

Harmonizing the Minds to Improve Exam Readiness in Engineering Students

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Abstract

This study examines the advantages of implementing pre-quiz activities and music to alleviate test anxiety among engineering undergraduates. A survey conducted with 35 students revealed that pre-quiz activities enhance confidence by helping to clarify misunderstandings, while group discussions promote peer support. Many participants noted that listening to smooth jazz, especially the Bossa Nova genre, helps calm their nerves and improve focus. Importantly, 58% of students reported experiencing anxiety during exams, primarily due to concerns about failure and time constraints. The findings indicated that 27 out of 35 students agreed that pre-quiz activities significantly diminish last-minute anxiety, and 66% felt that music contributed to better concentration. By incorporating regular pre-quiz sessions and tailored music selections, educators can create a supportive learning environment that nurtures emotional well-being and academic success. The research advocates for a course-embedded intervention strategy that combines low-stakes retrieval practice, peer support, exam strategy coaching, and stress-management resources to help reduce anxiety and enhance self-regulated learning among students.

Keywords—formative assessment; low-stakes quizzes; retrieval practice; test anxiety; self-regulated learning; engineering education.

Introduction

Assessment practices in engineering curricula strongly shape what students do, when they do it, and how they feel while doing it. High-stakes examinations can incentivize a sustained academic engagement; however, they may also increase stress, create time pressures, and instill a fear of failure. These factors have the potential to impede effective problem-solving and overall performance. Concurrently, research in learning science indicates that regular retrieval practice (i.e., testing as a learning event) and prompt feedback can foster resilient learning and enhance students' capacity to assess their own understanding and identify gaps in their knowledge.[1]-[10]. These insights have prompted numerous instructors to incorporate low-stakes quizzes, exam wrappers, and various formative assessment tools into their engineering courses. Despite the increasing adoption of these approaches, the implementation details differ significantly: some courses opt for weekly quizzes, while others employ ungraded practice exams, and some even integrate peer discussions or study-skills coaching. On the other hand, students exhibit a diverse range of preparation routines, metacognitive skills, and stress-management strategies upon entering courses. Gaining insight into students' perceptions of the barriers and supports they encounter during their preparation can potentially provide valuable information for instructors. This understanding can facilitate the design of interventions that are not only pedagogically sound, but also practically viable, thereby enhancing the overall effectiveness of instructional practices.

Background

Many instructors rely on traditional quizzes, midterms, and a final exam to assess students' understanding. However, this places a burden and fear of failure on students to demonstrate their understanding of teachings through just a few significant exams. Typically, the midterm and

final examinations carry considerable weight in the overall grade calculation, further intensifying the high-stakes mentality of potential failure. This realization prompted me to introduce multiple mini exams in my teaching, which blend elements of traditional exams and quizzes. By the end of that academic year, several students approached me to express how beneficial this strategy had been for them. They likened it to an “installment plan” that allowed them to showcase their acquired skills in a more manageable way, as they felt capable of catching up even if they struggled with one of the mini tests. For me, effective teaching entails more than just delivering high-quality information and fostering learning; it embodies a relationship founded on trust between the educator and the learners [11],[12]. This relationship is crucial and should be continually enhanced to provide a sustainable and enriching educational experience. In the pursuit of strategies to improve this relationship, it is vital to assess the most significant factors at play.

Test anxiety is commonly defined as a set of cognitive, emotional, and physiological responses that occur in evaluative situations and can impair performance. Cognitive factors, such as worry and intrusive thoughts, often compete for the working memory resources necessary for tackling complex problems. At the same time, emotional elements, such as tension, can heighten arousal levels, ultimately eroding our ability to persist in the face of challenges. This interplay negatively affects our problem-solving capabilities and can significantly hinder our overall performance [13]-[16]. Engineering examinations typically necessitate complex multi-step reasoning processes and the integration of both conceptual and procedural knowledge. Consequently, these assessments are especially vulnerable to disruptions in attention and working memory, which can significantly impede our performance.

Formative assessment is frequently proposed as an antidote to exam-driven cramming and anxiety. When designed as a low-stakes retrieval practice with feedback, formative assessments can improve long-term retention, transfer, and metacognitive calibration [6]-[9]. Therefore, from a motivational perspective, frequent practice can also reduce uncertainty about exam expectations, build self-efficacy, and provide evidence of progress, all of which may reduce anxiety [17],[18], [19].

Furthermore, peer discussion and cooperative learning play a significant role in enhancing educational experiences. Collaborative problem-solving helps to externalize reasoning, making it easier to identify misconceptions and normalizing the challenges encountered in the learning process. Additionally, structured peer instruction has been demonstrated to improve conceptual understanding, particularly in STEM fields. This approach fosters an environment where students can support one another, leading to deeper comprehension and engagement with the material [20]-[24]. However, group work requires careful structuring to ensure equitable participation and to prevent diffusion of responsibility or reliance on a single high-performing peer.

Finally, students frequently employ a range of idiosyncratic strategies to cope with stress, including physical exercise, counseling services, and various relaxation techniques. One prevalent method reported among students is the use of music as a coping mechanism. Engaging with music can serve multiple psychological functions, such as mood regulation, enhancement of perceived concentration, and reduction of anxiety associated with pre-examination pressures [25],[26]. Previous research has illuminated several key facets of music's role in alleviating anxiety. Empirical evidence regarding the relationship between music and cognition presents a varied picture, likely influenced by task demands, individual differences, and the genre of music

involved. Consequently, student perceptions may guide when and how music should be suggested as an optional support rather than a one-size-fits-all solution.[25]-[27].

Research Questions

Informed by the survey prompts and contemporary literature on formative assessment and test anxiety, this study seeks to address several pertinent questions, which are encapsulated in three primary research questions:

- What examination preparation strategies, perceived challenges, and anxiety-related experiences do students report in the lead-up to and during the examination process?
- How do students perceive pre-quiz activities and peer discussion as support for exam readiness, confidence, and anxiety reduction?
- What are students’ perceptions of music use, including jazz music, as a study or pre-exam strategy for focus and anxiety management?

Methods

The datasets for this work were derived from a brief survey that was submitted and reviewed by the author’s Institutional Review Board (IRB Protocol #26-013). The survey was administered to students within a consistent instructional context with minimal to zero risk. The first survey, termed the "Exam Survey," concentrated on aspects pertaining to exam preparation and the experiences encountered during the examination period. The second survey, designated as the "Pre-Quiz Survey," investigated students' perceptions regarding pre-quiz practice, peer discussion, and the influence of music on their learning processes. The pre-quiz activities were conducted right before the quiz, for a duration of 20-25 minutes.

Participants and Data Sources

The participants in this survey were enrolled in a required upper-division, senior-level course within the major. The Exam survey results comprise responses from 31 of the 51 students enrolled in the course, whereas the Pre-Quiz survey results include feedback from 35 of the 51 students enrolled. Since the available data consists of aggregated summaries rather than detailed item-level responses, the analyses are descriptive, concentrating on reporting the proportions and counts explicitly outlined in the survey results.

Survey Content

The survey questions comprise both multiple-choice and open-ended questions, as summarized in Table 1 below.

Table 1a. Pre-Test Activities Survey

Questions No.	Questions	Responses Scale
1	The pre-quiz exercise before a test helps me feel more confident and recall information during the test.	Strongly Agree, Agree, Neutral, Disagree, Strongly Disagree

2	Discussing the pre-quiz exercise with peers deepens my understanding and supports collaborative learning.	Strongly Agree, Agree, Neutral, Disagree, Strongly Disagree
3	The pre-quiz exercise reduces last-minute panic and exam anxiety.	Strongly Agree, Agree, Neutral, Disagree, Strongly Disagree
4	I expect improvement in my test performance due to incorporating pre-quiz exercises.	Strongly Agree, Agree, Neutral, Disagree, Strongly Disagree
5	The pre-quiz exercise contributes positively to my overall academic performance.	Strongly Agree, Agree, Neutral, Disagree, Strongly Disagree

Table 1b. Music Preference and Study Environment Survey

Question No.	Questions	Response Format
6	Do you prefer listening to music while studying?	Always / Sometimes / Never / Other
7	How does listening to music affect your concentration during study sessions?	Helps / Distracts / No difference
8	Does listening to music before an exam help create a positive mindset?	Yes / No / Depends on type
9	Does listening to jazz music during exams affect your stress levels?	Significantly reduces / Mildly reduces / No effect
10	What genres help you feel relaxed during study time or exams?	Open-ended response

Table 1c. Exam Preparation and Anxiety Survey

Question No.	Questions	Responses Format
11	Do you have a structured study plan before exams?	Always / Sometimes / Never
12	Do you have trouble understanding certain course material before exams?	Frequently / Sometimes / Rarely/Never
13	Have you felt unsure about how to approach certain types of exam questions?	Frequently / Sometimes / Rarely/Never
14	Do you experience anxiety or stress during exam periods?	Frequently / Sometimes / Rarely/Never

15	How do you manage time during exams?	Allocate by weight / Pace but struggle / Run out of time
16	Do you receive guidance on study strategies (time management, active learning)?	Thoroughly / To some extent / Not at all
17	How do you identify and address knowledge gaps in your study routine?	Self-assessment/resources / Peer discussion / Do not address
18	Do missed classes or insufficient review contribute to gaps in understanding?	Significantly / Somewhat / Not really
19	What factors contribute to your exam-related anxiety?	Fear of failure / Time pressure / Lack of preparation / Other
20	Would relaxation techniques or counseling services help reduce exam stress?	Yes / Possibly / No

Analysis Approach

The author presents descriptive statistics, including counts and percentages, where applicable, and summarize qualitative “majority” statements when exact proportions are unavailable. To translate these findings into actionable instructional insights, the author mapped the reported student needs, such as anxiety, uncertainty, and lack of guidance, to evidence-based instructional practices like retrieval practice with feedback, exam wrappers, and explicit strategy instruction. This mapping is detailed in the Discussion section as a course-embedded intervention package.

Results

Exam Planning, Conceptual Uncertainty, and Anxiety

The table below summarizes key findings from the Exam Survey with 31 participants, as reported in the aggregated analysis

Table 2: Summary of findings from the exam survey (aggregated analysis)

Key areas investigated	Evidence from aggregated survey analysis of the Exam Survey with n=31
Exam planning	<ul style="list-style-type: none"> • 54.8% reported “they have a well-structured plan”. • 41.9% reported “they may have a plan”. • 3.2% reported “they never have a plan”.
Pre-exam conceptual difficulty	<ul style="list-style-type: none"> • Nearly 74% reported difficulties understanding certain topics before the exam.

Problem-solving uncertainty	<ul style="list-style-type: none"> • About 83% students reported being unsure of how to solve a particular problem.
Exam anxiety/stress	<ul style="list-style-type: none"> • About 58% reported feeling anxious or stressed during exams. • 42% reported sometimes or never feeling anxious.
Time management during exams	<p>Evenly split with nearly 42 % of participants each reporting</p> <ul style="list-style-type: none"> • allocating time based on score weightage and • trying to pace but struggling to complete the exam.
Guidance on time management	<ul style="list-style-type: none"> • Nearly 48.4% of the participants reported receiving proper guidance and time-management techniques. • 41.9% reported not receiving guidance • 9.7% remaining response options were not specified in the analysis.
Value of self-assessment	<ul style="list-style-type: none"> • Nearly 97% of the participants see self-assessment as a vital tool for tracking their study progress.
Impact of missing class	<ul style="list-style-type: none"> • About 58 % of participants reported that missing a class creates a gap between current and previous topics.
Perceived causes of anxiety	<ul style="list-style-type: none"> • About 80 % reported that Fear of failure and time pressure were identified as key reasons for exam-related anxiety.
Perceived support for stress reduction	<ul style="list-style-type: none"> • About 74 % of the participants indicated that counseling or relaxation techniques might help reduce exam stress.

Two noteworthy patterns emerge. First, despite most students reporting some level of planning, many still expressed conceptual uncertainty leading up to exams and encountered challenges in problem-solving. Second, exam anxiety was widespread, affecting 18 out of 31 students. The primary causes of this anxiety included a fear of failure and pressure from time constraints, factors that align with cognitive models of test anxiety, which highlight evaluative threats and the stress of time-limited performance [13],[14],[15],[16].

Pre-Quizzes Value Perception and Peer Discussion

The table below summarizes the key findings from the Pre-Quiz Survey with 35 participants, as reported in the aggregated analysis.

Table 3. Summary of findings from the pre-quiz survey aggregated analysis

Key aspects investigated	Summary from aggregated survey analysis, Pre-quiz Survey for n=35
Pre-quizzes and confidence	<ul style="list-style-type: none"> Nearly 77% of the participants strongly agreed that pre-quiz tests boost confidence for the actual exam.
Peer or group discussion	<ul style="list-style-type: none"> Nearly 84% of the participants strongly agreed that discussion with peers or in groups helps them gain knowledge and enjoy collaborative learning.
Reduced last-minute panic	<ul style="list-style-type: none"> Nearly 80% of students agreed that pre-quiz exercises reduce last-minute panic and anxiety.
Correcting mistakes	<ul style="list-style-type: none"> Nearly 80% participants agreed that pre-quizzes help correct mistakes, so they are not repeated in the final test.
Identifying what to prepare	<ul style="list-style-type: none"> Nearly 58% of the participants strongly believed pre-quizzes help them understand mistakes and identify what to prepare before final exams.

The evidence indicates that students overwhelmingly view pre-quizzes as invaluable resources, serving both cognitive and affective functions. Cognitively, they aid in diagnosing errors and guiding study strategies, enabling students to focus their efforts where needed most. Affectively, these assessments play a critical role in alleviating anxiety and bolstering self-confidence. Furthermore, the strong preference for peer discussion underscores the importance of social learning dynamics, which can significantly enhance the individual's understanding and retention of course material. Emphasizing these aspects not only showcases the multifaceted benefits of pre-quizzes but also highlights the vital role of collaborative learning in fostering academic success.

Music Use and Anxiety

The author has chosen jazz music for this research because its typically instrumental style, steady rhythms, and moderate tempos help maintain concentration without causing distraction. The author's personal experience and prior conversations with some of the former students hinted at this genre of music. Since most jazz pieces do not contain lyrics, they reduce verbal interference, allowing students to focus more effectively on reading and writing tasks.

In the pre-quiz survey, students provided insights into their use of music as a study strategy. Eighteen students noted that listening to music while studying occasionally enhances their focus. Approximately 66% reported that music aids their concentration during study sessions. Furthermore, 21 students expressed that listening to music before exams boosts their confidence and has a favorable impact on their performance. Lastly, the survey analysis revealed that jazz music has a mild effect in reducing anxiety.

Because this data reflects self-reported perceptions, it should not be interpreted as causal evidence that music improves performance or reduces anxiety for all students. Instead, the data highlights that a meaningful subset of students already uses music as a self-regulation tool and perceives benefits for focus and affect.

Discussion

The survey results, though descriptive, align with three widely observed realities in engineering education: (1) many students experience exam anxiety; (2) students often overestimate the effectiveness of passive review and underestimate the value of retrieval practice; and (3) students benefit when instructors make preparation expectations explicit and provide structured opportunities to practice under exam-like conditions with feedback. It was shown that background music can influence mood and arousal levels, which in turn affect cognitive performance and task efficiency [28]. Additionally, studies on music and cognitive function suggest that listening to complex, structured music may temporarily enhance certain types of reasoning and mental alertness [29]. Although jazz differs from classical music, it shares instrumental richness and structural complexity that can stimulate the brain while supporting a calm and focused study environment.

Interpretation of Survey Findings

Planning alone is not sufficient if students lack diagnostic information about what they understand and how to solve representative problems. The combination of reported conceptual difficulty (nearly 74%) and problem-solving uncertainty suggests gaps in knowing one's knowledge and knowing how to proceed in solving problems. Low-stakes retrieval practice can address both by requiring students to generate solutions and then compare their work to feedback, thereby improving both learning and calibration [6],[7],[8],[9].

Anxiety stemming from the fear of failure and time constraints highlights the necessity for enhanced performance practice. Utilizing practice exams and timed problem sets can help diminish unfamiliarity and uncertainty. However, to prevent heightened stress levels, these activities should be positioned as learning opportunities, be of low stakes, and offer prompt feedback. Additionally, providing explicit coaching on time management during exams may assist students in implementing effective pacing strategies and alleviating panic when faced with challenging questions [30],[31],[32].

The strong endorsement of peer discussion complements these mechanisms. Peer explanation can strengthen understanding and reveal misconceptions; in addition, group norms can reduce the stigma of confusion by making struggle visible and shared. Structured peer work, such as guided problem sessions, peer instruction questions, or short collaborative review following a pre-quiz, may therefore simultaneously improve learning and reduce affective threat [20]-[24].

Survey-Inference and Recommendations

Drawing on the survey results and existing research, we present a robust four-part intervention package that instructors must adopt in instructor-specific contexts. This package is designed to be modular, allowing instructors to implement one component at a time, assess its feasibility, and expand its use as needed.

- **Weekly and/or topic-level pre-quiz activities**

For retrieval practice, give short, low-stakes quizzes aligned with core learning objectives. Include 1-2 items from previous topics to encourage spaced retrieval. Provide prompt feedback, including solutions and common errors, and allow limited reattempts or "error-correction" submissions to prioritize learning over grading.

- **Structured peer discussion linked to pre-quiz activities**

After a pre-quiz, allocate 10-15 minutes for small-group discussion of selected items, focusing on reasoning and common misconceptions. Encourage teamwork skills such as facilitator, scribe, skeptic, or rotating prompts to support equitable participation. When possible, conclude with a brief whole-class debrief or a second individual attempt to combine collaboration with individual accountability. This may not be advisable for a large class size.

- **Explicit exam-strategy coaching and self-assessment tools**

Provide students with pacing heuristics, including first pass and second-pass strategies, as well as time checkpoints. Show them how to decide when to move on from a problem they are stuck on. Use exam wrappers or reflection prompts after each exam to help students link outcomes to their preparation. Encourage maintaining an "error log" to categorize mistakes, conceptual, procedural, algebraic, or misread, and connect them to targeted practice.

- **Optional stress-management supports and normalization**

Normalize stress as a common experience while distinguishing between productive arousal and debilitating anxiety. Highlight campus resources like counseling and workshops, and introduce brief relaxation techniques, such as 2-minute breathing exercises. Given mixed evidence on music, suggest it as an optional self-regulation tool: encourage students to discover what helps them focus, while cautioning against distracting music during complex tasks.

The table below allows the mapping of the survey to a flexible set of strategies that could be potentially effective.

Table 4. Mapping survey signals to a modular intervention package

Participants reported needs	Course-embedded response	Rationale
Uncertainty about concepts and problem-solving	Low-stakes pre-quizzes with worked-solution feedback; error-correction submissions	Retrieval practice and feedback improve long-term learning and metacognitive calibration [1], [6]-[10].
Exam anxiety is linked to fear of failure and time pressure	Timed practice in low-stakes settings; explicit pacing heuristics; exam wrappers	Anxiety can consume working-memory resources; familiarity and strategy coaching reduce uncertainty

		and cognitive load [14][15][16], [18][33][34].
Need for collaborative learning supports	Structured peer discussion, peer instruction questions, small group debriefs	Peer instruction and cooperative learning improve conceptual understanding and engagement [20]-[24], [35][36]
Desire for stress reduction supports	Brief relaxation strategies; referral to counseling; optional music experimentation	Stress-management supports and self-regulation strategies can reduce perceived threat; music effects are mixed and may depend on individual differences [25][26][27].

Practical Implementation

One may ask how to implement pre-quizzes without adding to their workload. Fortunately, there are several low-effort options: (a) auto-graded conceptual checks via a learning management system; (b) brief paper-based quizzes graded for completion, accompanied by posted solutions; (c) shared question banks with randomized parameters; or (d) student-generated question prompts curated by the instructor. Also, to avoid pre-quizzes becoming yet another high-stakes pressure point, one may suggest that grading be minimal, such as based on participation points, and feedback should take precedence. Similarly, peer discussions can be fostered through structured recitation sessions, in-class think-pair-share activities centered around pre-quiz items, or guided study groups. Even in large classes, instructors can utilize polling questions or worksheet-based group work to facilitate discussion.

Limitations

There are limitations to this study. First, while the results are based on self-reported perceptions, they lack direct measures of learning outcomes and validated test-anxiety scales. Second, the available data are primarily aggregated summaries, which restricts our ability to examine relationships among variables, such as whether students without plans report higher anxiety levels. Third, the surveys are specifically tailored to a certain instructional context and may not be universally applicable to all engineering courses. Lastly, some items within the surveys displayed partial reporting, such as when the categories were not fully specified, which may affect precision.

Conclusion and Future Work

This paper synthesizes two course surveys to characterize student-reported exam preparation behaviors and to explore perceived support for enhancing confidence and reducing anxiety. The findings reveal that while most students engage in some level of planning, many still encounter challenges such as conceptual uncertainty, hesitation in problem-solving, and exam-related anxiety. Students expressed strong support for pre-quizzes as effective tools for building

confidence and alleviating panic and recognized the value of peer discussions for collaborative learning. A subset of students also indicated that music, particularly jazz, aids in maintaining focus and reducing mild anxiety. Drawing from these perceptions and existing literature, we propose a modular, survey-informed intervention package. This package combines low-stakes retrieval practice, structured peer discussions, explicit coaching on exam strategies, and optional stress-management resources. Future work should focus on implementing and evaluating this package through learning outcomes, longitudinal measures of anxiety, and qualitative feedback from students to gain a better understanding of which components have the most significant impact on different students. The author is collecting more data for in-depth studies based on a large and diverse population. Such datasets will allow the author to examine the relationships among variables, investigate direct metrics between learning outcomes and validated test-anxiety scales. Overall, integrating pre-quizzes and promoting peer discussions should be prioritized in educational strategies to optimize student learning outcomes.

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