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Students' emotional regulation in response to feedback from teachers, peers, and technology/AI tools

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ABSTRACT

Emotional regulation is central to how students engage with feedback, yet the strategies students use and the factors shaping them remain poorly understood, particularly in diverse feedback contexts. This study examines how students regulate their emotions in response to feedback from teachers, peers, and technology, and identifies factors shaping these processes. The data were collected from 29 secondary students in Singapore using think-aloud protocols with a novel Situational Judgement Test (SJT). Findings reveal six strategies: situation modification, attention deployment, cognitive change, response modulation, competence modification, and seeking social support. Strategy use was shaped by interacting learner, feedback, interpersonal, task, teacher, and cultural factors. Differences across feedback sources for emotional regulation emerged: teacher and peer feedback were evaluated relationally and informationally, whereas technology feedback was judged primarily for informational credibility. The findings provide a contextually embedded framework of emotional regulation in feedback.

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Introduction

Students must engage their cognitive, emotional, behavioural, and motivational processes to use feedback effectively (Lipnevich & Smith, 2022). Recent research has increasingly examined these dynamics, with systematic reviews showing that students experience positive and negative emotions based on perceived competence and feedback value (Chen & Nieminen, 2024; Lipnevich et al., *in press*). Students' emotional experiences in feedback are further influenced by their individual factors, feedback sources (e.g. teacher, peer, and technology), and cultural factors (Chen & Nieminen, 2024). Despite growing interest, the key role of emotional regulation in feedback situations remains underexplored, while regulation strategies can support adaptive cognitive, emotional,

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and behavioural engagement with feedback (Little et al., 2024). When students receive feedback, their emotions will be provoked in relation to how they interpret the feedback (Carless & Boud, 2018; Lipnevich & Smith, 2009; Winstone et al., 2017). To use the feedback information effectively, students need to regulate their emotions adaptively to support making sense of feedback and using it for their learning purposes. Particularly, when feedback is perceived with negative emotions (e.g. feeling frustrated), student adaptive regulation of emotions becomes a key process in enabling them to use feedback effectively. Otherwise, students may choose emotional regulation strategies (e.g. distraction) that might be maladaptive for using feedback for learning purposes. Predicated on this notion that emotional regulation might enable or disable adaptive engagement with feedback, the current study seeks to explore how secondary school students in Singapore regulate their emotions upon receiving feedback.

Emotional regulation refers to how individuals influence the type, duration, intensity, and expression of their emotions (Gross, 1998). Students use strategies such as situation selection, situation modification, attention deployment, cognitive change, response modulation, competence modification, and seeking social support to manage their emotions (Gross, 1998; Stockinger et al., 2025). Evidence suggests that these strategies are context-dependent; effective strategies in one context may not transfer to another, highlighting the need to examine emotional regulation in assessment-related contexts (Ben-Eliyahu, 2019; Harley et al., 2019; Xu & Muis, 2026). While a few studies have explored emotional regulation in exam contexts for managing anxiety (Daumiller et al., 2024; Putwain et al., 2025), research on emotional regulation in feedback practices remains limited particularly among secondary school students (Liu & Yu, 2022; Romo et al., 2025; Xu & Muis, 2026). This gap limits generating evidence regarding how students' adaptive or maladaptive emotional regulation impacts their receptivity and engagement with feedback content for enhancing their learning. Specifically, when emotional responses to feedback are left unregulated or are regulated maladaptively, students could become less receptive to the feedback's content, limiting its capacity to support learning (Carless & Boud, 2018; Harley et al., 2019).

To address these gaps and support student adaptive engagement with feedback, the current study leveraged a novel Situational Judgement Test (SJT) as a think-aloud stimulus to capture secondary students' emotional regulation strategies in feedback contexts in Singapore. In their responses, students articulated the strategies they would use and the factors shaping their choices when receiving feedback from teachers, peers, and technology. By focusing on an Asian context, this study also responds to the underrepresentation of evidence in regulation of academic emotions in Eastern contexts (Xu & Muis, 2026).

Literature review

Feedback

Feedback influences students' learning, sense of self, and engagement involving cognitive, affective, and behavioral processing alongside contextual factors (Hattie & Timperley, 2007; Lipnevich & Smith, 2022; Shute, 2008; Wiliam, 2018). Effective feedback recipience and engagement process for students involves appreciating feedback,

making feedback judgements, managing emotions, and taking actions (Carless & Boud, 2018). Factors including the characteristics of the receiver (e.g. responsibility and agency in feedback, motivation to improve, self-efficacy, skilled self-regulation), sender (e.g. credibility of and trust to the sender), message (e.g. descriptive, tone, manageable amounts), and context (e.g. training and assessment design) have been identified to impact student engagement and recipience of the feedback (Winstone et al., 2017). Altogether, integrative perspectives emphasise both the informational function of feedback in enhancing learning as well as its affective and relational nature, where the power of feedback reveals itself in the relationships that make it matter (Carless & Boud, 2018; T. Corbin et al., 2025; Gravett & Carless, 2024; Heron et al., 2023; Lipnevich & Smith, 2022). While feedback literature has highlighted the role of emotions in receiving and engaging with feedback, the key role of emotional regulation for student effective use of feedback has been underexplored. This study builds on existing feedback perspectives by focusing on how students regulate emotions in feedback contexts.

Feedback and emotions

Students interpret feedback, process it emotionally, evaluate its utility, and may select to implement it (Lipnevich & Smith, 2022). There is a growing recognition that emotions are key in feedback recipience. However, emotional processes remain relatively under-examined, prompting calls for research on emotionally informed feedback practices (Little et al., 2024). Recent reviews show that students' emotional responses are influenced by their individual learner factors (e.g. achievement goals, self-concepts, prior competency), feedback features (i.e. content, timing, and format), interpersonal relationships (e.g. teacher-student, and peer-to-peer relationships), cultural factors, and task characteristics (Chen & Nieminen, 2024). Although research on feedback and emotions is gradually expanding, emotional regulation in feedback contexts remains underexplored. Students' emotional regulation transpires after students' emotions about feedback. For example, a student might feel disappointed after the feedback receipt; however, their continued engagement with feedback also depends on how they manage their emotions. This study therefore attends to how students influence their emotional trajectory once they receive feedback, a dimension which has not been explicitly or directly examined in the previous emotion research in feedback contexts.

Feedback source also matters: teacher feedback carries institutional authority (Fong et al., 2018), peer feedback raises concerns about credibility (Panadero, 2016), and technology-based including AI feedback is evaluated for informational credibility (Lipnevich et al., 2021). This study extends this literature by exploring how informational and relational interpretations impact students' emotional regulation strategies in teacher, peer, and technology-generated feedback contexts.

Emotional regulation in assessment contexts

Given the limited research on emotional regulation in feedback contexts, existing work in educational psychology provides a useful foundation for conceptualising how students might potentially manage their emotions upon receiving feedback (Ben-Eliyahu, 2019; Harley et al., 2019; Xu & Muis, 2026). Harley et al. (2019) suggest a framework for

emotional regulation that integrates Gross's (1998) process model with Pekrun's (2006) control-value theory. Gross's model organises five strategies: (a) situation selection, (b) situation modification, (c) attentional deployment, (d) cognitive change, and (e) response modulation. Pekrun's control-value theory complements Gross's model by proposing two appraisals: perceived control and perceived value. Students appraise the extent they value and have competence over a task or an outcome. These two appraisals lead to various emotional responses. For example, anger can be provoked by one valuing a task but having low control over it. In this theory, emotional regulations are shaped by individual and contextual antecedents and are subject to regulation through four key processes: appraisal-oriented regulation (reframing control-value appraisals), emotion-oriented regulation (management of emotional responses), competency-oriented regulation (capacity-building for achieving academic goals), and situation-oriented regulation (approaching or avoiding learning situations) (Stockinger et al., 2025).

Importantly, regulation strategies are context-dependent (Ben-Eliyahu, 2019; Xu & Muis, 2026), with a few studies exploring how students manage their emotions in response to feedback practices (Hausman et al., 2023; Liu & Yu, 2022). Examining master students' emotional regulation in supervisory feedback situations, Liu and Yu (2022) identified four strategies. Task-focused regulation focused on actions that students employed to address the problems faced within their tasks. Cognitive regulation referred to cognitive change via reassurance, emotional acknowledgement, promise to put more effort, or lowered expectation upon feedback recipience. Response regulation refers to actions such as breathing, doing nothing, drinking, and resting that undermine or reinforce the emotional intensity. Finally, attention deployment focused on efforts to distract or focus on rewarding oneself. Hausman et al. (2023) also identified similar strategies employed by nursing students during an internship. These studies indicate that regulation is often unconscious and may benefit from explicit instructional training. However, research on emotional regulation for feedback contexts in K-12 settings remains scant. This gap limits the capacity to inform teachers and students on how emotions are regulated in feedback contexts as a basis to characterise what existing strategies students are using and what factors influence student use of these strategies. Such data will support teachers and students in identifying the patterns of emotional regulation strategies being used in feedback contexts as a basis to further develop the repertoire of adaptive strategies that students can potentially leverage to promote their learning.

Current study

The current study therefore examines the emotional regulation strategies secondary school students articulate in response to feedback from three sources (i.e. teachers, peers, and technology) and the contextual factors shaping their choices. To elicit student responses, a newly developed SJT was used to enable students to think aloud articulating what strategies they use when managing their emotions in feedback contexts and what factors drive such regulatory processes.

The study is situated in Singapore, a high-performing educational system in which assessment and feedback carry significant institutional weight and where the emotional stakes of academic performance are high for students (Wong et al., 2020). Singapore is

also an underrepresented Eastern context in the emotional regulation literature, where cultural values of harmony, face-saving, and relational respect may shape regulatory strategies in ways that Western models do not fully anticipate (Choo et al., 2025). Focusing on this context allows the study to examine both universal and culturally specific dimensions of emotional regulation in feedback. Further, feedback culture is encouraged by using teacher, peer, and technological means. Specifically, teachers are encouraged to support students to learn about AI, learn to use AI, and learn with and without AI. By integrating feedback with technological platforms in schools, teachers and students in this also leveraged these tools for feedback purposes, warranting further investigation of how students manage emotions when receiving technology-mediated feedback (Ministry of Education, 2026). The study is guided by the following research question: What emotional regulation strategies do secondary school students articulate employing in feedback contexts, and what factors shape their choice of strategies across three feedback sources?

Method

Study design

Think-aloud protocols were used in a qualitative design to examine students' emotional regulation strategies in feedback contexts using the novel SJT (Leighton, 2017). The design of these protocols entailed a sequence of interviews involving the intended respondents, where participants provided in-depth insights into their thought processes.

The emotion regulation in feedback situations' Situational Judgement Test

The think aloud data for this study was collected using the emotional regulation SJT. The SJT was developed and used in this study for two reasons. First, the existing instruments measure emotional regulation in academic contexts, but none specifically targets feedback situations (Burić et al., 2016; Hanin et al., 2017; Stockinger et al., 2025). Further, the SJT purposefully leverages situational scenarios, which is more useful for feedback contexts in supporting student and teacher learning about emotional regulation. This approach augments the existing self-report surveys on academic emotional regulation by provoking contextual reflections for student reporting and learning about their regulatory strategies in feedback contexts. Second, given that K-12 students may not be consciously aware of the regulation strategies they use, the SJT provides explicit examples across feedback scenarios that can provide more scaffolded and targeted data related to students' regulation strategies. In this way, the SJT can support both research and practice by informing interventions to enhance students' engagement with feedback (Hausman et al., 2023; Little et al., 2024).

For this study, the SJT was developed iteratively based on emotional regulation (Gross, 1998; Stockinger et al., 2025) and the feedback interaction framework (Lipnevich & Smith, 2022). The researchers collaboratively constructed scenarios and response options, refining them through successive rounds of review to ensure theoretical alignment and contextual relevance. The SJT comprises 30 scenarios evenly distributed across teacher-, peer-, and technology-generated feedback (See Appendix 1). Each scenario

presented a brief feedback situation followed by six strategies: (a) situation modification, (b) attentional deployment, (c) cognitive change, (d) response modulation, and (e) competence modification, and (f) seeking social support (Gross, 1998; Harley et al., 2019; Stockinger et al., 2025). For example, in a scenario depicting a teacher who, immediately following a presentation, comments that the student did not connect well with the audience and seemed underprepared—despite the student having prepared extensively but felt nervous on the day—the six corresponding strategies were represented as follows: situation modification (excusing oneself to the bathroom to calm down), attentional deployment (taking notes during the feedback to maintain focus and avoid dwelling on the criticism), cognitive change (reappraising the feedback as supportive advice rather than a critique of one's intelligence or skills), response modulation (taking a deep breath and smiling to regulate a negative reaction), competence modification (seeking additional feedback on how to improve), and seeking social support (sharing feelings about the feedback with a trusted classmate). The SJT was refined through expert panel reviews and piloted with four secondary school teachers to improve clarity and contextual relevance.

Data collection procedures

Upon securing the ethics application from the NTU-IRB board, participants were recruited through convenience sampling via contacting school leaders. Three government secondary schools participated. Thirty students (aged 13–14) were recruited from three schools; one was absent on the interview day, leaving 29 students (13 male, 16 female). Students were nominated by schools to represent a range of ability levels. Informed consent was obtained in accordance with ethical procedures.

Participants were interviewed in groups of three at their school. Each focus group engaged with six scenarios (two per feedback source). Students responded to the use of each strategy in a scenario and explained their reasoning for their choices. Interviews lasted approximately 60 minutes.

Data analysis

Data were analysed using thematic analysis with combined deductive and inductive coding (J. Corbin & Strauss, 2007). Two researchers independently coded an initial subset of transcripts, then met to compare codes, resolve discrepancies through discussion, and negotiate a shared codebook; this codebook was applied to the remaining transcripts, with periodic meetings held throughout coding to check for codebook drift and to revise code definitions as new instances emerged. Disagreements were resolved through discussion and, where interpretation remained ambiguous, by returning to the surrounding transcript context to adjudicate meaning rather than by majority rule.

Coding proceeded along two coupled dimensions that together generated the strategy–factor–source structure. The first dimension captured the emotional regulation *strategy and technique* enacted in each response. Deductive codes for this dimension were informed by the strategies and techniques outlined in the SJT and by prior frameworks (Gross, 1998; Harley et al., 2019; Stockinger et al., 2025); students also articulated additional techniques not anticipated by the SJT (e.g. sleeping, expression), which were

inductively coded and added to the codebook. The second dimension captured the *factors* students identified as shaping their strategy use. Deductive factor codes were informed by prior emotion-in-feedback frameworks (Chen & Nieminen, 2024); inductive coding additionally surfaced factors not represented in these frameworks or in the SJT's embedded model, including task, teacher, and cultural factors, which were retained as codes once they recurred across multiple participants and were agreed upon by both coders.

Critically, both dimensions were coded *within* each feedback source—teacher, peer, and technology (AI)—rather than pooled across sources. This source-stratified coding allowed the team to examine, for each strategy, which factors recurred within a given source, which recurred across sources, and which were source-specific, and produced the three factor-by-strategy coding matrices underlying the reported results.

Several procedures supported the trustworthiness of this analysis. Investigator triangulation was achieved through independent double-coding and negotiated consensus at each stage of codebook development. Constant comparison across participants and across the three feedback sources served as an internal check on emerging categories, prompting revision of code definitions when a code applied inconsistently across cases. Verbatim excerpts were retained alongside each code to preserve traceability between interpretation and source data and to support thick description in reporting.

Findings

The results are presented by each strategy, then by the factor (s) that shaped it, and finally by source (teacher, peer, AI) within each factor. Table 1 provides a high-level overview of strategy-factor-source structure present in the data, showing how each factor (learner, feedback, interpersonal, task, teacher, cultural) operates across the six emotional regulation strategies and feedback source(s) (i.e. teacher, peer, AI). As the table shows, all six strategies are shaped by learner, feedback, and interpersonal factors, while the remaining factors vary by strategy. A recurring pattern across strategies is that teacher and peer feedback more often carry interpersonal and cultural weight, whereas AI feedback is primarily regulated on informational grounds. The following subsection details the strategy-factor-source structure, indicating how each factor operates within an emotional regulation strategy and across feedback sources.

Situation modification

Situation modification was shaped primarily by student internal, feedback, and interpersonal factors.

Student internal factors

Teacher. Mastery and performance goals drove students towards personalised, one-to-one clarification: 'I put a 5, cos you know, I wanna improve as much as I ca' (S3). Emotional intensity set the threshold for more avoidant modifications, such as leaving the room, which most students rated as less likely regardless of distress.

Table 1. Emotion regulation strategies across factors and feedback sources.

Strategy	Learner	Feedback	Interpersonal	Task	Teacher	Cultural	Source Pattern
Situation Modification	✓	✓	✓	–	–	–	Teacher and peer feedback were regulated relationally and informationally; AI feedback was regulated informationally only, with relational needs redirected to human sources.
Attention Deployment	✓	✓	✓ (peer)	✓ (AI)	–	–	Task value was concentrated in the AI context; interpersonal codes were concentrated in the peer context.
Cognitive Change	✓	✓	✓ (peer)	✓ (teacher)	✓ (teacher)	–	Teacher characteristics (good intention, rapport) were exclusive to teacher-generated feedback.
Response Modulation	✓	✓ (teacher and peer)	✓ (teacher and peer)	–	✓ (teacher)	✓ (teacher and peer)	Interpersonal and cultural codes were present for teacher and peer feedback but absent for AI feedback.
Competence Modification	✓	✓ (peer and AI)	✓ (teacher)	✓ (teacher and AI)	✓ (teacher)	✓ (teacher and peer)	Teacher characteristics and cultural norms co-occurred, concentrated in teacher-generated feedback.
Seeking Social Support	✓ (teacher and peer)	✓ (peer)	✓ (all three sources)	–	–	✓ (teacher)	Mutual recognition was present across sources but redirected away from AI itself, not sought from it; the cultural norm referred to parental expectations.

Note: ✓ indicates the code was present for that column/source; – indicates the code was absent. Parenthetical labels specify which feedback source(s) the code applied to when the strategy did not apply uniformly across all sources.

Peer. The same achievement orientation resurfaced but filtered through judgments of peer competence: students sought a second peer opinion to ‘maximise my improvement’ (S1) or to confirm feedback before revising, while low perceived competence in the feedback-giver reduced the likelihood of seeking further peer input altogether.

AI. Feedback receptivity and performance goals manifested as active prompt engineering – asking the AI to simplify, summarise, or elaborate its output rather than disengaging outright (S1, S11, S24). Trust in AI’s competence functioned as a gatekeeping variable: several students who otherwise engaged productively with AI feedback reported redirecting to the teacher once trust broke down, ‘I don’t really trust AI ... I’d rather trust a teacher’ (S23).

Feedback factors

Teacher. Feedback that was generic or that failed to clarify what to improve prompted disengagement; feedback that was unclear instead prompted a request for a one-to-one meeting: ‘If I don’t understand the feedback, I will ask them about it, for more personal feedback’ (S9).

Peer. Perceived respect and value in the feedback shaped whether students sought a confirming second opinion or dismissed the exchange outright: ‘I might do it, but I also might not do it, because I feel like it’s disrespectful to my group’ (S10).

AI. Complexity and lack of clarity in AI output most directly triggered situation modification, manifesting as prompt-based simplification requests or, when the AI feedback remained unhelpful, escalation to the teacher: ‘Depends on what the comment is. If I feel like it’s unlikely, or it doesn’t sound right, I would go to my teacher for clarification so that I’m not learning the wrong things’ (S12).

Student interpersonal factors

Teacher. Fear of embarrassment in front of peers drove refusal to respond to teacher feedback in class: ‘I don’t want to answer because I’m scared ... I’ll embarrass myself’ (S13).

Peer. Existing peer friendship reduced the likelihood of seeking an alternative source of feedback altogether: ‘If my friend is in the same group as me, then it is very unlikely I will go and ask others’ (S10). Loyalty to the relationship outweighed the informational benefit of a second opinion.

AI. Interpersonal factors operated indirectly here, as the *absence* of relational recognition from AI pushed students back towards human sources. The same student who distrusted AI’s competence also noted a preference for the mutual recognition available from teachers, underscoring that situation modification away from AI was as much about relational validation as accuracy: ‘because I think asking real people is a lot better than using some robot’ (S7).

Attention deployment

Attention deployment was shaped by student internal, feedback, task, and interpersonal factors.

Student internal factors

Teacher. Perceived control, feedback receptivity, performance, and mastery goals jointly shaped whether students actively sought improvement areas ('prevent myself from making the same mistakes over and over again ... I'll feel frustrated at myself for not putting in the effort to learn from my mistakes', S3) or instead diverted attention (avoiding eye contact, looking at notes) to escape being called on.

Peer. Feedback receptivity shaped students' regulatory approaches to feedback, with some students selecting to review peer feedback point-by-point even when upset ('even though I'm upset, I'll still ... take it, note it down', S13), while others select to disengage and refocus on their own work: 'because I also don't care what they say' (S7).

AI. Perceived control-value, feedback receptivity, and performance goals influenced whether feedback was processed in full or skimmed in chunks: 'Even if I get a lower part of a grade ... if it's not important, I might do it. If it's important, then I'll 100% do it' (S14). Students otherwise reported ignoring content on topics not yet taught: 'I wouldn't pay much attention to ... what hasn't been taught ... I'll think that maybe I don't need it' (S21).

Feedback factors

Teacher. Low value, lack of clarity, disrespectful tone, and limited opportunity to implement collectively suggested student disengagement with feedback: 'cos there's nothing I can do about this already' (S13).

Peer. Clarity and untimeliness (feedback arriving after submission, with 'no opportunity to implement') similarly signalled student attentional withdrawal. 'There's nothing I could do now after I submitted, you gave me the feedback too late, so I would just ignore the feedback' (S14).

AI. Clarity operated much as it did with teacher and peer feedback but was compounded by volume: students described becoming 'overwhelmed' and losing interest when AI generated feedback in bulk (S21), a pattern less prominent in the teacher and peer data. 'Sometimes ask the AI to simplify it, or if it just gets too overwhelming ... I'll just surrender' (S17).

Student interpersonal factors

Interpersonal factors primarily surfaced in relation to peer feedback. Peer disliking and distrust directly reduced attentional engagement: 'if it's a person I really don't like, then I wouldn't really think much of it' (S19).

Task factors

Task factors were distinctly concentrated in the technology-mediated AI context, where subject and project value suggested whether students dedicated sustained attention to AI feedback at all: ‘it depends on what subject it is and how important the subject is to me’ (S14).

Cognitive change

Cognitive change was shaped by student internal, teacher, task, interpersonal, and feedback factors.

Student internal factors

Teacher. Perceived control and value, mastery goals, and feedback receptivity affected whether feedback was reappraised positively or dismissed in scenarios where teachers provided feedback. ‘There’s no shame in getting it wrong . . . then you just learn from your mistake. After that, I will probably figure it out’ (S14).

Peer. In contexts where peers provided feedback, reappraisal was explicitly tied to judgements of the feedback-giver’s competence; feedback from a higher-performing peer was more likely to be accepted, while feedback from a lower-performing or disliked peer was reframed as the other person ‘projecting their own insecurities’ (S20).

AI. In AI-feedback generated contexts, feedback receptivity and mastery-orientation enabled some students to seek to incorporate AI suggestions readily, while others treated AI output as one input among several to be weighed against the teacher’s or their own view: ‘Sometimes I would rely on my own understanding’ (S23); ‘even though AI can be helpful . . . I would ask instead a teacher, my friends, and family’ (S14).

Feedback factors

Teacher. Clarity, value, and perceived control in feedback shaped student reappraisals for teacher-generated feedback. ‘Because [what] the teacher . . . told you wasn’t, like, that good . . . I wouldn’t like take it as a learning opportunity’ (S24).

Peer. Peer-context reappraisal was also influenced by clarity, value, and opportunity to implement the feedback. ‘If they don’t tell me what I’m doing wrong, I don’t care what they say’ (S7).

AI. AI-context reappraisal was found to be influenced by accuracy and value of feedback (‘sometimes it may be correct, so it depends on whether it gives good feedback’. S23).

Student interpersonal factors

Interpersonal factors were concentrated in the peer context, where reappraisal frequently hinged on the perceived intention behind the feedback (i.e. whether it was seen as

constructive or as intentionally harsh or shaming). ‘I also remind myself that sometimes people give criticism just to criticise you, not for the better . . . I would just put it aside, because I know what I’m doing’ (S17).

Task factors

Task or subject value influenced cognitive change in both teacher and AI contexts. For example, a student would only consider feedback for math (‘I would look at my answer, or key of my answer, and compare it. But it’s only for math’, S9).

Teacher factors

This factor was concentrated primarily in the teacher-generated feedback context, where perceived good intention, rapport, and care underpinned reappraisal: ‘I know that my teachers . . . want me to do better’ (S20); ‘if they support me . . . I will definitely do try my best to do better’ (S19).

Response modulation

Response modulation was shaped by student internal, interpersonal, teacher, feedback, and cultural factors.

Student internal factors

Teacher. In teacher-generated feedback contexts, students varied in their perceptions of the utility of specific regulation techniques (breathing, stress balls, sleeping, music). For example, a student articulated, ‘I find ways to calm myself down, like, take a deep breath . . . and try again’ (S13). These techniques were further influenced by the intensity of perceived emotion: ‘If I’m not so nervous, then I think I’ll just thank my teacher then go back to my seat and just try to calm myself down’ (S16).

Peer. In peer-generated feedback scenarios, students also varied in their perceptions of the utility of specific techniques (breathing, playing games, music, sleeping). While several did not find breathing to be useful (‘I do not do breathing exercises or like anything before I read the feedback’, S8), individual techniques such as sleep were found to be a dominant technique used by a student. This shows that some students may rely heavily on one technique for response modulation.

AI. In AI-generated feedback contexts, emotional intensity influenced student choice of using response modulation. While some did not need response modulation (‘I would like to finish our project first’, S10), others conditioned it on emotional intensity (‘depends on how frustrated I am’, S12). Students also varied in their perception of utility of specific techniques (e.g. sleep, music, stretching, social media).

Feedback factors

Teacher and peer. Perceived unfairness, low value of feedback, and lack of clarity influenced the rare instances of open expression of frustrations across teacher and peer contexts alike: ‘I might also get a bit frustrated, because I sometimes don’t get what the

question is asking for, and I might just lose control' (S28); 'I will try to maintain a neutral expression, but I know sometimes when receiving negative reaction, I will uncontrollably show an angry expression' (S21).

Student interpersonal and cultural factors

While interpersonal factors were present for shaping response modulation similar to the other strategies, cultural factors surfaced specifically in relation to response modulation. This is where the sharpest source-based divergence in the entire dataset emerged.

Teacher. In teacher contexts, response modulation was heavily shaped by face-saving and cultural factors of respect and harmony: students nodded, smiled, and suppressed visible distress 'because I don't want people to be that concerned about me' (S17) and to avoid disrupting the classroom to observe harmony. 'Usually, when I receive feedback, I'll just nod, then just go back to my seat. Usually, after I present there are people behind me, so I don't want to disrupt the presentation' (S16).

Peer. In peer contexts, interpersonal factors were even more dominant; fear of retaliation, friendship preservation, trust, and face-saving collectively explained why most students maintained a neutral expression regardless of how they felt internally, and why perceived unfairness in peer feedback was one of the few conditions under which students reported open frustration or confrontation (S27, S28).

Teacher factors

Teacher rapport surfaced narrowly within the data, where students reported being less willing to express disagreement when they had an established rapport: 'for teachers you like, you're a bit calmer, you don't really talk back' (S29).

Competence modification

Competence modification was shaped by student internal, interpersonal, feedback, teacher, task, and cultural factors.

Student internal factors

Teacher. Student mastery and performance goal as well as feedback receptivity shaped their competence-modification strategy to regulate emotions. Students noted seeking additional feedback from their teachers, competent peers, and online sources to improve their learning. 'If I can't reach out to them, I'll definitely go online, search different ways to help me improve' (S19); 'I always tend to ask my friends more about math than my own teacher' (S7).

Peer. Similarly, mastery and performance goals as well as receptivity to feedback shaped competence-modification strategy in response to peer feedback. Students noted seeking peer feedback to improve their learning. 'When I make improvements to the project, I might ask them if it's alright' (S12).

AI. Within the AI-generated feedback context, mastery and performance goals prompted students to seek additional examples from AI to improve their learning. Feedback receptivity additionally affected whether students trusted the AI enough to act on its suggestions or instead used it as a stepping stone towards human feedback. 'I'd rate it a 2, because I don't really rely on AI a lot, because AI gives you, like a whole essay of things. But I rely on other people around me, like my friends, my parents, yeah, to help me out' (S15).

Feedback factors

Peer and AI. Clarity, value, and timeliness influenced competence modification most visibly in the peer context; students who found peer feedback unclear or low value did not act on it. 'Well, it depends if like the feedback they give is, like, very impolite, and is in a way that I don't appreciate it, and is like illogical, then I would put away their feedback' (S17). In AI-generated feedback contexts, students evaluated the value of feedback to modify their competence. 'Let's say in this case I actually care . . . Ask the AI to give me some ways that I can, like improve on my work' (S13).

Student interpersonal factors

Teacher. Interpersonal factors were distinctly concentrated in the teacher-generated feedback. Fear of embarrassment and anxiety prompted students to seek one-to-one meeting to discuss feedback or refuse to answer the teacher's feedback. 'Like, tell the teacher that I don't want to answer because I'm scared, like, if I answer too quick without, like, confirming, then I'll embarrass myself' (S13).

Task factors

Teacher and AI. Subject value appeared narrowly in both teacher and AI contexts, moderating how much additional effort students were willing to invest. 'When I just don't find the subject or the teacher good, I just don't care about anything they say' (S7).

Teacher and cultural factors

These two factors were concentrated almost exclusively in the teacher-generated feedback context, and frequently co-occurred: rapport with the teacher predicted whether students sought additional feedback at all ('if I like the teacher, then I might ask for feedback and strategies', S16), while the cultural factor of harmony shaped how that seeking was enacted (e.g. waiting until after class, in a less crowded setting, to avoid disrupting the classroom, S17).

Seeking social support

Seeking social support was shaped by student internal, feedback, interpersonal, and cultural factors.

Student internal factors

Teacher and AI. Feedback receptivity and emotional intensity influenced the baseline propensity to seek social support in teacher and AI-generated feedback contexts. When a teacher was the source of feedback, some students chose to

keep it to themselves for privacy reasons. ‘I just feel like it’s better to keep to myself’ (S11). A similar pattern was observed for feedback in AI contexts: ‘I can ask my brothers for help ... But overall like I wouldn’t really ask people or my family’ (S8).

Feedback factors

Peer. This factor concentrated almost exclusively in peer context and focused on whether students put value on peer-generated feedback. ‘With my close friends, I don’t actually take any feedback seriously’ (S6).

Student interpersonal factors

Teacher, peer, AI. Mutual recognition (i.e. the sense of being understood and seen by the person one confides in) was the single most consistent driver of this strategy and the clearest thread linking all three sources. In teacher contexts, students sought out friends or family who could recognise the emotional weight of the teacher’s feedback (‘I would most likely talk to my family members, because they are the ones that understand me the most’, S13). In peer contexts, mutual recognition operated via students seeking support from friends to process feedback received from peers, with attention to saving the face.

The person in my group, right, say something that I don’t really like relate to it ... I would talk to it with my close friend. Because if I were to talk to it with that person who suggested it, I’m afraid that if I say something rude and eventually offends them. (S25)

In AI contexts, students preferred to keep it to themselves: ‘I just don’t like telling people about what’s happening’ (S7).

Cultural factors

Teacher. Cultural factors, specifically parental expectations, appeared distinctly within the teacher context, where several students described disclosing scores to parents pre-emptively to manage anticipated reactions (‘I try to tell my mum why I got such a low mark ... so that my mum wouldn’t scold me’, S2). This dynamic did not recur in the peer or AI data, suggesting that parental-expectation management is tied specifically to formal, teacher-graded feedback rather than informal peer exchange or AI-generated output.

Discussion

This study examined the emotional regulation strategies secondary school students articulate in feedback contexts and the factors shaping their use. Feedback is well established as shaping learning, motivation, and self-concept through cognitive, affective, and behavioural processes (Hattie & Timperley, 2007; Shute, 2008; Wiliam, 2018), yet how students actively regulate their emotional trajectory once feedback is received, rather than simply how they initially feel, has remained comparatively underexamined (Little et al., 2024). Beyond cataloguing six regulation strategies, the primary contribution of this study is a more granular account of how each strategy is shaped by different constellations of factors depending on the source of feedback. Prior reviews have identified the learner, feedback, and

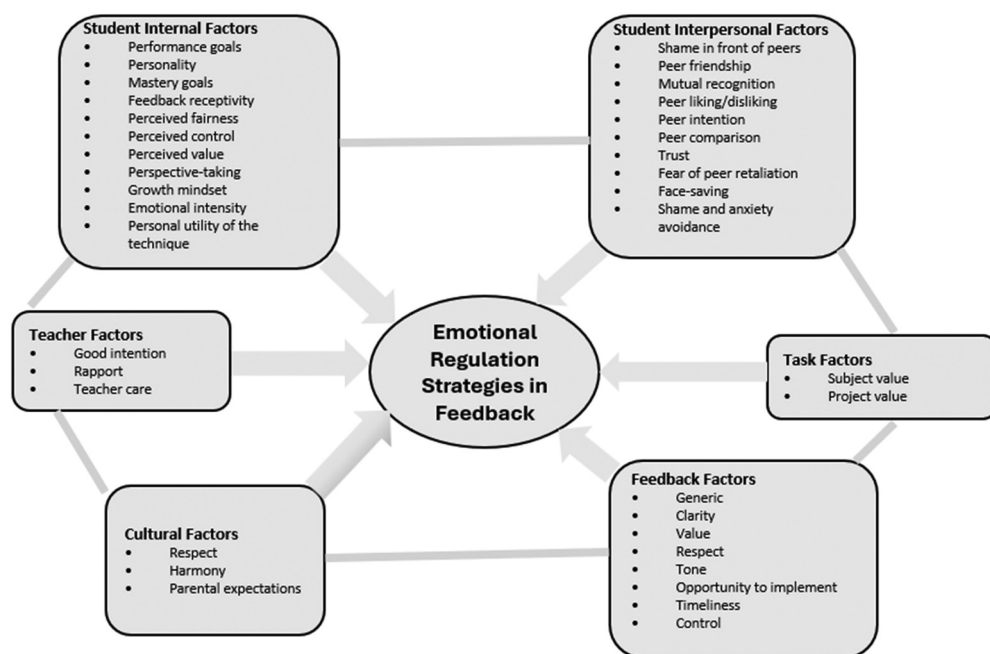


Figure 1. Factors underpinning students' emotional regulation strategies.

interpersonal factors that shape students' emotional responses to feedback broadly (Chen & Nieminen, 2024), and prior regulation frameworks have organised emotion regulation into discrete strategies (Gross, 1998; Harley et al., 2019; Pekrun, 2006; Stockinger et al., 2025). What has not been examined is how these two lines of work intersect within feedback encounters: whether the same factor influences every strategy uniformly, and whether the same strategy operates uniformly across feedback sources. By coding data along a strategy-factor-source structure (Table 1; Figure 1), this study provides an empirically grounded, more fine-grained account of this intersection than has previously been offered in feedback or emotion-regulation literatures, and responds directly to calls for research examining how students manage their emotional trajectory once feedback has been received (Little et al., 2024).

Factors within and across strategies

Student internal factors such as achievement goals, feedback receptivity, and perceived control influenced all six strategies and all three feedback sources (save for peer feedback in seeking social support), consistent with their status in prior work as core individual antecedents of both emotional response to and engagement with feedback (Chen & Nieminen, 2024; Winstone et al., 2017). This omnipresence suggests student internal factors function more as a lens through which every other strategy and feedback source is filtered. This is consistent with characterisations of the feedback receiver's motivation, self-efficacy, and self-regulatory capacity as central to feedback engagement more broadly (Winstone et al., 2017), while extending this work

by showing the same learner-level dispositions recur across markedly different regulatory mechanisms, from boundary-setting avoidance in situation modification to reappraisal in cognitive change.

The remaining factors, by contrast, were strategy-selective rather than uniformly distributed. Task factors shaped attention deployment, cognitive change, and competence modification. For instance, students reported disregarding AI feedback on low-value tasks, while engaging closely with feedback on subjects they cared about. Task factors, however, were largely absent from situation modification, response modulation, and social support seeking. Teacher factors such as rapport and perceived care shaped cognitive change, response modulation, and competence modification specifically, and only ever emerged in relation to teacher-generated feedback, echoing students' reliance on the recognition typically attributed to teachers within institutional assessment relationships (Fong et al., 2018). Cultural factors were most pronounced in response modulation, where students' reliance on internally regulated strategies such as nodding, suppressing visible distress, and maintaining a neutral expression to avoid disrupting the classroom was tied explicitly to harmony and face-saving considerations salient within the Singapore education context (Choo et al., 2025; Ministry of Education Singapore, 2020; Tan & Tan, 2014).

This uneven distribution adds specificity to existing process models of emotion regulation (Gross, 1998; Harley et al., 2019) and to accounts emphasising the context-dependence of regulation more generally (Ben-Eliyahu, 2019; Xu & Muis, 2026). Rather than treating context as a general moderator of regulation, these findings indicate that particular contextual factors attach to particular regulatory mechanisms: response modulation appears substantially more culturally embedded than attention deployment or cognitive change, which were shaped more strongly by feedback and interpersonal factors. Within cognitive change specifically, positive reappraisal was consistently tied to perceived clarity, trust, and fairness in the feedback, and breakdowns in any of these prompted students to dismiss or reinterpret feedback negatively rather than reappraise it constructively, consistent with prior findings on the conditions under which reappraisal succeeds or fails in feedback contexts (Rasooli et al., 2018). This distinction adds empirical texture to Pekrun's (2006) control-value account and to Stockinger et al.'s (Stockinger et al., 2025) distinction between emotion-oriented and competency-oriented regulation, suggesting these processes may draw on qualitatively different contextual resources rather than a shared, generic pool of contextual influence. It also extends prior taxonomies of student emotion regulation in feedback and supervisory contexts (Hausman et al., 2023; Liu & Yu, 2022) by specifying, within each identified strategy, which contextual conditions were most consequential.

Factor-strategy patterns across feedback sources

A second pattern concerns how the same strategy was regulated differently depending on feedback source. Across situation modification, cognitive change, response modulation, and competence modification, teacher- and peer-linked regulation consistently recruited student interpersonal factors such as fear of embarrassment, mutual recognition, trust, perceived intention behind the feedback. In addition, teacher- and peer-linked regulation were tied to informational considerations such as feedback clarity and value. Regulation

linked to AI-generated feedback, by contrast, was governed almost entirely in an informational register: accuracy, competence, and perceived usefulness, with markedly fewer interpersonal codes. In response modulation, this contrast was sharpest: both teacher and peer contexts showed evidence of face-saving, harmony, and relational trust shaping how students modulated visible emotional expression. Students were also explicit about this distinction in their own reasoning, favouring ‘real people’ over ‘some robot’.

Even where interpersonal codes did appear alongside AI-linked feedback, as in social-support seeking, they typically described students withholding disclosure or redirecting towards human sources rather than seeking recognition from the AI itself. Notably, the rare instances of overt emotional expression (rather than internally regulated response) across sources were consistently tied to perceptions of unfair feedback, suggesting that fairness in feedback delivery, and student capacity to recognise and articulate unfairness, may be a distinct lever supporting more open response regulation regardless of source (Rasooli & DeLuca, 2024). Taken together, the broader pattern suggests that teacher and peer feedback tend to be processed through both informational and relational registers, while AI feedback is processed primarily informationally, with relational needs met, where they arise, through human sources outside the AI interaction itself. This observation should be read as a pattern emerging from a small, single-timepoint qualitative sample responding to hypothetical scenarios, rather than as an established asymmetry across feedback ecologies; it is nonetheless consistent with characterisations of teacher feedback as carrying institutional authority (Fong et al., 2018), peer feedback as bound up with credibility judgements among status-equals (Panadero, 2016), and technology-mediated feedback as evaluated chiefly for informational credibility (Lipnevich et al., 2021). It also adds to integrative feedback perspectives emphasising feedback’s relational as well as informational function (Carless & Boud, 2018; T. Corbin et al., 2025; Gravett & Carless, 2024) by suggesting that this relational dimension may not transfer uniformly to non-human sources, a question meriting direct investigation as AI-mediated feedback becomes more common in classrooms.

This relational patterning also carries a cultural inflection. Students’ reliance on significant others (i.e. teachers, peers, and family) for both emotional co-regulation and relational validation is consistent with interdependent constructions of self, in which emotional experience is negotiated through webs of relationship rather than resolved individually (Markus & Kitayama, 1991; Turner & Trucano, 2014). Where students did not seek this validation from AI, this may reflect the absence of a relational tie through which recognition could meaningfully occur, a possibility that would require dedicated study to confirm, particularly given the emphasis on criticality and relational engagement increasingly promoted within Singapore’s values education policy (Ho & Barton, 2022; Wong et al., 2020).

Implications for research and practice

These patterns suggest that supporting students’ emotional regulation in feedback requires attention to both which strategy a student is using and which source that strategy is directed towards, rather than treating emotional regulation as a general competency taught independently of context. For teachers, this implies that improving informational qualities

of feedback, such as clarity and specificity, may be insufficient on its own; relational conditions such as trust, rapport, and psychologically safe peer environments appear tied to specific regulatory processes, particularly response modulation and cognitive change. In practice, this could involve teachers making emotional responses to feedback an explicit part of the feedback conversation: for example, helping a student who withdraws from critical feedback to name the emotion, reappraise the feedback's intent, and identify a concrete next step, rather than assuming regulation will occur unassisted (Little et al., 2024). For technology-mediated feedback specifically, findings suggest students may need explicit support in supplementing AI feedback with human interaction, rather than an assumption that AI feedback will be received relationally in the way teacher or peer feedback typically is. For research, the strategy-factor-source structure used here offers a more precise unit of analysis than treating 'context' as an undifferentiated moderator of emotion regulation and may be useful for future studies examining which contextual conditions matter most for which regulatory processes and sources.

Limitations and future directions

Several limitations qualify these findings. Think-aloud responses to hypothetical SJT scenarios capture articulated reasoning rather than observed behaviour, and the sample of 29 students from three schools in a single national context limits generalisability. The strategy-factor-source structure proved analytically useful for organising and interpreting this dataset, allowing patterns to be identified with more granularity than a strategy-only or factor-only coding scheme would have permitted. However, this study does not claim that the specific factor-strategy-source configurations identified here will replicate identically across other cultural or institutional contexts; whether student internal factors remain uniformly dominant, whether cultural factors remain concentrated in response modulation, and whether the relational-informational source distinction holds, are empirical questions warranting further investigation in more diverse samples. Future research could extend this work using larger, quantitative samples to test these patterns statistically, for example through moderation analyses examining whether feedback source moderates the relationship between specific contextual factors and strategy use. Longitudinal and observational designs would additionally help clarify how articulated regulation strategies relate to enacted behaviour over time.

Conclusion

This study offers a more granular account of how secondary students' emotional regulation strategies in feedback contexts are shaped by learner, feedback, interpersonal, task, teacher, and cultural factors, and of how this factor-strategy pattern shifts across teacher, peer, and AI feedback sources. A recurring pattern across strategies is that teacher and peer feedback appear to engage both relational and informational regulatory processes, while AI-generated feedback is regulated primarily through informational judgements, with relational needs redirected towards human sources. The strategy-factor-source structure introduced in this study offers an analytic route through which future studies, quantitative and qualitative alike, might pursue them further.

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Authors' contributions

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Data availability statement

Research data are not shared.

Ethics approval statement

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