An Immediate And Retrospective Analysis Of Stability And Change: Examining Students' Emotion And Motivation Profiles In Response To Outcome-Presenting Learning Analytics Dashboards

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Abstract

Learning Analytics Dashboards (LADs) have been studied to support student learning and motivation, yet how their effects evolve or endure over time remains in question. This study examines students' immediate and retrospective emotional and motivational responses to two types of outcome-presenting dashboards: a class-performance comparison dashboard (CP-D) and an individual-comparison dashboard (IC-D). Using a mixed-methods approach with survey data, clustering of Achievement Goal Orientations (AGOs), and qualitative analysis of student reflections, the study explores how emotions persisted or diminished across the semester. Results showed that emotions more strongly associated with perceived control (e.g., pride, hope) tended to persist, whereas those less tied to control (e.g., assurance, hopelessness) were less stable. Reductions in anxiety and disappointment emerged most clearly among Mastery-Oriented students, with other clusters showing little differences between dashboard conditions. Interestingly, IC-D supported hope even among some lower-performing Non-Competitive students, while CP-D anchored students more strongly to the class average. These findings underscore that dashboard design interacts with performance and motivational profiles, suggesting the need for adaptive and hybrid designs that balance comparative feedback with individualized progress indicators.

CCS Concepts

• **Human-centered computing** → **Visualization**; • **Applied computing** → **Education**.

Keywords

learning analytics dashboards, achievement emotions, motivation, sensemaking

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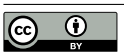

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1 Introduction

As more learning activities take place in digital environments such as learning management systems (LMSs, e.g., Canvas), new opportunities arise to better understand student learning through the data these systems generate. Learning analytics (LA) has emerged as a field dedicated to studying learner experiences and performance by analyzing such data [9]. A central tool within this field is the Learning Analytics Dashboard (LAD) [27], which democratizes access to learning data by presenting it in a digestible format for different stakeholders.

For learners in particular, LADs function as a feedback mechanism that can foster self-regulation and reflection, ultimately supporting greater autonomy, motivation, and participation in learning [9]. A common example is the boxplot-style LAD on the Canvas "Grades" page, which allows students to view their assignment grade in relation to the class distribution, helping them contextualize their performance among peers. However, despite Canvas being used by roughly 50% of all enrolled students in North America by the end of 2024 [11], it remains unclear whether such dashboards actually motivate students to persist and achieve at higher levels over time.

Understanding the motivational influence of LADs requires recognizing that learners' reactions are both emotional and cognitive, shaping their subsequent behaviors [15, 21]. As [22] argues, emotions play a critical role in learning, influencing engagement and outcomes in both positive and negative ways.

This study examines immediate and retrospective emotional and motivational responses to two types of outcome-presenting LADs: the class-performance comparison dashboard (CP-D), similar to the Canvas implementation, and an individual-comparison dashboard (IC-D). Using a mixed-methods approach, it explores the temporal dynamics of these dashboards through the lens of emotion and motivation. The aim is to provide insight into learners' reflective sense-making processes and to understand how evolving emotions across a semester may influence motivation beyond immediate dashboard exposure.

2 Background

2.1 Motivation, Social Comparison Theory, and LAD

Motivation is one of the core factors in learning, especially today, where self-driven and self-monitored learning is highly relevant and valuable. According to Self-Determination Theory (SDT) student motivation is closely tied to the satisfaction of three psychological needs: autonomy, competence, and relatedness [24]. Similarly, the Expectancy-Value-Cost (EVC) theory [4] states that motivation is shaped by a student's expectation of the outcome, the value they assign to a task, and the perceived cost of effort or failure [4]. Social comparison (SC), an inherent feature in many commonly used LADs, can impact these motivational factors. The Social Comparison Theory suggests that learners tend to evaluate their performances in comparison with external frame of references such as task standards, peer performances, self-progress, and more [7, 15, 31]. When carefully integrated into the learning experiences, learners could reflect on their learning better and be motivated to work better. In fact, research shows that when individuals perform moderate upward comparison, meaning when they compare themselves to peers who perform slightly better than they do, their motivations and performances could potentially increase [12, 13]. On the other hand, while the implementation of the social comparison theory was in the effort to encourage students to achieve higher, extreme comparison may trigger negative emotions such as shame and hopelessness, resulting in withdrawal and demotivation in learning [19, 20, 30]. Lim et al. [15] compared dashboards that implemented different frames of reference with students, showing all of them falling behind the rest of the class in terms of time spent on the assignment and scores. The result shows mixed feelings from the students, as some reported demotivation when seeing the results, while others expressed feeling motivated by the disappointment. The authors called for a further study incorporating students' individual differences in terms of goal orientations to understand the diversity of student reactions [25]. Understanding how individuals interact with the LADs is critical in evaluating the motivational impact of LADs.

2.2 Sense-Making and LADs

Learners must first be able to process the information presented to them on a dashboard. Sensemaking is the ongoing process through which individuals interpret and give meaning to new or "chaotic" environments [29]. When a LAD presents unfamiliar or unexpected information, it can act as a trigger for this process [3, 29]. Importantly, sensemaking is not a one-time, linear event. Rather, it is iterative and dynamic: "individuals and the environment are both object and subject that undergo continual redefinition" ([3], p. 394), evolving into a reciprocal and ongoing cycle of interpretation and adjustment [3, 29]. Thus, evaluating the impact of LADs on student learning and emotions requires attention not only to immediate reactions but also to delayed reflections [5].

Because identity plays a pivotal role in sensemaking [29], it is also critical to consider how students with different motivational profiles, such as distinct achievement goal orientations, interpret and respond to dashboard information. This allows for a fuller understanding of how dashboard information is processed differently by diverse students over time and how it shapes students' future actions.

2.3 Achievement Goal Orientations and LAD Effects

As mentioned above, while motivation serves as an overarching concept in promoting student learning, it's essential to account for individual differences when designing feedback tools like dashboards. One way to categorize these differences is through Achievement Goal Theory, which distinguishes between students with mastery goals and those with performance goals [25].

Students with mastery goals are driven by a desire for self-improvement and intrinsic interest in the subject, whereas those with performance goals are motivated by demonstrating ability, often through comparison with others [25]. These orientations can also be split into approach and avoidance dimensions. For example, performance-approach goals reflect a drive to outperform peers, while performance-avoidance goals reflect a fear of underperforming or appearing incompetent [6].

Though mastery goals have traditionally been seen as superior, [25] suggests that both goal types have value, and that a balanced or mixed goal orientation could be beneficial for learners and should be further studied.

Shirazi Beheshitha et al. [26] examined how different learning analytics visualizations (comparing with class average, comparing with top contributors, and displaying matrix evaluating post qualities) influence students' participation and message quality in online discussions, and how these effects vary depending on students' achievement goal orientations (AGOs). The findings are heterogeneous across different AGOs and dashboard conditions, revealing that AGOs do play a critical role in students' learning and their engagement with the dashboards. For example, performance-approach students would benefit more from comparative dashboards while mastery-avoidant students may not.

Nonetheless, these findings suggest that AGO makes a complex impact on students' learning performances and cognitions, calling for more research to better understand these dynamics and provide clearer guidance for designing more effective LADs.

2.4 Achievement Emotions

Pekrun et al. [22] argues that emotions play a critical role in learning, shaping engagement, and influencing outcomes both positively and negatively. Educational technologies not only trigger emotional responses but can also be designed to measure and even regulate them.

Grounded in Pekrun's Control-Value Theory (CVT) [20], this theoretical perspective suggests that learners' emotions are shaped by their perceptions of control over a task and the value they assign to it [22]. Activating emotions, such as hope or pride, are typically linked to perceptions of high control and/or high value and can foster greater motivation and engagement. In contrast, deactivating emotions, such as hopelessness or disappointment, often arise from perceptions of low control and/or low value and may lead to disengagement and reduced motivation [22].

That being said, not all activating emotions are positive. In fact, moderate negative emotions such as guilt may be linked to controllable causes such as insufficient effort, leading to motivation increases [20]. Wu & Yu [32] conducted a systematic review of 23 publications investigating the findings of achievement emotions' impact on motivation, performance, engagement, satisfaction, and achievements in online learning environments. They concluded that positive emotions, in moderation, such as pride, enjoyment, and relaxation, generally enhance online learning motivation, while the effects of negative emotions remain inconsistent, and more context-based analysis should be done.

Overall, existing literature demonstrates the powerful impact of achievement emotions on motivation and outcomes, yet more studies are needed to reveal how the negative emotions impact motivation in context.

Together, these frameworks suggest that LADs sit at the intersection of motivation, cognition, and emotion. Motivational theories (i.e. CVT, EVC, SC, SDT) shape perceived competence, control, and value, while sensemaking processes and individual differences in achievement goal orientations influence how dashboard information is interpreted and emotionally experienced over time. Understanding LAD effects therefore requires an integrative perspective that accounts for how students interpret comparative information and the emotions such interpretations activate.

3 Research Questions

This proposed study employs a mixed-methods approach, combining thematic analysis and statistical visualization, to investigate how students' immediate emotional states and motivation profiles change in relation to LAD exposure over the course of a class. In the context of students' achievement goal orientations, the focus is on both emotional responses before starting an assignment and after they see the results shown on one of the LADs. The research aims to address the following questions:

- **RQ1:** To what extent do students' immediate emotional and motivational responses to two outcome-presenting LADs persist or diminish by the end of the semester?
  - **RQ1a:** Are certain emotions more likely to persist with specific dashboards, and does this vary by students' Achievement Goal Orientation (AGO)?
- **RQ2:** How do students with different AGO respond to different outcome-presenting dashboards at the end of the semester?

4 Method

4.1 The Design of LADs

The two LADs in question utilize the Social Comparison Theory [7] differently. The first one is inspired by what many students see on Canvas LMS, a dashboard showing the student's own score along with the mean, maximum, and minimum scores in the class, as shown in Figure 1. Next to the numbers is a box plot that visualizes where the student stands among their peers. It uses the summarized class performance as a frame of reference. This study identifies it as a Class-performance Dashboard or CP-D.

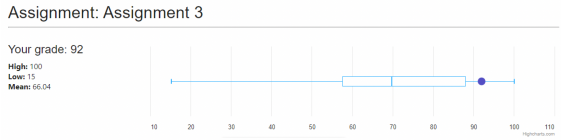

Figure 1: A Canvas-inspired CP-D dashboard using the class-performance comparison method

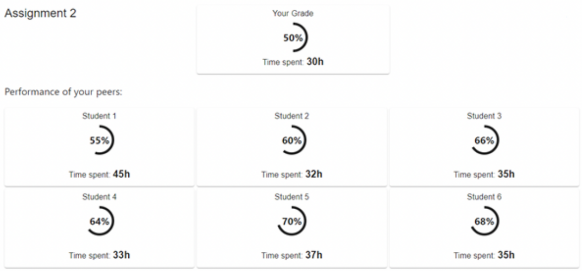

Figure 2: The IC-D dashboard using the model of individual comparisons. The top rectangle shows a student's grade and time spent on the assignment. Below it are the grades and time spent by their peers who performed slightly better.

The design of the other LAD draws inspiration from these motivational frameworks and incorporates principles from other pedagogical and motivational theories, such as Weiner's Attributional Theory [30] and Festinger's Social Comparison Theory [7]. It allows learners to reflect on their performance relative to 6 anonymized peers who achieved slightly better results with similar effort levels (see Figure 2), with the aim of motivating them to invest more effort in future tasks [7, 30, 31]. This dashboard was evaluated in our prior study as the most motivational out of the 13 alternatives [1]. As it utilizes comparison with individuals as a frame of reference, this study defines it as the Individual-comparison Dashboard or IC-D.

The IC-D dashboard has been extensively evaluated through the lens of motivation in previous studies conducted within the lab. However, most of these studies have focused primarily on students' immediate reactions to dashboards designed using established motivational theories. For example, in our earlier study [1] we presented a version of theory-informed LAD including features showing students' own performances, their performances in comparison with other peers' in terms of grades, time spent, and proficiency. In the effort to understand students' sense-making of the dashboard, attribution to their performances, and their feelings about the comparisons, interviews, and think-aloud exercise with a prototype were conducted and thematically analyzed. As a result, most students choose to compare themselves with peers with whom they share some similarities, such as time spent or proficiencies. [1] concluded that lower-performing students may attribute their relatively low outcomes to the lack of effort, which is potentially motivating and leads to more endeavors in future assignments.

Although [1] helped guide the lab's ongoing LAD design, it was limited by a small sample size and its focus on immediate motivational responses. Given that motivation and emotion are dynamic and unfold through iterative sense-making processes, this limitation of this study calls for further research to understand the dashboards' effect on delayed reactions and motivational changes, taking into account emotional responses and using a larger dataset to support broader generalization.

4.2 Research Process

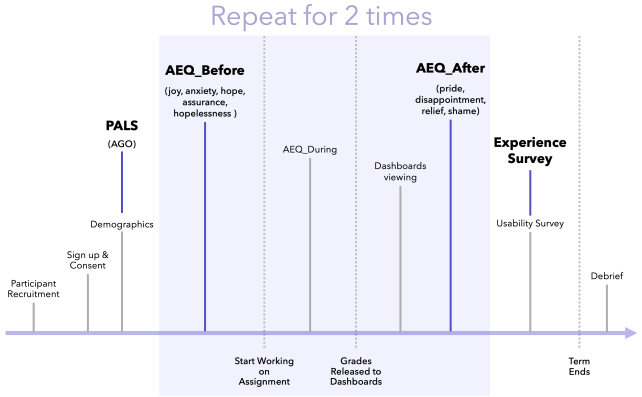

Figure 3: Research Process Visualization

Our University Research Ethics Board-approved research process is shown in Figure 3. To examine students' emotional and motivational changes across a course, we conducted surveys and monitored dashboard-viewing sessions. With instructor approval, participants were recruited during class and offered 2% extra credit. After providing consent and demographic information, students completed the Patterns of Adaptive Learning Scales (PALS; [18]) to assess achievement goal orientations.

Prior to a major assignment, students completed the Revised Achievement Emotions Questionnaire [23] – the before task section (AEQ_Before), which measured prospective emotions (i.e. joy, anxiety, hope, assurance, hopelessness) and motivational profiles (expectancy, value, cost; [14]). In this study, joy is dropped because it was not measured in responses collected at the end of the semester, and it would be inappropriate to map joy to other emotions. After beginning but before completing the assignment, participants also completed AEQ section for emotion during the task (AEQ_During); however, these data were not considered in this study. Upon submission, students reported the time spent on the assignment.

Following grading, participants viewed their results in the lab or at home using either CP-D or IC-D (Figures 1 and 2). All grades were extracted from course learning management systems (i.e., Canvas). For the sessions conducted in the lab, biofeedback was collected during viewing but excluded from analysis (partly analyzed in [28]). Immediately afterward, students completed AEQ section after the task (AEQ_After), capturing retrospective emotions (i.e., pride, disappointment, relief, shame), and another AEQ_Before for the next assignment. Participant emotional profiles were calculated by averaging 5-point Likert-scale scores of related questions for each emotion.

At semester's end, students completed experience and System Usability Scale (SUS; [2]) in which they reported the dashboard to be highly usable and learnable. All surveys were administered through SurveyMonkey. For this study, the qualitative data came from students' answers to the following questions:

- Please recall the feelings and thoughts you had after you submitted [Assignment] and before you viewed the dashboard with your results. Please address the following questions: What did you expect your performance on [Assignment] to be? How confident were you about your programming skills and ability to solve problems similar to [Assignment]? How did you feel about the effort you put into [Assignment] before you viewed the dashboard?
- Please elaborate on the following questions: How did your sense of confidence about your skills change, if at all? Which emotions did viewing the dashboard for [Assignment] evoke, and what do you think was the reason? (emotions such as joy, pride, relief, shame, guilt, sadness, disappointment, hopelessness, anger, etc.) How did viewing the dashboard for [Assignment] affect your motivation to work on [next Assignment]?
- How did seeing how other students performed in [Assignment] impact your feelings and motivation? What were your thoughts?
- Was viewing the dashboard generally motivating or demotivating for you when working on the assignments?

4.3 Participants

Between 2023 and 2024, the lab implemented this research process with undergraduate students enrolled in several recurring foundational programming courses in an interdisciplinary program at a North American higher education institution. In total, 157 students were recruited: 144 were between 18–24 years old and 13 between 25–30; 88 identified as women, 62 as men, 3 as non-binary, and 4 did not disclose. Regarding course load, 72 students were enrolled in three courses (including the study course), 47 in more than three, and 38 in fewer than three. Participants were stratified by prerequisite grades and alternately assigned to dashboard conditions (CP-D or IC-D) and no significant differences in prior academic performances or initial motivation profile were found. After excluding incomplete responses, 127 students remained. Depending on course enrollment and assignment structure, participants could complete the research cycle once or twice per semester, yielding 217 completed cycles. Each record represented a unique pairing of immediate and retrospective emotion and motivation profiles.

4.4 Clustering

This study identified student clusters by first normalizing the averaged survey scores related to mastery and performance goals, as measured by the PALS instrument. Agglomerative hierarchical clustering (hclust in R) was then applied using the Euclidean distance metric and Ward's method. The optimal number of clusters was determined by examining the dendrogram and evaluating the solution using the Silhouette statistic. A three-cluster solution was

Table 1: Number of Records in Each Cluster

	Performance-Oriented	Mastery-Oriented	Non-Competitive	Total
CP-D	32	16	40	88
IC-D	38	23	68	129
Total	70	39	108	217

selected, with each cluster characterized based on students' distinct Achievement Goal Orientations (AGO) [25]:

- *Cluster 1 – high performance-approach, medium mastery, and medium performance-avoidance:* These students are primarily driven by a desire to outperform their peers, while also striving for personal growth and avoiding perceptions of incompetence. This study refers to students in this cluster as **"Performance-Oriented"** learners.
- *Cluster 2 – high mastery, medium performance-approach, and low performance-avoidance:* These students are primarily driven by self-improvement, show some interest in outperforming their peers, but are less concerned about being perceived as incompetent. This study refers to students in this cluster as **"Mastery-Oriented"** learners.
- *Cluster 3 – medium mastery, low performance-approach, and medium performance-avoidance:* These students are somewhat motivated by self-improvement and by avoiding the perception of incompetence, but place the least importance on outperforming others. This study refers to students in this cluster as **"Non-Competitive"** learners.

4.5 Qualitative Analysis

Emotion recall was measured through applying established definitions of achievement emotions ([8, 20, 22, 30]) to students' open-ended responses in the end-of-term experience survey. Emotions identified included anxiety, hope, assurance, hopelessness, pride, disappointment, relief, and shame. Categories beyond emotions were also identified, but they were not analyzed in the scope of this study. Coding was performed in NVivo, with inter-rater reliability established using Cohen's Kappa ($\kappa = 0.761$). To reduce researcher bias, coding was performed without explicit reference to dashboard conditions.

5 Results

In this study, emotion persistence was defined as cases where a student reported experiencing a strong immediate emotion (threshold = 3.5; following [16, 17]) and successfully recalled it at the end of the semester. Emotion diminishment referred to cases where a student reported a strong immediate emotion but did not recall it later. All percentages of reported strong immediate emotions, coded recall, and coded recall among students who reported strong immediate emotions are presented in Figures 4 and 5.

5.1 RQ1: Persistence and Diminishment of Emotions

The findings are summarized in Figure 4 and 5. In general, groups using CP-D reported more intense negative emotions, with a higher percentage of students experiencing both immediate and recalled anxiety and hopelessness. In contrast, groups using IC-D demonstrated more activating emotional profiles, characterized by a greater number of students reporting hope both immediately and retrospectively, along with more moderate levels of immediate and recalled anxiety.

Anxiety. Immediate anxiety levels were largely comparable across conditions, except among Mastery-Oriented students using the IC-D, who reported notably lower rates at 30%. Anxiety recall was generally slightly lower under IC-D than CP-D across achievement goal orientations (e.g., Non-Competitive: 38% vs. 29%), though this pattern was not uniform. In addition, the recall rate among those who reported immediate anxiety was visibly lower for Mastery-Oriented students in the IC-D condition (9%) than in the CP-D condition (25%). Overall, differences in anxiety recall were most pronounced for mastery-oriented students under the IC-D condition.

Hope. Hope was consistently higher among IC-D users, particularly in the Mastery-Oriented group (52% immediate, 65% recall) and the Non-Competitive group (28% immediate, 50% recall). By contrast, the CP-D Non-Competitive group reported far lower immediate hope (10%), although recall rose to 40%, suggesting that many students who did not initially feel hopeful nevertheless recalled hope at the end of the semester. Overall, IC-D appears to better sustain hopeful outlooks. This is further supported by the percentage of students who both reported immediate hope and successfully recalled it later, which was generally higher in IC-D groups. The difference was most pronounced in the Non-Competitive group (IC-D: 19%, CP-D: 2%).

Assurance. Assurance recall remained generally low across all groups and dashboard types. Although immediate assurance was reported at low to moderate levels, most groups showed minimal or no recall by the end of the semester. This suggests that assurance was not a persistent emotion in relation to dashboard use.

Hopelessness. Immediate hopelessness was more evident among CP-D groups, particularly in the Non-Competitive group (35%). In contrast, IC-D groups reported low levels of immediate hopelessness across all orientations. Recall of hopelessness was generally low across both dashboard conditions and goal orientations. This pattern suggests that boxplot comparisons may amplify perceptions of falling behind, particularly for the Non-Competitive group, which is also moderately motivated by performance-avoidance, whereas IC-D tends to attenuate such feelings. Nonetheless, hopelessness did not appear to persist under any condition.

Pride. Pride demonstrated moderate to high immediate and recall rates across orientations and dashboard types. Students using IC-D generally reported higher immediate and recalled pride than those using CP-D, particularly in the Mastery-Oriented group (IC-D: 61% immediate, 43% recall vs. CP-D: 56% immediate, 31% recall). These patterns suggest that pride persisted most strongly among Mastery-Oriented students using IC-D.

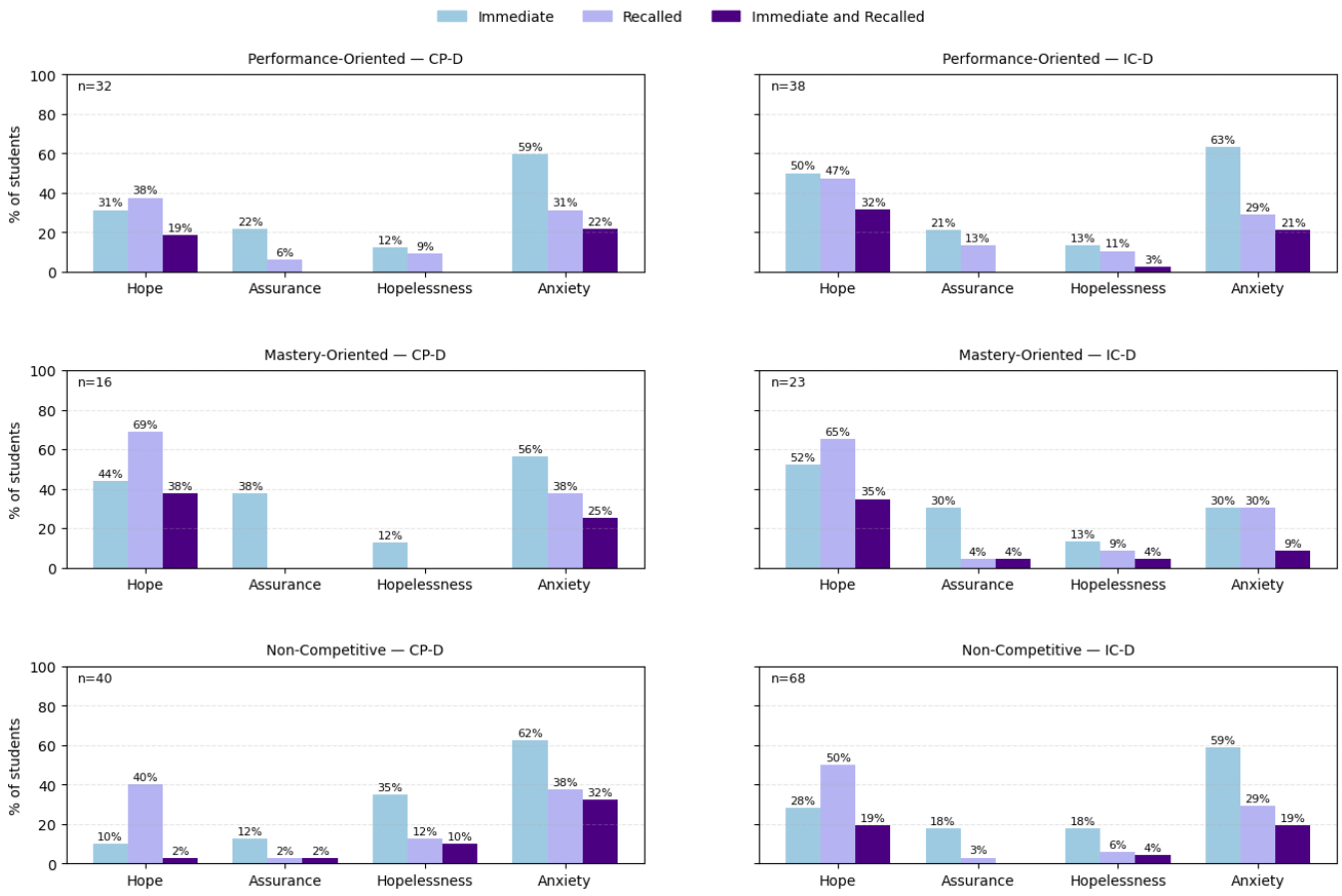

Figure 4: Occurrence and recall of prospective outcome emotions at the beginning of the assignments

Relief. Immediate and recalled relief recall was consistently higher for IC-D users than for CP-D users in both Performance- and Mastery-Oriented groups. For example, Mastery-Oriented students using IC-D reported 65% immediate relief and 43% recall, compared to 56% immediate and 31% recall in CP-D. The recall rates within students who reported immediate relief for Mastery- and Performance-Oriented groups are also relatively high for both dashboard conditions (Mastery-Oriented IC-D: 30%, CP-D: 31%; Performance-Oriented IC-D: 32%, CP-D: 34%). Among Non-Competitive students, relief was comparatively lower, with immediate r̂ecall of 19% in IC-D and 15% in CP-D. This indicates that relief was more persistent for Mastery-Oriented students, especially when using IC-D.

Disappointment. Disappointment showed moderate recall rates across groups, with generally lower immediate and recalled levels for the IC-D condition. For example, Performance-Oriented students reported higher immediate disappointment with CP-D (44%) compared to IC-D (24%), and those in the CP-D group also demonstrated stronger recall among students who initially reported the emotion. Overall, disappointment appeared to persist most strongly for Performance-Oriented students using CP-D.

Shame. Shame recall remained low across all orientations and dashboard types. The highest recall among students who initially reported shame appeared in the Performance-Oriented group using IC-D (11%), while most other groups reported recall levels below 10%. This suggests that shame was not a persistent emotional response to dashboard use.

5.2 Emotion Recall and Grades

In [10], we analyzed the interaction effect between grades and dashboard type on the immediate retrospective outcome emotions, specifically pride, disappointment, relief and shame. Here, we further examine student diversity in relation to emotional retention, motivation, and dashboard interpretation by analyzing students' assignment grades and visualizing them in scatterplots to identify potential patterns. We also identified grade thresholds for analysis: low grades (grade < 64; Q1), moderately low grades (64 <= grade < 80; Q1 to M), moderately high grades (80 <= grade < 98; M to Q3), and high grades (grade >= 98). This section highlights key observations from the visualizations (e.g. 6 and 7), with only the most distinctive patterns included due to space limitations.

Pride. The recall of pride was most common among students who both earned moderately high to high grades and reported high

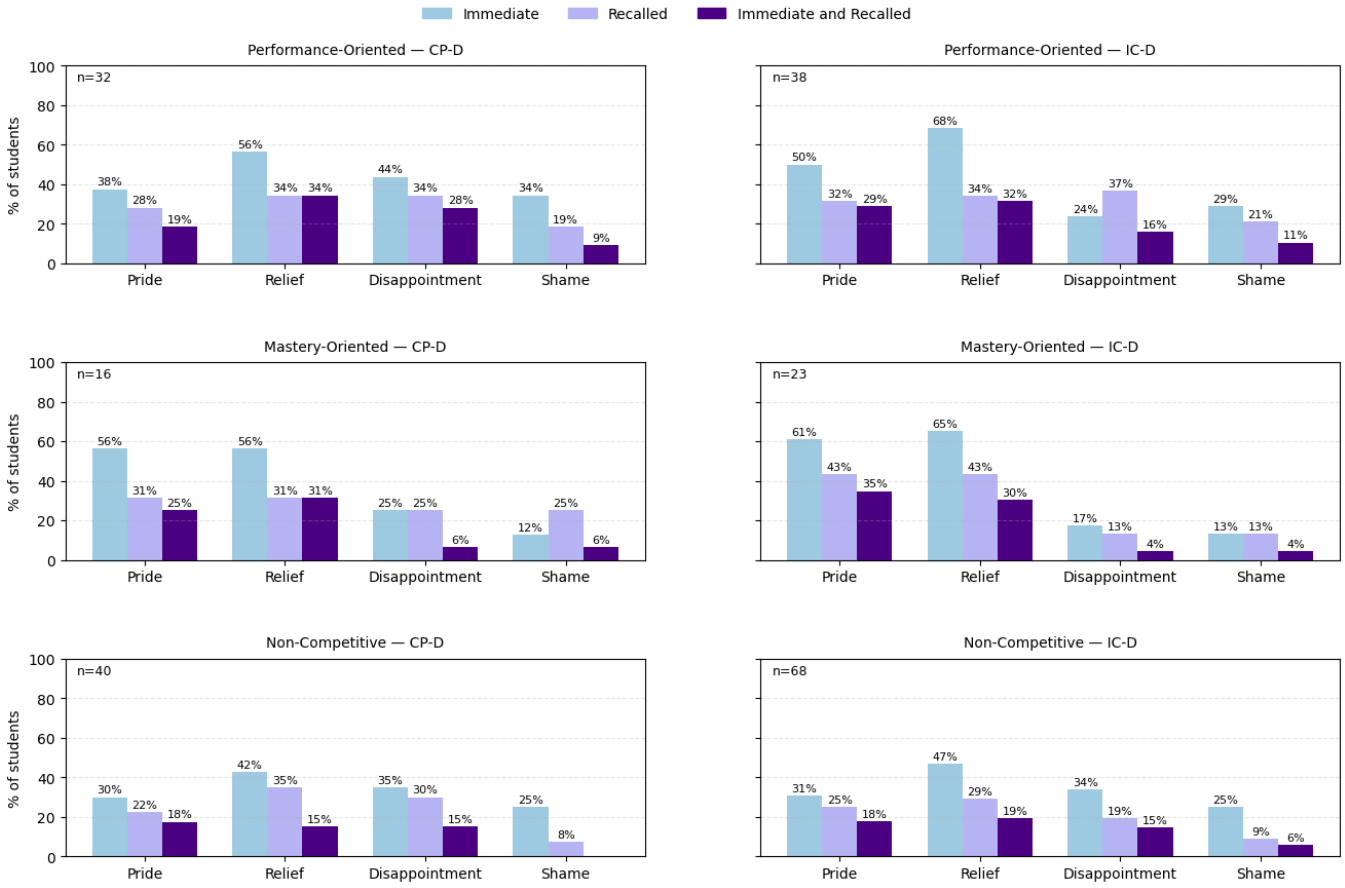

Figure 5: Occurrence and recall of retrospective outcome emotions after viewing dashboards.

immediate pride scores. Only a few cases were observed among students with lower grades or lower immediate ratings (see Figure 6).

Relief. Relief followed a pattern similar to pride: most recalls occurred among students with high immediate relief ratings and moderately high or high grades. However, some Non-Competitive students recalled relief despite reporting low immediate ratings in both dashboard conditions. Notably, one student in the Non-Competitive IC-D group reported strong relief despite earning a grade below 40 and successfully recalled this emotion at the end of the semester.

Disappointment. Students with moderately low to low grades generally reported stronger immediate responses, yet no consistent relationship emerged between disappointment recall and grades. Interestingly, some students who reported very low immediate disappointment nevertheless recalled the emotion at the end of the semester.

Hope. Recall of hope occurred consistently among high-performing students in the Performance-Oriented group, with similar trends observed in the other orientations. Interestingly, some low-performing students in the Non-Competitive IC-D group also recalled hope at the end of the term, suggesting that individual comparisons may help sustain positive outlooks even among students with lower achievement (see Figure 7).

Hopelessness. The recall rate of hopelessness was generally low. Among the few recalled cases, some contradicted expectations. For example, one Performance-Oriented student using IC-D reported low immediate hopelessness yet achieved a high grade. While this aligns with the assumption that high-achieving students typically feel less hopeless, the student nevertheless recalled hopelessness at the end of the semester, suggesting a complex interaction between achievement and emotional recall.

5.3 RQ2: Comparing Student Responses Across Dashboards

5.3.1 Class Performance Dashboard (CP-D). Students using CP-D primarily compared their scores with the class average, which strongly shaped their emotional reactions. For example, one Performance-Oriented student reflected:

"I did above average which surprised me greatly and impacted me in a positive way. It gave me hope in my programming abilities." (Grade = 87)

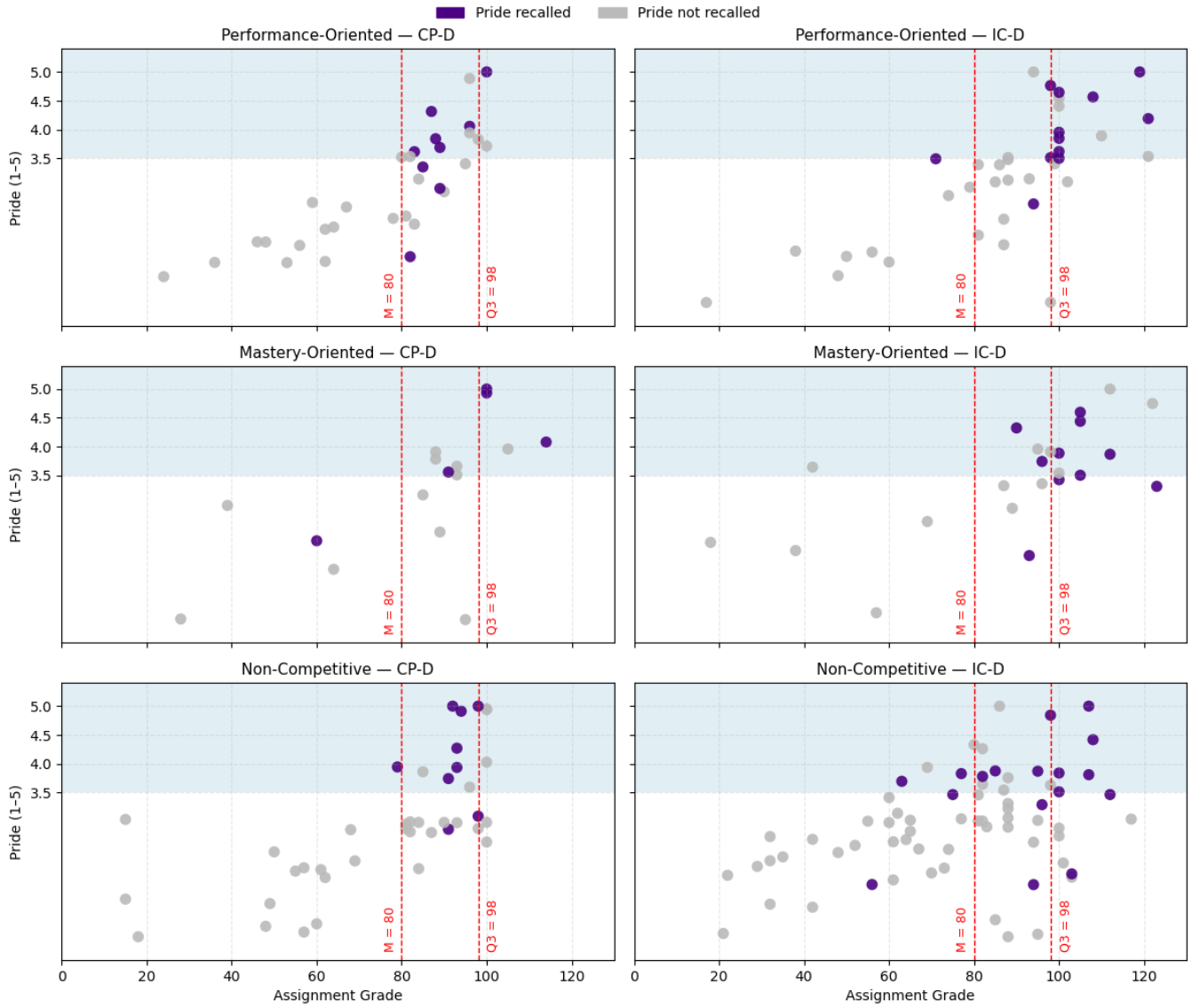

Figure 6: Scatterplots of immediate pride (y-axis) and assignment grades (x-axis) by AGO profile and dashboard type. Purple dots represent students who recalled pride at the end of the semester, and gray dots represent those who did not. The shaded area above 3.5 indicates strong immediate pride. Vertical red dashed lines mark grade thresholds at 80 (median) and 98 (Q3).

Meanwhile, a Non-Competitive student noted:

"I saw the mean was higher than my score. I felt disappointed but I tried harder for the other one". (Grade = 69)

These accounts illustrate that the average served as the main frame of reference, influencing students' perception and feelings of their grades, echoing social comparison theory [7, 15, 31].

While some students reported activating emotions such as pride and hope when scoring above average, indicating a potential increase in motivation, others experienced the dashboard as deactivating, feeling more at ease and consequently losing the desire to strive for higher achievement. As some participants commented:

"[the dashboard] made me a little overconfident (which is bad for my A4)." (Grade = 100; Mastery-Oriented)

"The dashboard helped me realize that the amount of effort I was putting into my coding assignments was paying off, which meant I should probably keep putting in that much effort, but the high scores made me feel more at ease when I did have to get to work." (Grade = 94; Non-Competitive)

These responses show that some participants experienced assurance when their score was higher compared to the average.

5.3.2 Individual Comparison Dashboard (IC-D). Students using IC-D responded differently, even when achieving moderately high

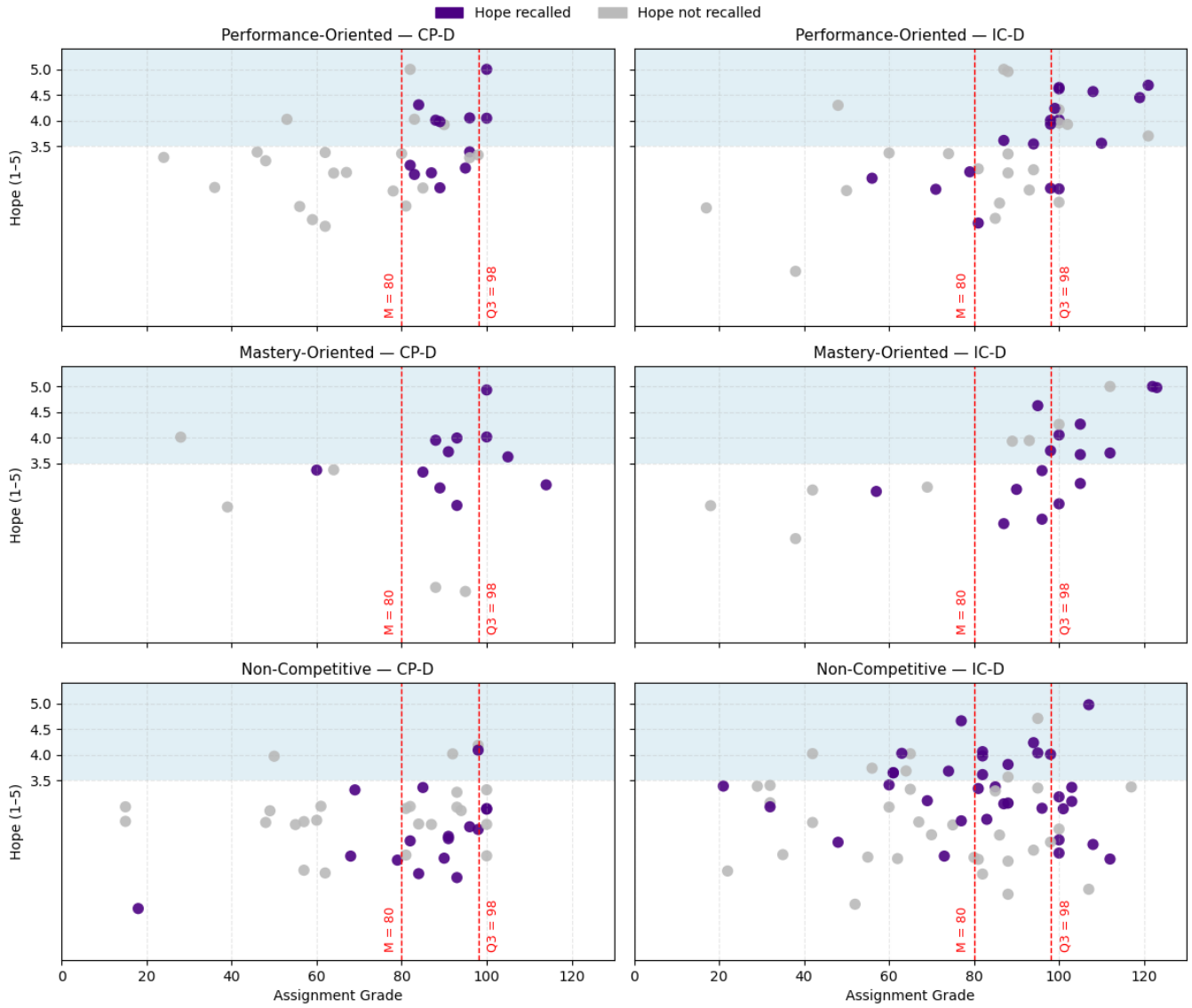

Figure 7: Scatterplots of immediate hope (y-axis) and assignment grades (x-axis) by AGO profile and dashboard type. Purple dots represent students who recalled hope at the end of the semester, and gray dots represent those who did not. The shaded area above 3.5 indicates strong immediate hope. Vertical red dashed lines mark grade thresholds at 80 (median) and 98 (Q3).

grades. Some felt deflated when comparing themselves to peers with equally high or higher scores:

"the dashboard showed me that there were at least 5 students who put more time into the game and got better scores than I did, it shocked me and kind of dimmed my pride to be honest." (Grade = 119; Performance-Oriented)

Others, though surprised by their peers' high grades, expressed admiration or motivation to work harder:

"I was surprised on their high achievement, and a bit admire them of their high achievement. This let me thought I need to work even harder." (Grade = 93; Mastery-Oriented)

"Seeing other students performance made me feel guilty about my own. Especially when I saw the amount of time others had spent on the assignment. It made me motivated to spend more time on A4." (Grade = 87; Performance-Oriented)

Interestingly, lower-achieving students using IC-D often reported encouragement rather than frustration, contrasting with low-achieving students using CP-D:

"I felt better seeing other students because they weren't far off from my marks. It feels that I'm not the only one who isn't good at programming." (Grade = 42; Mastery-Oriented)

These findings highlight that IC-D may amplify upward comparisons, leading to more heterogeneous emotional responses than

CP-D. By keeping the frame of reference closer and more concrete to students' own grades, IC-D encourages more personal interpretations and comparisons of performance. For lower-achieving students, this proximity made comparisons feel attainable, offering concrete possibilities for improvement. In contrast, high-achieving students, particularly those with strong performance orientations, were more likely to feel let down when peers outperformed them, as their comparisons carried higher stakes.

6 Discussion

6.1 Persistence and Diminishment of Emotions (RQ1)

This study examined whether students' immediate emotional and motivational responses to outcome-presenting LADs persisted or diminished by the end of the semester. The results show that persistence varied considerably across emotions, dashboard types, and achievement goal orientations.

Anxiety exhibited the clearest reduction among Mastery-Oriented students using the IC-D, with smaller reductions among Non-Competitive students and minimal differences for Performance-Oriented students. Disappointment showed a similarly nuanced profile where Mastery-Oriented students reported noticeably lower persistence under IC-D. This reduced recall may reflect the tendency of Mastery-Oriented students to focus on self-improvement rather than external comparison [25].

In contrast, pride and hope were more consistently retained, particularly among Mastery-Oriented and Performance-Oriented students, with IC-D supporting these activating emotions more effectively than CP-D. Patterns by grade further supported this trend: pride and hope were most often recalled by students earning moderately high to high grades, while IC-D also sustained hope among lower-performing students in the Non-Competitive cluster. This suggests that academic performance remains a strong anchor for emotional recall, yet IC-D may foster positive activating emotions more effectively than CP-D, particularly for motivating lower-performing students.

Assurance and hopelessness were seldom retained, with both emotions showing little to no recall across all orientations and dashboard types, indicating limited long-term influence of either dashboard design on these feelings.

Taken together, these findings highlight that emotional persistence is not uniform: emotions tied to perceived control (e.g., pride, hope) were most durable, whereas emotions linked to less controllable factors (e.g., assurance, hopelessness) faded more quickly. IC-D supported the retention of positive activating emotions across more AGO groups, while reductions in anxiety and disappointment emerged selectively based on AGO profiles rather than uniformly across conditions. This interaction between dashboard design and AGO profiles reflects how learners interpret feedback through ongoing sensemaking processes [3, 29] and how perceived control and value judgments shape which emotions are carried forward [22].

6.2 AGOs and Dashboard Effects (RQ2)

Students using the CP-D often anchored their interpretations on the class average, in line with social comparison theory [7, 31]. For high-performing students, being above average elicited pride, hope, and assurance, whereas being below average elicited disappointment but also motivated additional effort. By contrast, the IC-D elicited more mixed reactions: some high-achieving students felt deflated when comparing themselves to peers with equally high or higher scores, while others reported admiration and a boost in motivation. Interestingly, lower-achieving students using IC-D were more likely to feel encouraged and motivated, seeing themselves as "not the only one struggling," a finding consistent with Self-Determination theory that belongingness fosters motivation [24], and sensemaking theory [29], where learners reconstruct meaning through comparisons and interaction of the environment. These findings further attest how activating emotions, could be a driver of motivation [22].

6.3 Implications for Dashboard Design

Together, these findings suggest that LAD design is unlikely to be one-size-fits-all and should instead account for students' motivational profiles and learning contexts. Individualized comparison dashboards may be more appropriate for mastery-oriented students, who showed less persistent anxiety, and for some lower-performing non-competitive students who reported higher levels of hope under IC-D. In contrast, some high-achieving performance-oriented students may benefit more from class-level comparisons, as comparisons with equally or higher-performing individuals may undermine motivation for this group. Overall, the heterogeneous emotional patterns observed across achievement goal orientations indicate that no single dashboard design is optimal for all learners. Hybrid or adaptive approaches that combine class-level reference points with individualized progress indicators may balance the benefits of social comparison with the need to support diverse emotional and motivational experiences.

6.4 Limitations and Future Work

Limitations remain, suggesting directions for future work. First, guilt and shame could not be distinguished in the adapted AEQ instrument. However, prior work suggests that these emotions may have distinct motivational consequences, although nuances remain debated: guilt is often linked to reparative action and positive motivational outcomes, whereas shame is more associated with avoidance and reduced motivation [30]. In fact, students' responses in the experience survey revealed distinctive retrospective expressions of shame and guilt toward the dashboards. Failing to measure shame and guilt separately limited the interpretation of their distinct motivational roles. Moreover, the sample was drawn from foundational programming courses within an interdisciplinary program at a single North American institution, which may limit generalizability due to potentially different grading practices across domains and cultures. External factors, such as students' other academic or life commitments, were also not fully considered. Future work should distinguish between guilt and shame, extend analysis to diverse contexts, and account for broader influences on student experiences.

7 Conclusion

This study explored how students with different motivational profiles and performance levels retained emotions in response to two types of outcome-presenting dashboards. By comparing students' immediate emotional responses to assignments and dashboards with their retrospective accounts at the end of the semester, we employed a mixed-methods approach to examine patterns of persistence and diminishment.

The findings show that average-comparison dashboards (CP-D), such as the boxplot-style dashboard on Canvas, encouraged activating emotions among higher-performing students, motivating them to sustain, but not necessarily improve, their performance. In contrast, individual-comparison dashboards (IC-D) fostered a sense of belongingness and reduced deactivating emotions among lower-achieving students, potentially supporting their motivation [22, 24]. These effects were further shaped by students' achievement goal orientations, such that those motivated by self-improvement experienced emotions differently from those focused on peer comparison.

Overall, the results highlight the diverse ways learners engage with dashboards depending on their emotional, motivational, and performance profiles. These findings point to the need for adaptive and hybrid dashboard designs that can personalize feedback to better support diverse student audiences.

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