	2.44	162	1.11
Feeling embarrassed when saying	2.82	83	1.28	2.33	79	1.12	2.58	162	1.22
Feeling hopelessness	2.43	83	1.25	2.13	79	1.04	2.28	162	1.16
The feeling of hopelessness reduces energy	2.63	83	1.28	2.28	79	1.17	2.46	162	1.23
Feeling of boredom	3.06	83	1.22	2.51	79	1.28	2.79	162	1.28
Boredom makes time pass difficult	3.28	83	1.27	2.90	79	1.19	3.09	162	1.25

Note. SD = standard deviation, n = number of participants, and M = mean.

The lowest mean value of the item (nervousness leads to class skipping) for females is 2.20 with *SD* = 1.23. The mean range for the remaining six items lies between 3.02 (moderate) and 2.20 (low). For shame, the highest mean value of the item (feeling embarrassed when saying) for males is 2.82 (moderate mean value) with *SD = 1.28.* The lowest mean value of the item (feeling of shame under powers) for females is 2.32 (low) with *SD* = 1.01. The mean range

for the remaining four items lies between 2.82 (moderate) and 2.32 (low). For hopelessness, the highest mean value (feeling of hopelessness reduces energy) for males is 2.63 (moderate mean value) with *SD* = 1.28. The lowest mean value of the item (feeling hopelessness) for females is 2.13 (low) with *SD* = 1.04. The mean range for the remaining six items lies between 2.63 (moderate) and 2.13 (low). For boredom, the highest mean value of the item (boredom makes time pass difficult) in males is 3.28 (high mean value) with *SD* = 1.27. The lowest mean value of the item (feeling of boredom) for females is 2.51 with *SD* = 1.28. This shows a low level on the mean range table. The mean range for the remaining three items lies between 3.28 (high) and 2.51 (low).

Table 7 reports the group statistics for class-related emotions of males and females with standard error mean, standard deviation, mean values, and many respondents. Moreover, Moidunny's (2009) interpretation of the mean score is used for determining the effect of a response. For enjoyment, the cumulative mean value for females is 3.83 (high) with *SD* = 0.782, and for males, it is 3.47 (high) with *SD* = 0.839. For hope, the cumulative mean for females is 3.96 (high) with *SD* = 0.667, and for males 3.74 (high) with *SD* = 0.936. For pride, the cumulative mean value for females is 4.01 (high) with *SD* = 0.603, and for males, it is 3.83 (high) with *SD* = 0.954. For anger, the cumulative mean value for males is 3.06 (moderate) with *SD* = 0.859, and for females, it is 2.72 (moderate) with *SD* = 0.893. For anxiety, the cumulative mean value for males is 2.81 (moderate) with *SD* = 0.920, and for females 2.61 (moderate) with *SD* = 0.808. For shame, the cumulative mean value for males is 2.60 (low) with *SD* = 0.970, and for females, it is 2.33 (low) with *SD* = 0.772.

Table 7

Male and Female Class-Related Emotions

	Mean		SD		SEM		ES *d*
	Male	Female	Male	Female	Male	Female	
Enjoyment	3.47	3.83	0.839	0.782	0.092	0.088	0.45
Hope	3.74	3.96	0.936	0.667	0.103	0.075	0.27
Pride	3.83	4.01	0.954	0.603	0.105	0.068	0.23
Anger	3.06	2.72	0.859	0.893	0.094	0.1	0.38
Anxiety	2.81	2.61	0.92	0.808	0.101	0.091	0.23
Shame	2.60	2.33	0.97	0.772	0.107	0.087	0.31
Hopelessness	2.47	2.21	1.05	0.906	0.115	0.102	0.27
Boredom	3.08	2.61	1.04	1.08	0.114	0.122	0.44

Note. SEM = standard error mean, ES *d* = effect size, SD = standard deviation, and M = mean

For hopelessness, the cumulative mean value for males is 2.47 (low) with *SD* = 1.048, and for females, it is 2.21 (low) with *SD* = 0.906. For boredom, the cumulative mean value for males is 3.08 (moderate) with *SD* = 1.036, and for females, it is 2.61 (moderate) with *SD* = 1.081. Pride receives the highest mean score of 4.01 (high) for females, whereas hopelessness receives the lowest mean score of 2.21 (low) for females. Similarly, pride receives the highest mean score in males 3.83, whereas shame receives the lowest mean score in males 2.60. Pride mean scores for females and males are the highest than any other class-related emotion.

The t-test for independent samples was conducted to test hypotheses for comparing mean values between male and female undergraduates (Table 8). The mean value for class-related enjoyment showed statistical difference, $t = -2.83$, $df = 160$, $p < .05$, $d = 0.45$; for males ($M = 3.47$, $SD = .839$, n = 83), and female ($M = 3.83$, $SD = .782$, n = 79). The analysis indicated a medium-level effect size ($d = 0.45$) according to Cohen's (1988) convention. On average, males' and females' class-related enjoyment emotions were approximately the same. Similarly, the t-test result for equality of means reported somewhat similarity in the mean values for male and female undergrads. Hence, the null hypothesis was rejected. The mean score of class-related hope for male ($M = 3.74$, $SD = .936$, n = 83) and female ($M = 3.96$, $SD = .667$, n = 79) showed no statistical difference, $t = -1.70$, $df = 160$, $p > .05$, $d = 0.27$. The analysis suggested a small level of effect size ($d = 0.27$) according to Cohen's (1988) convention. On average, the class-related hope emotions of males and females were approximately the same. However, the t-test result for equality of means showed significant differences in the mean values of males and females. Hence, the null hypothesis was accepted. Similarly, the class-related mean scores for pride in male ($M = 3.83$, $SD = .954$, n = 83) and female ($M = 4.01$, $SD = .603$, n = 79) shows the statistical difference, $t = -1.44$, $df = 160$, $p > .05$, $d = 0.23$. The analysis suggested a small level of effect size ($d = 0.27$) according to Cohen's (1988) convention. On average, the class-related pride of male and female undergraduates was approximately the same. However, the t-test result suggested significant differences in the mean values of male and female undergrads. Hence, the null hypothesis was accepted.

Table 8

Independent Sample t-Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	Df	Sig. (2-tailed)	MD	SE	95% CID Lower	Upper
Enjoyment	EVA	.789	.376	-2.83	160	.005	-.361	.128	-.612	-.109
	EVNA			-2.83	159.93	.005	-.361	.127	-.612	-.109
Hope	EVA	8.130	.005	-1.70	160	.092	-.218	.128	-.471	.036
	EVNA			-1.71	148.43	.089	-.218	.127	-.469	.034
Pride	EVA	10.530	.001	-1.44	160	.153	-.181	.126	-.430	.068
	EVNA			-1.45	139.46	.149	-.181	.125	-.428	.066
Anger	EVA	.001	.976	2.45	160	.015	.337	.138	.065	.609
	EVNA			2.45	158.77	.016	.337	.138	.065	.609
Anxiety	EVA	2.774	.098	1.46	160	.146	.199	.136	-.070	.468
	EVNA			1.47	158.98	.144	.199	.136	-.069	.468
Shame	EVA	7.263	.008	1.96	160	.052	.271	.138	-.002	.544
	EVNA			1.97	155.16	.050	.271	.137	.000	.543
Hopelessness	EVA	4.957	.027	1.68	160	.094	.260	.154	-.045	.564
	EVNA			1.69	158.56	.093	.260	.154	-.044	.563
Boredom	EVA	.018	.894	2.81	160	.006	.467	.166	.138	.795
	EVNA			2.80	158.66	.006	.467	.167	.138	.796

Note. Sig = significance, Df = degree of freedom, MD = mean difference, SED = standard error difference, CID = confidence interval difference, EVA = equal variance assumed, EVNA= equal variance not assumed.

The class-related mean values for anger emotions in male (M = 3.06, SD = .859, n = 83) and female (M = 2.72, SD = .893, n = 79) shows statistical difference, t = 2.45, df = 160, $p < .05$, d = 0.38. The analysis reported a medium level of effect size (d = 0.38) according to Cohen's (1988) convention. On average, the class-related anger of male and female students was approximately the same. However, the t-test result suggested no significant difference in the mean values between male and female students which led to the rejection of the null hypothesis. The mean scores on the anxiety of class-related emotions in male (M = 2.81, SD = .920, n = 83) and female (M = 2.61, SD = .808, n = 79) shows the statistical difference, t = 1.46, df = 160, $p > .05$, d = 0.23. The analysis suggested a small level of effect size (d = 0.23) according to Cohen's (1988) convention. On average, the class-related anxiety of male and female students was approximately the same. However, the t-test result suggested a significant difference in the mean values of the two genders, which led to the rejection of the null hypothesis. The mean score of class-related shame in males (M = 2.60, SD = .970, n = 83) and females (M = 2.33, SD = .772, n = 79) shows statistical difference at the 0.05 level of significance, t = 1.96, df = 160, $p > .05$, d = 0.31. According to Cohen's (1988) convention, the analysis indicated a small-medium level of effect size (d = 0.31). On average, the class-related shame of two genders students was approximately the same. However, the t-test result

suggested a significant difference in the mean values of the two genders, which led to the acceptance of the null hypothesis. Moreover, the mean values of class-related hopelessness for male (M = 2.47, SD = 1.05, n = 83) and female (M = 2.21, SD = .906, n = 79) shows the statistical difference, t = 1.68, df = 160, p > .05, d = 0.27. According to Cohen (1988), there existed a small level of effect size (d = 0.27). On average, the class-related hopelessness of male and female students was approximately the same. However, the t-test result suggested a significant difference in the mean values of the two genders, which led to the acceptance of the null hypothesis. Finally, the mean values of class-related boredom for male (M = 3.08, SD = 1.04, n = 83) and female (M = 2.61, SD = 1.08, n = 79) shows statistical difference, t = 2.81, df = 160, p < .05, d = 0.44. As per Cohen's (1988) convention, the analysis suggested a medium level of effect size (d = 0.44). On average, the class-related boredom of male and female students was approximately the same. However, the t-test result suggested no significant difference in the mean values of the two genders, which led to the rejection of the null hypothesis. In sum, the class-related emotions for hope, pride, anxiety, shame, and hopelessness showed significant differences; while, enjoyment, anger, and boredom showed no significant differences in class-related emotions between male and female students. To summarize, the t-test results indicated differences of class-related hope, pride, shame and hopelessness; however, no significant differences found for enjoyment, anger, anxiety, and boredom between the male and female undergrads of a math course.

Discussion

The objectives of the study were two-fold: to assess class-related emotions, and to inquire about gender differences in these emotions. The findings revealed confirmatory results with alpha values of the AEQ (Pekrun et al., 2011, study .79 to .96; present study .85 to .96). In line with CVT (Pekrun et al., 2007; Goetz et al., 2010), and value (Goetz et al., 2010); and can enhance academic performance (Pekrun & Stephens, 2012). Specifically, undergrads enrolled in a math course mostly showed enjoyment and pride as the activating academic emotions, while anxiety and anger as the less deactivating academic emotions. Literature indicates that the nature of emotions varies in a math course as academic emotions comprise of specific motivational, psychological and cognitive components (Fraschini & Tao, 2021). Moreover, in math related academic emotions, the psychological processes involve a particular object to focus and appraisal system (Putwain et al., 2018), while boredom indicates deactivating academic emotions (Tze et al., 2016), and hope receives relatively low score; the attributes may be fewer activating emotions like interest, effort, and self-regulation creating somewhat positive effects (Pekrun & Stephens, 2012). This finding corroborates with that the enjoyment activates positive influence on learning outcomes (Kim et al., 2014),

while boredom and anger activate negative emotions, and boredom deactivates negative emotions on learning outcomes (Loderer et al., 2020; Parker et al., 2021).

The second finding reported differences between male and female undergrads who studies a math course. The difference highlighted that females demonstrated more positive activating emotions, enjoyment, hope, pride, and less anger, anxiety, shame, hopelessness, and boredom than males toward math-related academic emotions. The research evidence shows specific results in other domains of knowledge, which offer mixed results for academic emotions (Wang et al., 2022; Golding and Jackson, 2021; Wu et al., 2021a) in male experience more anxiety than female (Mahande et al., 2021) in different situations. Moreover, there were found no notable differences between male and female in a study on students' online learning experience (Stephan et al., 2019). However, there is a limitation of studies on academic emotions pertaining to class-related emotions with focus on finding differences between males and females.

The third finding informed that differences of class-related emotions exist between male and female undergrads. Females were found different on class-related emotions of hope, pride, shame, and hopelessness than male undergrads, whereas similarity was found in class-related emotions of enjoyment, anger, anxiety, and boredom between male and female students. This finding indicates that females hold more positive emotions and less negative emotions that foster favorable math-class related emotions. It portrays that combinations of emotions—hope, pride, shame, and hopelessness; and enjoyment, anger, anxiety, and boredom represent mixed emotions (Cross Francis et al., 2020) between male and female math class-related emotions. However, it indicates that high scores in math attribute to enjoyment and pride, and lower level of hopelessness, shame, anger and anxiety; whereas anger, boredom, and enjoyment predict achievement in math (Kim et al., 2014). Similarly, anger (Peixoto et al., 2015), anxiety, hopelessness (Burić & Sorić, 2012), and boredom (Ahmed et al., 2013) are negatively associated with math achievement. Furthermore, anxiety, shame, and anger as class-related emotions reported negative activating emotions which reduce cognitive resources (Pekrun & Stephens, 2012) inducing low focus on control and value for academic achievement in math, while help in focusing attention might be due to anxiety (Grills-Taquechel et al., 2013) On the contrary, Pekrun and Stephens (2012) argued that possibly negative activating emotions induce resilience to avoid failure through repeated efforts in learning. Shame carries ambivalent effects as it induces motivation when students believe that academic goals are achievable and they continue their commitment to achieving future goals, and avoid failure (Sánchez Rosas et al., 2011). Moreover, the low mean score for anger corresponds to less negative activating emotions with moderate self-efficacy, average performance, and self-regulated learning (Pekrun & Stephens, 2012) while consuming fewer

cognitive resources. The negative deactivating emotions with the low mean score for boredom and hopelessness suggest low external and internal motivation, foster surface-level information processing, and demand fewer cognitive resources (Pekrun, 2006). Additionally, boredom reduces performance (Vodanovich et al., 2011), and gifted students often experience boredom (Sisk, 1998). In line with theoretical expectations (Artino & Gehlbach, 2009) boredom and hopelessness reflect negative motivation, study behavior, and performance achievement.

Implications for Future Research

The anxiety remained central to research on math emotions and partially on emotions. Subsequently, a paucity of literature exists on gender differences related to math emotions. The findings corroborate the assumption that females are different than male students when it comes to math-related emotions, and different values and controls in genders. The findings seek support from Pekrun's (2006) CVT of achievement of emotions, where internal value and control drive emotions either in positive or negative ways. Gender-wise quality of experiences, values, and controls set the tone of emotions. The implications of findings necessitate a need to focus on efforts to further positivity and devise measures to curtail negative emotions of boredom, hopelessness, shame, and anxiety, which hinder emotional experiences in a math-class. Moreover, the gender-specific class-related emotions reflected more female-dominant and less male-dominant positive emotions. So, when designing interventions, the focus should the social environment, subject-related competence, and the internal value and control system of individuals (Pekrun, 2000). In a nutshell, the findings show the instrumentality of CVT of achievement of emotions using cognitive and social approaches to treat students' appraisals, for understanding undergraduate males and females' class-related emotions toward math. This study recommends future research focus on verifying the generalizability of these findings in other contexts, other subjects, and different age groups. More future research to focus on the effectiveness of teachers, parents, and peers; subject-related competency, and emotional management support.

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