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# Exploring Intrapersonal Factors in an Engineering Module on Emergency, Disaster, and Crisis Management: A Work-in-Progress Study

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Abstract

The frequency and cost of emergencies, disasters, and crises continue to increase in the United States, with hundreds of weather-related disasters since 1980 and total damages measured in the trillions of dollars. Engineers and engineering organizations play critical roles in preparedness, response, and recovery, yet structured emergencies, disaster, and crisis management (EDCM) education remains uncommon in engineering curricula. To address this gap, we designed and implemented a three-week instructional module that introduces engineering students to EDCM standards and guidelines, foundational concepts, and professional practices aligned with the National Incident Management System. The module was implemented in Spring 2025 within an Advanced Systems Safety Engineering course at a large public Hispanic-Serving Institution in the United States.

This Work-in-Progress paper examines intrapersonal factors that may shape how students engage with and benefit from the module. Specifically, we investigate students' self-regulated learning (SRL) focusing on motivational orientations and learning strategies, and their achievement emotions during module learning activities. Understanding how SRL and emotions co-occur, and whether patterns differ by demographic characteristics, is especially important for equitable module redesign and assessment.

Participants included 53 students (undergraduate seniors and graduate students) who completed all study measures. Students completed (1) a pre-test assessing baseline EDCM knowledge, (2) an adapted subset of the Motivated Strategies for Learning Questionnaire (MSLQ) capturing motivational orientations (administered prior to the module) and learning strategies (administered mid-module), and (3) an adapted Achievement Emotions Questionnaire (AEQ) aligned with the engineering course context (administered after module completion). Analyses included handling minimal missingness via mean replacement, $F$-tests and post-hoc comparisons to examine demographic variation, and Pearson correlations to examine relationships among SRL, emotions, and baseline knowledge.

Preliminary findings indicate statistically significant differences across racial groups in motivation, learning strategies, and both positive and negative emotions, while differences by gender were not statistically significant. Correlation analyses show that motivation and learning strategies are positively associated with positive emotions (notably enjoyment and pride), and motivation is negatively associated with multiple negative emotions. Baseline EDCM knowledge showed limited direct association with SRL and emotions, though it was significantly related to enjoyment. These results motivate targeted module revisions to more explicitly scaffold SRL and

promote positive, activating achievement emotions, particularly for students who may enter with lower baseline EDCM familiarity.

**Keywords:** Emergency, Disaster, Crisis, Standards, Motivation, Emotion, Learning Strategy

## 1. Background

With respect to large-scale disasters, there have been hundreds of weather-related disasters in the U.S. since 1980, with total damages estimated in the trillions of U.S. dollars [1]. Beyond daily emergencies and large-scale disasters, public health crises such as the COVID-19 pandemic have caused unprecedented disruption worldwide. These emergencies, disasters, and crises (EDCs) pose escalating threats to households, local communities, and business operations. Engineering organizations, in particular, play critical roles in managing EDCs, and more than 80% of engineering manager positions require an engineering degree [2]. Nonetheless, emergency management programs are offered by only a small fraction of colleges and universities in the U.S. [3]. Therefore, engineering education needs a structured approach to equip engineering students with strong skills and knowledge in emergencies, disaster, and crisis management (EDCM) as they transition into the workforce. National level calls for action emphasize both accessibility and equity in science and engineering education [4]. Similarly, emergency planning must account for the diverse needs of entire communities [5]. In response, we designed an engineering course module that addresses EDCM standards and guidelines aligned with FEMA, NFPA, and CDC frameworks, and that introduce foundational EDCM terms, concepts, and principles through authentic learning experiences (e.g., computer simulations, augmented reality, and computer games). Prior to module development, we conducted focus-group interviews with engineering students, faculty members, and public safety professionals (32 participants total) to explore the importance of, existing assets for, and needs in EDCM standards and guideline education. Findings identified six key learning elements to integrate into course design: basic drills, emergency actions, the incident command system, engineering knowledge, psychological aspects, and financial aspects [6]. Accordingly, we carefully integrated these elements into the module design.

The learning module was first implemented in Spring 2025 in an engineering course at a large public university, and we are revising it for re-implementation in Spring and Fall 2026. Our project has three aims: (1) revise the module, (2) design tools to assess the intervention’s impact on student learning, and (3) examine relationships between intrapersonal factors and student learning. This Work-in-progress paper advances the third aim by investigating key intrapersonal factors, their interrelations, and their associations with students’ demographic characteristics and baseline learning performance. Specifically, we focus on student self-regulated learning (SRL) and achievement emotions, and examine how these constructs relate to one another and vary across demographic groups and baseline EDCM Knowledge.

Intrapersonal factors such as SRL and emotion are widely recognized as central to learning and academic performance. Learning is often most effective when it is proactive: learners exert effort to construct understanding rather than merely reacting to instruction. When learners recognize their strengths and limitations, monitor progress toward goals, and reflect on learning strategy effectiveness, they tend to sustain motivation and improve learning outcomes. Such students are commonly characterized as self-regulated learners [7]. Zimmerman conceptualized self-regulation as self-generated thoughts, feelings, and behaviors oriented toward goal attainment [8], and SRL is often framed as a foundational competency for lifelong learning [7].

Empirical and theoretical work further clarifies SRL's structure. Pintrich and De Groot highlighted two primary SRL components: motivational orientations and learning strategies [9]. Building on this model, Pintrich and colleagues developed the Motivated Strategies for Learning Questionnaire (MSLQ) to assess college students' motivational orientations and use of different learning strategies [10]. Motivational orientations encompass value, expectancy, and affective components. The value component includes intrinsic goal orientation, extrinsic goal orientation, and task value. Expectancy involves control-of-learning beliefs and self-efficacy for learning and performance. The affective component is typically operationalized as test anxiety. Learning strategies incorporate cognitive, metacognitive, and resource-management strategies. Cognitive and metacognitive strategies include rehearsal, elaboration, organization, critical thinking, and metacognitive self-regulation, while resource-management strategies include time and study environment management, effort regulation, peer learning, and help seeking. Prior research has extensively employed the MSLQ and provides evidence supporting its use in capturing learners' SRL in higher education contexts [11].

Although SRL frameworks incorporate affective elements (e.g., test anxiety, confidence in course success), the broader taxonomy of achievement emotions has been underexamined in SRL research, particularly in engineering education context although students encounter a range of emotions intertwined with their learning and engagement in learning activities. Pekrun and colleagues' control-value theory provides a framework for understanding achievement emotions and their interplay with control and value beliefs [12], [13]. Achievement emotions are classified by valence (positive vs. negative) and activation (activating vs. deactivating) [14]. Valence distinguishes between positive states, such as enjoyment and pride, and negative states like anger and anxiety. In terms of activation, there is a distinction between activating states and deactivating states, such as excitement versus relaxation [14]. Importantly, Pekrun et al. emphasize that valence alone does not determine learning consequences: some positive emotions (e.g., relief) may be deactivating and reduce immediate task engagement, while some negative emotions (e.g., anger, shame) can be activating and influence students' effort and persistence [15]. Therefore, understanding achievement emotions requires attention to both valence and activation, particularly in educational interventions aiming at improving learning.

These considerations are especially relevant to the implementation of newly designed educational interventions. Intrapersonal factors are not peripheral; they help determine how students interpret, engage with, and benefit from instructional experiences. In particular, prior findings suggest that EDCM education should address not only cognitive and behavioral dimensions of learning but also psychological dimensions as its content may be emotionally salient and connected to students' lived experiences as community members and potential responders [6].

In summary, this work-in-progress study examines how engineering students' intrapersonal factors related to each other within a newly implemented EDCM standards instructional module. By clarifying these relationships, the study aims to inform iterative redesign of the EDCM modules for Spring and Fall 2026 and contribute to a more integrative understanding of learning in EDCM education that promotes both SLR process and positive learning experiences. Therefore, the research questions are 1) to what extent do SRL components and achievement emotions vary by students' demographic characteristics (e.g., gender and race)? 2) how are SRL components (motivational orientations and learning strategies) related to achievement emotions in the EDCM module?, and 3) how are SRL components and achievement emotions associated with students' baseline EDCM knowledge?

## 2. Methods

### 2.1. Module Design

We designed a module to foster engineering students' competencies in basic emergency preparation and response, emergency communications, and incident action planning and management systems. The module was implemented in Spring 2025 as part of the 'Advanced Systems Safety Engineering' course at a large public Hispanic serving university in XXX state. The module expanded existing course content from one lecture to a three-week module (two classes a week, in total six classes). The module includes lectures, homework, an exam, and an optional simulation-based project informed by the prior needs analysis [6] and aligned with the National Incident Management System (NIMS) [16].

The three-week module comprised three parts: (a) fundamentals, (b) pre-incident processes, and (c) post-incident processes. Fundamentals covered key EDCM terms and definitions, major disasters in history, governmental disaster management organizations, common attributes of disasters, mission areas, and guiding principles. Pre-incident processes included preparedness, emergency planning, hierarchical levels of planning, and different planning approaches. Post-incident processes included financial aid, resource management, information and communication, and command and coordination during disasters.

As an optional individual project, some students carried out a simulation-based planning project using *Stop Disasters* game designed by the United Nations Office for Disaster Risk Reduction

(UNDRR). Utilizing the principles they learned from the class, students created a disaster plan and tested its efficacy against simulated disaster scenarios.

### 2.2. Data and Participants

#### 2.2.1. Pre-test

Before the module began, students completed a 12-item multiple-choice pre-test covering core module topics (e.g., basic emergency management practices, emergency communication, incident command system concepts). The pre-test was intended to assess baseline EDCM knowledge. Example items are shown below (correct answers indicated in *italics*).

**Q04.** Which of the following is not a recommended way for emergency communication at workplace?

A. Create and update emergency contact list
*B. Use a single communication method (e.g., cell phone) to avoid confusion*
C. Pre-designate meeting place or muster area
D. Call 9-1-1 and provide location of incident, injuries, type of emergency, and other details about the situation

**Q07.** Which of the following functions is not carried out by the Planning Section?

A. Facilitate incident planning meetings
*B. Setting up, maintaining, securing, and demobilizing incident facilities*
C. Recording the status of resources and anticipated resource needs
D. Collecting, recording, and safeguarding all incident documents

#### 2.2.2. Instruments

To examine relationships among motivational orientation, learning strategies (LS), and achievement emotions, we adapted two established instruments: the MSLQ [10] and the Achievement Emotions Questionnaire–Mathematics [17]. For the MSLQ, we streamlined the instrument by removing redundant items and excluding items specific to test anxiety. We administered motivational orientation scales prior to the module (to capture incoming motivation) and learning strategy scales mid-module (to capture enacted strategies during engagement). After module completion, students completed an adapted AEQ-M aligned with engineering course experiences (hereafter AEQ-E), reporting their achievement emotions related to class activities, studying, and assessments. Higher scores indicate stronger endorsement of the corresponding construct (motivation/strategy use/emotion intensity).

2.2.3. Participants

A total of 73 engineering students were enrolled in the course; 53 students completed all study measures (MSLQ components, AEQ-E, and pre-test) and were included in analyses. Out of the 53 students, 13 were female and 40 were male. Table 1 summarizes participants' race information. One student did not report their race; therefore, race data were available for 52 students.

**Table 1** Participant students' demographic information

| Race | Number | Percent (%) |
|---|---|---|
| White | 8 | 15.38 |
| Asian | 23 | 44.23 |
| Black | 7 | 13.46 |
| Hispanic | 14 | 29.92 |

2.3. Data analysis

The missing data rate was low (approximately 1.90% per measure); therefore, missing values were imputed using the mean [18]. Specifically, we applied item-level mean substitution for missing responses. To address the research questions, we conducted one way ANOVAs (*F*-tests) to examine variation in SRL and emotion constructs across gender and racial groups, Tukey's HSD post-hoc tests to identify which groups differed when omnibus test were significant, and Pearson correlation analyses to examine relationships among baseline knowledge (pre-test), SRL variables (motivational orientation and learning strategies), and achievement emotions.

3. Results

3. 1. Variation in SRL and Achievement Emotions by Demographics

We examined differences in SRL and achievement emotions across gender and racial groups. Figure 1 presents box-and-whisker plots for each construct by race/ethnicity.

Results showed no statistically significant differences by gender across constructs. However, there were statistically significant differences across racial groups in motivation, $F(3,48)=5.825$, $p < .05$; learning strategies, $F(3,48)=2.896$, $p < .05$; positive emotions, $F(3,48)=13.726$, $p < .05$; and negative emotions, $F(3,48)=4.368$, $p < .05$.

Tukey post-hoc tests indicated that Asian students reported significantly higher motivation ($m = 17.34$, $sd = 1.12$, $p < .05$ ) and learning strategies ($m = 16.72$, $sd = 1.84$, $p < .05$ ) than Hispanic students (motivation: $m = 16.19$, $sd = 0.61$; LS: $m = 14.93$, $sd = 1.89$). Black students also reported significantly higher motivation than Hispanic students (Black: $m = 17.47$, $sd = 1.0$, $p < .05$; Hispanic: $m = 16.19$, $sd = 0.61$; $p < 0.5$). Across SRL components, Hispanic students consistently had the lowest average scores.

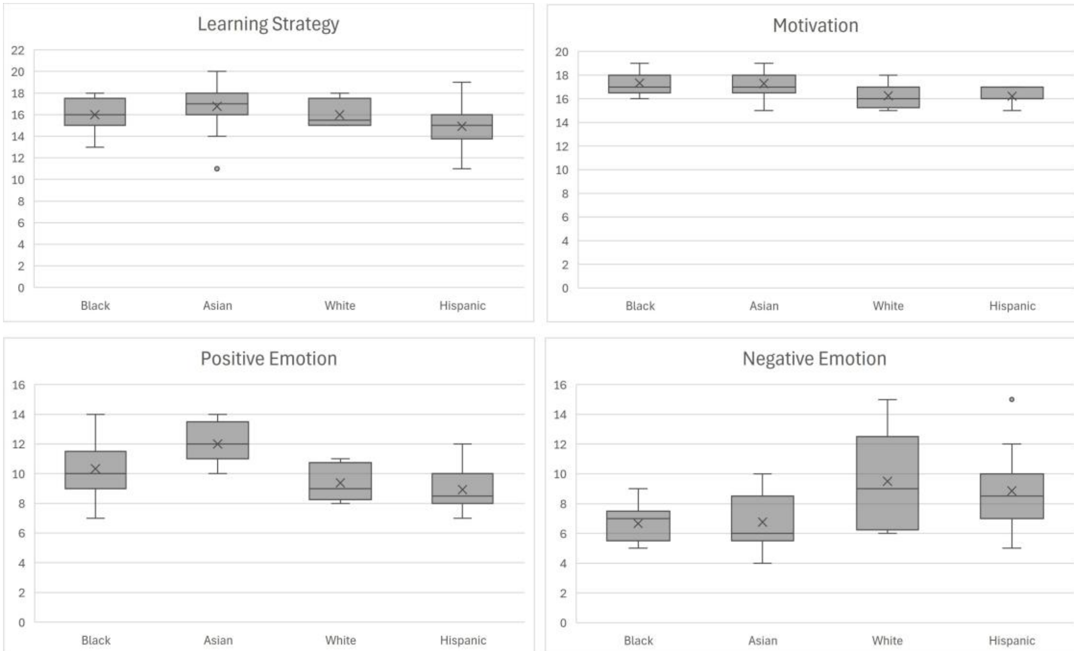


**Figure 1.** Learning strategy, motivation, and achievement emotions by race/ethnicity

For achievement emotions, Asian students reported significantly higher positive achievement emotions (*m* =12.00, *sd* =1.41) than White (*m* = 9.24, *sd* = 1.20), Black (*m* = 10.37, *sd* = 2.11), and Hispanic (*m* = 8.97, *sd* = 1.32) students ($p < .05$). Asian students also reported significantly lower negative emotions (*m* = 6.78, *sd* = 1.75) than White (*m* = 9.19, *sd* = 3.24) and Hispanic students (*m* = 8.77, *sd* = 2.44) ($p < .05$). Asian and Black students showed similar average negative emotion levels (Black: *m* = 6.68, *sd* = 1.22), though this difference was not statistically significant.

When examining specific emotions, we found that 'Boredom' was significantly higher among White students (*m* = 7.25, *sd* = 2.19) than among Asian (m = 4.45, sd = 1.516; $p < .05$) and Black students (m = 4.72, sd = 1.48; $p < .05$). Differences in other negative emotions (hopelessness, shame, anxiety, and anger) were not statistically significant.

3.2. Relationships Between SRL and Achievement Emotions

Table 2 presents Pearson correlations among pre-test scores (baseline EDCM knowledge), SRL variables (motivational orientation and learning strategies), and achievement emotions. Motivation and learning strategies were strongly and positively correlated with positive emotions ($p < .05$), particularly enjoyment and pride. Motivation was significantly and negatively correlated with overall negative emotion, particularly with multiple negative emotions (anger, anxiety, hopelessness, boredom), indicating that students who reported stronger motivational orientations tended to report lower negative emotions.

Learning strategies were significantly correlated with positive emotions particularly with enjoyment and pride but not significantly correlated with the overall negative emotions. Notably, learning strategies were positively correlated with anger and anxiety, and negatively correlated with boredom. The finding suggests that student learning strategies use may co-occur with some activating negative emotions (e.g., anger, anxiety) while also relating to reduced disengagement (lower boredom) in this sample.

**Table 2** Pearson correlations among pre-test, SRL variables, and achievement emotions

| | Pre-test | Motivation | LS | Emotion | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Variables | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) |
| Pre-test (1) | 1.000 | | | | | | | | | | | |
| Motivation (2) | .211 | 1.000 | | | | | | | | | | |
| Learning Strategy (3) | .091 | .260 | 1.000 | | | | | | | | | |
| Enjoyment (4) | .291* | .602* | .459* | 1.000 | | | | | | | | |
| Pride (5) | .143 | .507* | .443* | .788* | 1.000 | | | | | | | |
| Anger (6) | -.240 | -.353* | .136 | -.425* | -.279* | 1.000 | | | | | | |
| Anxiety (7) | -.120 | -.297* | .219 | -.258 | -.258 | .713* | 1.000 | | | | | |
| Shame (8) | .003 | -.248 | .053 | -.226 | -.125 | .677* | .735* | 1.000 | | | | |
| Hopelessness (9) | -.141 | -.430* | .017 | -.434* | -.306* | .742* | .770* | .665* | 1.000 | | | |
| Boredom (10) | -.119 | -.456* | -.201 | -.648* | -.343* | .519* | .291* | .301* | .441* | 1.000 | | |
| Positive Emotion (11) | .252 | .598* | .477* | .974* | .907* | -.393* | -.271* | -.200 | -.409* | -.570* | 1.000 | |
| Negative Emotion (12) | -.157 | -.440* | .067 | -.474* | -.329* | .869* | .884* | .787* | .932* | .576* | -.446* | 1.000 |

*Note. * $p < 0.05$, 'no mark' refers to 'non-significant.'*

### 3.3. Baseline EDCM Knowledge and Intrapersonal Factors

Students' pre-test scores differed significantly across racial groups, $F(3,48)=2.929$, $p < .05$, and did not differ significantly by gender. Asian students had the highest average pre-test scores, followed by Black, White, and Hispanic students. Tukey's test indicated Asian students' pre-test scores ($m$ = 22.86, $sd$ = 6.68) were significantly higher than Hispanic students' scores ($m$ = 16.71, $sd$ = 5.48) at $\alpha$ = .05.

Baseline EDCM knowledge was not significantly correlated with motivation, learning strategies, or overall positive/negative emotion composites (Table 1). However, baseline knowledge was significantly correlated with enjoyment ($r$ = .291, $p$ < .05). While most correlations were not statistically significant, the overall pattern suggests that higher baseline knowledge may be associated with higher motivation and positive emotions and lower negative emotions in this sample.

## 4. Discussion

This Work-in-Progress study examined engineering students' SRL (motivational orientations and learning strategies) and achievement emotions in the context of a newly implemented EDCM standards module. Because EDCM learning is inherently applied, consequential, and often emotionally salient, examining both SRL and emotions is necessary to understand how students engage with and benefit from the module. Below, we interpret the findings through established SRL and achievement emotion theory and identify implications for iterative redesign.

A central finding is that SRL and achievement emotions varied significantly across racial groups but not by gender in this sample. Specifically, Asian students reported higher motivation and strategy use than Hispanic students and also reported higher positive emotions and lower negative emotions. Hispanic students consistently exhibited the lowest SRL composite scores and comparatively higher negative emotions.

These patterns warrant attention because they may indicate differences in perceived control and task value [12], [13], and differences in prior exposure to EDCM concepts that shape confidence, relevance, and engagement. Importantly, these findings should not be interpreted as group-deficit explanations; rather, they motivate closer examination of structural and instructional factors that may differentially shape students' perceived belonging, preparedness, and opportunity to learn in EDCM contexts. For module redesign, an actionable implication is to incorporate more explicit guidance in learning EDCM concepts, and responsive teaching such as epistemic empathy and using culturally relevant examples so that students with less prior familiarity can build early competence and control.

Correlational findings show that motivation and learning strategies were strongly associated with positive emotions, particularly enjoyment and pride. This is theoretically consistent with SRL models that emphasize motivational orientations as a driver of engagement and persistence [7]–[10] and with control-value theory, which predicts that higher perceived control and value are associated with positive activating emotions that support learning [12]–[15].

Motivation also showed significant negative associations with multiple negative emotions (anger, anxiety, hopelessness, boredom). This pattern suggests that motivational orientations may function as a protective factor against deactivating negative emotions (e.g., hopelessness and boredom) that can undermine persistence and strategy use. In contrast, learning strategies were not significantly correlated with the overall negative emotion composite, and their direction of association varied by emotion type (e.g., positive associations with anxiety and anger). This nuance aligns with the idea that some negative emotions can be activating rather than purely detrimental [15]. For example, moderate levels of anxiety may co-occur with increased effort, planning, and monitoring—particularly in a module that introduces unfamiliar standards, coordination structures, and planning artifacts. At the same time, the negative association between learning strategies and boredom suggests that students who actively deploy strategies may experience less disengagement.

It is also noteworthy that motivational orientations showed stronger and more consistent associations with a broad range of emotions than did learning strategies. Whereas learning strategies were primarily and significantly related to positive emotions, motivation was closely connected to both positive and negative emotions. This pattern may indicate that students' motivational orientations are more sensitive to their emotional experiences, while their use of learning strategies may be comparatively less influenced by negative emotions.

A design implication is not simply to "eliminate" negative emotions, but to reduce deactivating negative emotions (hopelessness, boredom) while helping students regulate activating negative emotions (anxiety) so they remain productive rather than overwhelming. This supports adding structured SRL scaffolds (e.g., weekly goal setting, planning templates, self-check questions, and reflection prompts) consistent with Zimmerman's guidance for fostering self-regulation (e.g., goal setting, strategic instruction, self-evaluation) [7], [8].

Baseline EDCM knowledge was not significantly associated with most SRL and emotion measures, but it was significantly related to enjoyment. This finding suggests that students who enter with more EDCM familiarity may find the module more immediately enjoyable—potentially because they experience higher control (confidence) and can more readily see relevance. Because enjoyment is consistently associated with deeper engagement and persistence [14], this relationship indicates a possible lever for equity-oriented redesign: provide early experiences that quickly increase perceived competence for students with lower baseline knowledge.

We note this Work-in-Progress study's limitations. The sample is from a single institution and course section, demographic group sizes were small and uneven, and measures relied on self-report using adapted instruments (MSLQ and AEQ-E), which warrants additional validity and reliability checks in this context. Because analyses are correlational, causality cannot be inferred.

As next steps, we will re-implement the revised module in Spring 2026 and 2027, strengthen the assessment plan by adding pre/post knowledge measures to examine students' knowledge gains, and evaluate whether the instructor's SRL and emotion supports reduce observed disparities while improving learning experiences and outcomes. We also plan to interview students to better understand their SRL and emotions and how these factors relate to their learning processes and outcomes.

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