



Give me a coffee break! Pilot study on improving exam performance and reducing student stress

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Abstract

Traditional exams are widely used to assess students' acquired knowledge in engineering courses, and although traditional exams have a purpose and a role, it is also known that they bring different levels of stress and anxiety to students, which can result in an inaccurate reflection of students' knowledge or even poor performance. Although research shows this type of exam may not be adequate for all types of students, little is known about how to improve traditional exam assessment experiences. This pilot study aims to design an intervention—a coffee break during an exam—to help reduce students' stress and anxiety levels and improve their exam performance. To assess the intervention, the authors used a qualitative approach to learn about students' perceptions of the impact on their stress levels of including a coffee break in the exam. Open- and closed-ended questions were conducted during four phases: the days prior to the exam, and during the examination—before, during, and after the coffee break. Results of this pilot study suggest that introducing a coffee break during a traditional exam lowers students' levels of stress, reduces their fear of failure, and improves students' performance. The authors discuss the possible factors driving the results, next steps and explore the avenues academia could take to form better assessment methods. Implications for research and practice are provided.

Introduction

Traditional exams are widely used by instructors to assess that students have enough knowledge to pass onto the next stage, avoiding the risk of having external factors that might help students excessively [1]. A problem of traditional exams is that they can generate an excess of stress and anxiety on students, reducing their academic performance [2]–[5]. It is common to have students complain after exams, explaining that their performance was bad because their minds went blank [1]. However, for engineering students, most of the exams are traditional (individual, time-limited, closed-book). This is even the case in post-graduation exams such as the fundamentals of engineering and the professional engineering exam [6].

From early courses (e.g., math, chemistry, physics) in engineering programs, students are evaluated by individual work and tests [7]. This trend is common regardless of the location. A previous study has concluded that engineering students have similar perceptions of culture despite their country [8]. Many students report feeling academic stress at some point in the semester; a great number of them agree that studying for exams is the biggest source of stress and anxiety, especially when there is a grade competition or a large amount of theory to master in a small amount of time [9].

Alternative ways to measure the students' knowledge and understanding have been proposed. A previous study concluded that visual representations have many benefits on engineering students' thinking, and the findings highlight the creation of assessments that include visualizations [10]. Another type of active learning is the charrette process, a role-playing activity that involves the students with their field of study and helps them to visualize its application [11], [12]. It can be said that an instructional approach can promote the mindset of students and help them to improve their performance in class [13], [14]. However, even if students can learn in a better way, their performance in an exam may not reflect such learning due to stress. Stress has proved to be negative for a student's performance during exams, and traditional exams generate large amounts of stress, including anxiety in some students.

New alternatives to adapt final examinations have been proposed, such as providing choices among questions, take-home examinations, reducing time pressure (increasing the time limit), and open-book exams, but these still require further research [1], [15]. The following section presents a literature review about traditional exams, stress and anxiety produced by this type of examination, and its relationship with students' performance. First, some definitions such as traditional exams, stress and anxiety are explored. Then the definitions are expanded to make a relation between traditional exams, stress and anxiety. Finally, the authors present current efforts that aim to reduce stress and anxiety in students.

Background

Traditional exams are used to engage the student with the course content and to evaluate students' knowledge, but they also can evoke negative feelings such as fear and anxiety. These effects are common in traditional exams [15], [16]. Traditional exams are generally defined as a set of questions and problems that require individual, closed-book, and time-limited work. [17], [18]. Traditional exams are used since they fulfill the twelve principles for enhancing students' learning such as to be learner centered, focus on student outcomes and critical content, use fair testing and grading procedures, incorporate active cooperative learning into the class, and others [19]. Other traditional ways to evaluate the knowledge of students are presentations, projects, summaries, etc. All of them help to measure their knowledge, but they are similar to traditional exams in structure and purpose [15].

The most famous example of a traditional exam is “the midterm and the final exam,” a classic assignment in the middle or at the end of the course with a significant percentage in the final grade [20]. In Grand View University in Iowa, many students used the phrase *dead week* referring to the week before final exams. Some of them using this term describe how they feel during that week [21]. In a previous study, over 296 static course students proved that traditional time-limited exams can generate stress and anxiety; some students had worse performance than students who were unaffected by the time factor in the exam [6]. Moreover, most of the students in this research agreed that time-limited exams are harder than other types of exams, even those students who assured not being affected by the time limit.

Time-limited final exams are widely used in academia due to schedule time constraints. However, even if the effects may produce anxiety, some researchers do not support the idea that increasing time or giving students unlimited time could increase students’ scores [22]. Even if increasing time can reduce anxiety and stress, this modification on traditional exams can cause negative effects on students such as changing answers due to insecurity and second guesses. [6]. These effects prevent achieving the goal of an exam, which is to determinate the knowledge and understanding acquired by students throughout the course. In any case, the statement that exams are a source of stress and anxiety is recurrent.

Stress is a term used to describe a set of physical and psychological responses produced by the perception of a dangerous or challenging situation [23]. Perceiving psychological stress is nowadays an important factor to determinate individual performance [24]. Exams generate stress on students, although a little degree of stress is normal and can be a good thing to incentivize students to perform well [1]. However, for some students, that situation presents serious problems related to stress during examinations, affecting their performance and scores. Some effects of excessive stress during exams are mental block, blank mind, lack of concentration, excessive time dedicated to just one question, thinking about other things, procrastination, etc. [1], [25]–[27].

Many researchers have proved that stress can cause poor performance in some students [1], [6]. An important reason for stress during examinations is the fear of failure [28]. The fear of failure was used as a tool to incentivize students to improve their performance, study habits, and prepare for exams. However, there are certain groups of students that cannot deal with the anxiety, and the fear of failure has an opposite effect on their performance due to high levels of stress. Excessive stress reduces the functionality of some cognitive functions such as memory, attention, problem solving, and information processing [29]. All these cognitive functions are crucial to have a good performance on exams. Some researchers have shown that 60% of highly stressed students during exams will fail [30].

While high levels of stress and anxiety during exams happen to some students, it does not apply to all of them, and the stress levels can differ for different groups of students.

For example, low-score students are more likely to suffer from examination stress, since their previous experience of failing exams makes them more anxious [1].

Since stress and anxiety can reduce the performance of some students, affecting the purpose of the examination, alternative methods to alleviate stress and anxiety are under study, such as providing choices among questions [31], take-home examinations [1], space for comments on some test items [31], reducing time pressure [1], and open-book exams [15]. These methods can be used during exams to reduce stress and anxiety in students; however, more research needs to be done to determine if these methods help students with high stress.

Previous investigations determine the benefits of alternative examinations such as the examples described above, finding that certain types of formats (such as open-book exams) promote critical thinking, problem-solving, and reflection since the need of memorization is not part of the exam [18], [32]. Moreover, open-book exams also have a big impact on student emotions and psychological thinking; they minimize anxiety and raise confidence [33], [34]. Many students said that they feel less anxious and more relaxed during open-book exams because students feel a sense of calm and more control of the situation, which has a positive impact on cognitive functions [34].

Many investigations have analyzed alternatives to traditional final exams with the purpose of reducing stress in students. For example, the University of Wisconsin studied the effect of making the comprehensive engineering exams optional to students, and this approach reduced stress on students [35]. Another faculty decided to switch the final exam to a group test, and they found that students' opinions were varied [36]. An interesting alternative to the final exam is the "Epic finale" [37]. This technique consists of implementing a memorable learning experience at the end of the courses, motivating students to remember, and thinking after the class has finished [38]. This approach has proved to be positive for engineering students; they assured that this method builds engineering identity, promotes research, creativity, and critical thinking, gives memorable feelings about the course, and most importantly reduces stress [39].

The "group exam" is another alternative to assess students' learning where students contrast their knowledge within a group to solve the exam [40]. The group exam seeks to increase cooperative learning among students and to reduce stress levels that traditional exams cause [41]. In group exams, the knowledge the group shows is at least the same as the more knowledgeable member of the group. If a traditional exam were to be used in a group exam, students with less knowledge would benefit with a higher score without the equivalent learning [42], [43]. We focus on traditional exams and how the coffee break still allows students to be tested on their individual knowledge.

New alternatives to the traditional exam are being investigated; however further work needs to be done. This paper tests the influence of a coffee break during a final exam on student's stress levels. The research design uses a qualitative analysis (closed- and

open-ended surveys) to learn about student perception about their stress levels and performance when having a coffee break in an exam.

Research Objective

The objective of this research was to pilot-test the influence of a coffee break on students' performance during traditional midterms or final exams. The purpose of this study was to help students reduce stress and anxiety levels (i) the days before the examination, knowing they would have a coffee break, and (ii) during the examination. This article presents the responses of the first pilot of assessment validation.

Methodology

The first part of this exploratory study, which is reported in this article, uses a qualitative approach [44]–[46] to measure the cognitive performance among civil engineering and architecture students. The data was collected during the Spring 2022 semester with students from the engineering Statics courses (n=28, n=27 students), and from two architecture courses Structures-2 (n=23, n=21 students) to a total sample size of n=99 students. For the case study, the researchers conducted a survey with the students participating in the experimental and the control groups of the study (n=99 students). The survey contained both closed- and open-ended questions. The instructor randomly assigned the students to the control group (traditional exam) and to the experimental group (coffee break exam). The survey aimed for students to self-report their feelings and state of being during the days leading up to the examination. The survey also aimed to understand their self-reported feelings and state of being during the examination in all phases—before, during and after the coffee break.

Data Analysis

The unit of analysis for the case study [46] consisted of the days leading up to the examination and to the moment when the examination itself ended. The surveys were administered using Qualtrics software and cleaned up in the Excel software. The answers were coded for evidence of how the coffee break influenced students' feelings and well-being prior to the exam, and how they thought it helped them to improve their performance. Students' answers were coded for content analysis—using a-priori and emerging codes—following Saldana's [47] and Yin's guidelines [48]. The codes were grouped by overarching themes.

The sets of questions were divided into four phases. The first set of questions were open questions that asked about the students' feelings and psychological status the days prior to the exam, and the influence on their stress and wellbeing of knowing they would have a 15-minute coffee break to discuss anything with their classmates. The second set of questions referred to their feelings during the first 45 minutes of the exam, before having the coffee break. Did they feel anxious? Did they have problems concentrating

on the test? Did their minds go blank? Did they experience a mental block reading the questions? And if so, explain.

The third set of questions inquired about their feelings during the coffee break. These questions were related to how useful it was to mingle with classmates in the middle of the exam, and if they were able to help their peers, and how. The fourth set of questions referred to the time of the exam after coming back from the coffee break. The questions inquired about their feelings after returning from the coffee break, if they were more comfortable and confident after the break, or if they felt anxious or could not concentrate. Other questions asked if they were able to recover from any stress felt during the first part of the exam, or if the coffee break negatively impacted their concentration. For the control group—students who took a regular traditional exam—the questions were similar to those corresponding to the first and second stages for the other group, plus about their perception of performance during the test.

The exam characteristics

All courses reported in this study had the same instructor who designed the exams. The exam that was implemented for the two engineering courses and for the two architecture courses had the same set of questions in terms of difficulty, pedagogy, solving approaches, and themes. The exams consisted of six multiple choice questions and three problem-solving questions. To prevent cheating, three different versions of the exam were implemented; the questions were similar but with subtle differences such as changing small items and values so students could not have the same answers. Before starting the exam, students were informed about the different versions of exams, warning them that they would not have similar answers to their classmates.

The exam rules were the following: students were allowed to have a pen, pencil, eraser, ruler, calculator, and a non-alcoholic drink; those were all the materials they would need for the exam. Everything else would be put away in the student's backpack, which had to be closed at all times during the exam. Cellphones were not allowed; they had to be turned off and put in the backpack, not in the pockets of students' clothes. The professor assured that all these rules were explained to the students before the exam.

The exam was divided into three parts. In the first part, students took the exam for 45 minutes, and they had to be quiet and follow all the rules mentioned above. After these 45 minutes, they had a 15-minute break in another room where they had water, juice, coffee, cookies, and chips. During this time students were allowed to talk about anything (including the exam), but they were not allowed to bring anything from the exam room, and they were not allowed to write down anything. Finally, they returned to the exam room and finished answering all the questions. The time limit to complete the exam after the coffee break was 60 minutes.

Results

Students who participated in the exam with a coffee break

In this section the authors reported the qualitative results obtained in the pilot study. The students who participated in the coffee break exam reported that all four phases of the exam (days prior to the exam, the beginning of the exam, the coffee break, and the last part of the exam) were useful to improve students' performance and reduce their stress caused by the exam. The following table summarizes the results:

Phase of the Coffee Break Exam	Coffee Break perceived benefits
Phase 1: Days prior to the exam (2-3 days)	<ul style="list-style-type: none">- Reduced feelings of stress and anxiety- Calmed down student's mind
Phase 2: The first part of the exam, before the coffee break (45 min)	<ul style="list-style-type: none">- More clarity to understand the exam- Feelings of calm and tranquility
Phase 3: The coffee break (15 min)	<ul style="list-style-type: none">- Recharge energies- Clear their minds from stress- Feelings of self-confidence after advising classmates- Conflicted to hear multiple approaches to solve the exam questions
Phase 4: The last part of the exam, after the coffee break (60 min)	<ul style="list-style-type: none">- Cleared minds- Reduced stress- More confidence that the exam went well- Confused to not know which approach was right

Table 1: Self-report answers of students who had a coffee break exam

For the first phase, student self-reported answers stated that the anticipated coffee break reduced stress and anxiety on students. For example, one student stated, "I felt calm and less nervous of a possible mind block. I knew that in the break I could clear my mind, and if I did not understand something I could leave it for the break." Also, students knowing they would have a break experienced calmer mind: "I felt less anxious, I was not confident, but the coffee break helped me to feel calm because maybe someone could help me to be confident about my knowledge and my answers."

For the second phase, student self-reported answers suggested the coffee break helped students to understand the exam questions and go through the exam with calm and tranquility. One student reported, "I felt that I could focus more on the statements because I knew that if I had a doubt my classmates would be there to help me, so I felt less stressed and anxious." Another student said, "I was calm during the exam because the coffee break would reduce the pressure of the exam, to help me clear my mind. That helped me focused and go through the exam."

For the third phase, student self-reported answers suggested the coffee break helped students to recharge energies and clear their minds from stress. One student reported, “The coffee break was good. I talked to friends and laughed, which helped me to calm down and recharge energies for the second half of the exam.” Students also reported that being able to advise their classmates brought them confidence in their own work. For example, another student said, “I could help my classmates. When we compared answers and procedures, I felt sure about my answers.” Finally, there were conflicting answers regarding the fact that multiple answers/approaches to solve a problem were discussed during the coffee break. While one student reported, “Hearing that my classmates were solving the problems with different approaches and answers made me feel less confident about my solutions,” another stated, “Everybody was giving opinions and ideas about the most difficult question. It helped me to feel calm from the test and distracted from its pressure.”

Finally, for the fourth phase, student self-reported answers suggested that the coffee break helped students to finish their exam with a cleared mind and reduced stress. For example, one student stated, “I felt relieved; when I compared answers with my classmates, I knew that I was doing well so I could finish the exam.” Another student said, “I felt a considerable reduction of stress. In a traditional exam you feel alone, and nobody can validate your work. Knowing that everybody has similar answers and procedures gives you tranquility.” Few answers showed that the coffee break was not useful for those students who were not prepared for the exam. For example, one student said, “I left some questions blank. There were some parts where I didn’t remember what to do even after asking my friend during the break.” Another student said, “I lost a lot of time trying to understand what my classmates said. Not knowing which approach was right brought me even more stress.”

Students who participated in the traditional exam (without a coffee break)

In this section the authors report the qualitative results obtained in the pilot study from the students who did not participate in the coffee break. The students without a coffee break were asked about their status before and during the exam. The following table summarizes the results:

Phase of the Traditional Exam	Types of answers
Phase 1: Days prior to the exam (2-3 days).	- Feelings of stress and anxiety - Harder to study
Phase 2: During the exam, NO coffee break (105 min).	- Mental block - Blank mind - Lack of concentration
Post Exam	- Relief but remorseful about the exam - Thinking a coffee break would have been beneficial

Table 2: Self-report answers of students who had a traditional exam (without a coffee break).

In the first phase, many students reported feeling stressed and anxious the days before the exam. One architecture student said, “I felt very stressed because I thought that I didn’t master the topics of the exam and it made me feel nervous.” Another engineering student stated, “I am bad at math, so it makes me nervous to be tested under pressure of time. These feelings make studying harder, and many topics are confusing to me”. Furthermore, an architecture student said, “I was very stressed, which added to my anxiety problems... I felt really bad the days prior the exam.” Students mentioned feeling stressed, nervous, and anxious prior to the exam, and that those feelings affected their ability to study.

In the second phase, the students without a coffee break experienced many of the symptoms related to the stress and anxiety caused by traditional exams such as mental block, blank mind, and lack of concentration. An engineering student said, “I was nervous, I had the impression that I was missing something in my study, and, during the exam, I got stuck in an exercise.” Another engineering student also confirmed, “I was very anxious. I don’t like exams. I was nervous and I didn’t remember the formulas and procedures.”

Other problems were also found such as post-exam stress, regret, and insecurity about answers. An architecture student explained his feelings after the exam: “I felt relieved and regretful. There were many parts where I was unsure about my answers, but I also think that the procedure was clear.” And an engineering student said, “I left one question blank that I could not understand, and also because I wasted too much time in the other questions.”

Students who did not participate in the coffee break exam reported feeling stressed and anxious, affecting their performance. They also claimed to have problems during the exam such as mental block, blank mind, lack of concentration, etc. These students were asked whether something would have been different if they had had the coffee break. An engineering student affirmed, “It would be much better because during the break I could identify the parts that I made a mistake and also it could help me to be calm.” An architecture student said something similar: “I think it could have been better, maybe because I could talk about things that I didn’t remember during the exam and also to confirm my answers and be sure of them.”

Discussion

Students fall under pressure on traditional exams, and their performance suffers, limiting the accuracy of the learning assessment [5]. A coffee break during the exam aims to advance knowledge of how to adapt stress dissipates in traditional exams both before and during the exam. Many students affirmed that the exam with a coffee break was less stressful than the traditional exam without one. Also, students reported that the

natural stress they felt with an exam was reduced and dissipated during the first part of the coffee break exam because they knew they would be able to interact with their peers during the exam.

Students were able to focus better and feel calmer during the days leading up to the exam, since they knew they would have a coffee break where they could discuss any topic, including questions that could help them unlock those specific items that may have been holding them back. This effect also occurred during the exam, both before and after the coffee break; students felt more relaxed and confident. However, this was different from a group exam, since the students had to solve the problems individually; their classmates could not do the exam for them. For instance, one of the students said that he could not complete the test even after the explanations received during the coffee break because he couldn't remember exactly what to do. This shows a big difference when compared to a group exam, which may be more appropriate for a different examination pedagogy design.

This modification of the traditional exam did not help students who did not prepare well for the exam in the first place, since they could not receive a full explanation and solution of a problem during the coffee break. This break is useful only for students who know the contents but are stuck in one part. The coffee break can also help to evaluate students' knowledge since having a student who can explain the part where he is stuck and can understand a simple explanation of how to proceed means that the student has a good understanding of the material and may simply be experiencing a momentarily blocked mind. In the same way, the student who can understand someone else's issue and can provide an explanation on how to proceed shows a command of the course material. Many students affirmed that they helped and were helped by their classmates, and most of the time they compared answers and procedures between themselves.

Students from the coffee break exam seemed less anxious and more confident during the exam. This reduction in stress and anxiety is because they felt there was an "insurance," meaning they knew that if they got stuck in a problem, they could ask their classmates during the coffee break so they could continue with the following questions. This perception reduced the pressure derived from the fear of failing questions on the exam [25]. Of course, the student had to have some/high level of understanding because they could not get a full answer during the break. The coffee break exam was a good way to reduce the fear of failure due to the possibility of comparing their answers, approaches to solving the exam problems, and the reasoning of the solution, which strengthened their individual knowledge, thus reducing their fear of failure.

The coffee break exam has similar benefits to the open-book exam, since students feel calmer and in control of the situation, reducing their stress and anxiety [31]. In the open-book exam, they know that if they forget something, the book is there to help. In the same manner, in the coffee break exam the students know that if they forget

something or experience a mental block, their classmates will be there to help during the break.

Many students from the control group (students without a coffee break) claimed to have experienced stress and anxiety the days prior to the exam. Most students from this group affirmed that this was a challenge to study, although they were used to it. The main problem came during the exam where their stress and anxiety affected their performance. Many reported to be unsure about their answers and knowledge, spending too much time on one question, generating feelings of fear of failure and stress because of the limited test time [5]. This stress and anxiety also made them forget what they had studied and affected their concentration [25][26]. Finally, this group reported interest in participating in a coffee break as they perceived it to be beneficial to their stress and exam performance.

This study is the first approach to a traditional exam with a coffee break, but more data and tests need to be collected and analyzed to have a better understanding of these types of exams. Research monitoring students' cognition and their conversations during the coffee break will be conducting in the upcoming year. This study also aims to learn and develop guidelines on how to design engineering exams that include a coffee break.

Conclusion

Traditional exams are widely used nowadays, so it is important to improve their pedagogy. Many factors can interfere with students' performance in this type of examination, causing the evaluation grade and the acquired knowledge to be misleading. This study focused on the introduction of a coffee break to improve students' performance and reduce levels of stress and anxiety caused by traditional exams. Students self-reported that having a coffee break during the exam seemed to improve their performance and reduce stress and anxiety levels. These outcomes can be due to eliminating the fear of failing questions, which reduces anxiety effects such as mental blocks, blank minds, lack of concentration, and excessive time dedicated to just one question. However, students who did not prepared and study for the exam did not perform well even with the coffee break, showing that the coffee break does not help students without knowledge of the course contents. It was observed that students without a coffee break presented all these problems related to stress and anxiety, as well as their implications during the exam, which confirms the theory presented in the background about how stress and anxiety can affect students' performance. This study seeks to pilot this explorative research that aims to better understand students' cognition during the exams and how some modifications and interventions (such as the coffee break for this study) can help to improve the exam experience. Another goal of this study is to investigate a new pedagogical design of traditional exams to make them easy to implement for professors.

Future Work

This paper reports the findings of the first part of this exploratory study. Currently, the team is working on validating the set of questions and analyzing quantitative data that compares students' scores in exams with and without a coffee break. This includes the past four years of results. This exploratory study opens a path for future work on understanding the physical cognition process of students during exams with and without a coffee break. We plan to apply head sensors that monitor brain blood flow to better understand how a coffee break impacts students' performance and cognition. Furthermore, we plan to record the conversations that occur between students during the coffee break, analyze them, and apply them to improve teaching pedagogies and assess design. Finally, we plan to start incorporating coffee break exams across multiple instructors in the same engineering course as well as diverse types of engineering courses to build guidelines that allow incorporating coffee breaks—and aligning interventions—to improve the effectiveness of this type of exams.

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