

The Effects of Meditation on Test Anxiety Levels Among High School Students

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ABSTRACT

Important exams often cause increased test anxiety in high school students, which further negatively affects their learning and academic performance. The practice of mindfulness meditation guides one to focus on the present moment, allowing them to calm their mind and concentrate at the same time. Although several studies have previously been done on meditation, mental health, and test anxiety, no research has specifically examined the effect of meditation on reducing test anxiety for high school students. This study analyzes the effects of meditation on mindfulness and test anxiety among students in two honors (accelerated) Algebra 2 classes ($n = 60$). Over the course of two weeks leading up to the final exam, all students followed a guided meditation program, requiring them to practice five-minutes of meditation during every class period and every night before they went to sleep. A pre-post survey design was adapted from the Mindfulness Attention and Awareness Scale, Westside Test Anxiety Scale Validation, and the Test Anxiety Inventory for Children and Adolescents. After participating in the meditation program, 75% of all the results comparing the pre-meditation survey to the post-meditation survey depicted significance ($p \leq 0.05$). These results reveal that there was a significant improvement in the students' mindfulness, as well as a significant reduction in test anxiety. Furthermore, those who meditated both in class and before bed tended to exhibit better and more significant results than those who only meditated in-class.

Introduction

As summer approaches, so does the last week of school filled with final exams, which serves as a major source of stress and anxiety among high school students. A study examined the prevalence and treatment of mental health issues, such as depression and anxiety, in recent years. According to data from the National Survey of Children's Health, around 7.1% of children aged 3 to 17 years old experience anxiety; although this percentage may seem small, it represents approximately 4.4 million children across the United States. Furthermore, 40.7% of those with anxiety problems did not receive treatment within a year (of diagnosis), which was shown to negatively affect condition severity and possibly lead to the development of further mental disorders (Ghandour et al., 2018).

Test anxiety is a specific type of anxiety that gives rise to physical symptoms, as well as emotional reactions due to distress, nervousness and insecurity about upcoming exams. As pressure to do well in school is increasing, especially around the San Francisco Bay Area in California, high school students feel that they are required to achieve superior grades because they play such an important role in the students' self image and college applications. The problem of test anxiety is further worsened as poor results previously would interfere with the preparation and performance on upcoming tests.

Practices that help with test anxiety, such as exercise, eating habits, time management, therapy, and medications, have been recommended previously. Another rarely discussed method to help ease test anxiety

could be meditation. The history of meditation spans thousands of years, beginning in Eastern traditions, focusing on the concept of consciousness and helping to calm one's thoughts (Goleman, 1976). This practice focuses on "mind and body integration" and involves maintaining mental focus on a particular sensation, such as breathing, a sound, or an image. Meditation also incorporates mindfulness: the awareness of oneself and their environment at the present moment, free of judgments, enhancing one's mental well-being (National Center for Complementary and Integrative Health, 2022).

As the current vice president — and projected president — of the Meditation Club at the high school where this study was conducted, I, along with the current president, lead guided meditations once every week. Following each meditation session, all members and officers would discuss their mental states, and compare how they felt before to how they feel after the meditation. I strongly feel that practicing meditation on a habitual basis has led to a more calm, yet focused mindset. These beneficial results were not only evident for myself, but were also shown in the opinions of many members of the club. For example, people have felt they "overall could control [their] emotions better and stay calm", have "better focus when studying", and developed "a more opened mindset" in their lives. One specific member shared that, throughout her attendance in meditation club meetings, "it felt kind of awkward at first, but I got used to it, and doing it really helps to lower my stress and anxiety".

In view of the overall success of the Meditation Club regarding students' mental health, I planned out a two-week meditation program, implemented in this research project, that would give students some breathing space before an intense week of final exams from all their classes. Short surveys were given out through Google Forms to every student in the selected sample of Algebra 2 Honors students before and after the program; the data collected from these would help evaluate the effects of mindfulness meditation on everyday mental well-being and test anxiety levels in high school students. Furthermore, the program does not only help these students ease anxiety levels during final exams, but it would also help to fill in the gap in literature for this specific topic. Due to the significant results of this research study, implementing similar meditation programs for more classes in the future could greatly help students struggling with test anxiety.

Literature Review

From recent literature published regarding the effects of the COVID-19 pandemic in the United States, it was found that 36% of students sampled from a public high school in New York exhibited moderate to severe anxiety symptoms (Yin et al., 2022). Anxiety was found to be one of the major factors associated with burnout and emotional exhaustion — tolls on mental health that dramatically increased after the onset of the pandemic. (Lluch-Sanz et al., 2022).

More specifically, test anxiety has become more prevalent among students, with approximately 40% of high school and college students having reported experiencing some form of this mental health issue, and around 10% reporting high levels of it (Ross & Driscoll, 2006). This conference was held well over a decade ago, but its data remains true today, as anxiety becomes an ever more prominent issue after the pandemic, with increasing efforts among students to perform well academically in competitive schools like those in the San Francisco Bay Area. Apart from this conference, according to a study that was done to assess test anxiety among first-year undergraduate health science students in University of Gondar, the prevalence of test anxiety among the students was 54.7%, primarily due to general psychological distress and their field of study (Hanfesa et al., 2020). These past results from previous research seem to correlate with the data collected from my study. Based on the responses from a 5-point Likert scale survey conducted before the meditation program (specifics of survey are further described in Methodology - Measurements section), approximately 63.3% of the students of the sample claim that they either agree (4) or strongly agree (5) with the statement, "I get stressed before tests", and around 45% responded 4 or 5 to the statement, "I worry so much before a major test that I am too worn out to do my best on the test."

It is important to note that during the process of reviewing published literature, it was found that there exists a concept of “mathematics anxiety”, which is defined as test anxiety that specifically arises in situations involving mathematics. However, research that employed correlational factor analysis generated results suggesting that math anxiety and test anxiety were likely non-distinct concepts (Kazelskis et al., 2000). On account of this, mathematics anxiety was considered under the broader term of test anxiety for purposes of this research project.

While no studies so far have examined the effects of meditation on test anxiety for high school students, certain articles about the effects of meditation and test anxiety, as separate constructs, have been analyzed to gain a better understanding of this research topic. For example, Rehman and other researchers studied the effects of test anxiety on a student’s academic achievement at a secondary school in Pakistan. The sample consisted of 840 students randomly selected from 30 different secondary schools in a district, who all took the 20-item Test Anxiety Inventory Questionnaire adapted and translated into Urdu for the study. The findings reveal that test anxiety and academic achievement have a negative relationship, so the higher levels of test anxiety result in lower test scores (Rehman et al., 2021).

Moreover, a different research paper by Fleishmann and Posner studied the effects of meditation on mindfulness and memory. This study sampled students from a high school in Hartford county, and it used a pre-post survey design, along with a control group (randomly assigned), to determine whether meditation benefits one’s mindfulness and their working memory capacity. For seven consecutive days, the experimental group followed a five minute guided meditation by Diana Winston, a Professor at the UCLA Mindful Awareness Research Center. On the other hand, the control group was required to run for 10 minutes every day throughout the week. Both the experimental and control groups took the Human Benchmark Memory Test and the Mindfulness Attention Awareness Scale before and after a week of meditation or running. This study ultimately produced significant results, with data depicting that mindfulness of the meditation group increased by an average of 0.8 points, while mindfulness of the control group increased by 0.03 points. Additionally, memory test scores increased by an average of 40.3% for those who did daily meditation, compared to 8.3% for those in the running control group (Fleischmann & Posner, 2020). The resulting increase in mindfulness seems to agree with similar outcomes of my study, in which participating in meditation also led to an improvement in one’s mindfulness. While Fleischmann analyzes the results based on averages of the data collected, my analysis of the data had a different approach through calculating the percent change and p-values from t-tests to determine significance and compare the pre- versus post-meditation survey responses with each other (specifics of analysis are further explained in Results - Methods of Analysis section).

From reviewing literature, a lot of previous research has been done on how test anxiety negatively impacts test performance, and how meditation improves mental health, focus, and memory; however, so far, there has been no studies revealing the impacts of meditation on test anxiety specifically for high school students. A research question was accordingly formed: How does two weeks of recurring meditation affect levels of mindfulness and test anxiety among high school students in a relatively competitive environment? It was hypothesized if such a meditation program was implemented for these students, then there would be an improvement in their degree of mindfulness and reduction in their test anxiety levels because meditation helps with lowering stress and calming the mind.

Methodology

Sampling

For participation in this research project about the effects of meditation on test anxiety, a high school in the San Francisco Bay Area was chosen due to its proximity to and strong relationship with the researcher, along with the number of students willing to participate in the study. A total of 60 students, who were currently taking the

Algebra 2 Honors class, were selected. Grade levels of those sampled included freshman (ninth grade), sophomores (tenth grade), and juniors (eleventh grade); 55% of the students identified as female, 41.7% identified as male, and the remaining preferred not to say.

Measurements

Three revised scales, adopted from professional literature, were employed in this study and combined into a 16-item survey with questions that use a 5-point Likert-type scale, ranging from 1 being strongly disagree to 5 being strongly agree. These measurements were used because they have been cited hundreds of times, and their consistency and validity has been proven to be high from numerous studies. It is also important to note that the scales were revised and edited to better fit the context of the study.

Six questions about mindfulness in general were taken from the first scale as follows. The Mindful Attention Awareness Scale (MAAS) is a 15-item scale that assesses different aspects of mindfulness, attention, and various conscious states of the mind. A study using this scale used confirmatory factor analysis on the data collected from a sample of college students, resulting in a high internal consistency of 0.82 (Brown & Ryan, 2003). It would be important to note that in this measurement, the questions survey “non-mindfulness” or the “non-mindful” aspects of daily experiences, for example, unconsciousness of one’s emotion, difficulty focusing on the present, etcetera. Accordingly, when it is mentioned that there is an improvement or increase in mindfulness levels, a reduction or decrease in these non-mindful aspects is also implied. The questions for this portion of the meditation program survey were not modified from the original MAAS, nor were they altered in any way for the post-program survey. The full table of all six questions are shown below:

Table 1. Measurements for mindfulness

Citation (Author(s) last name, Year)	Original Item Number	Survey Item Number	Keyword(s)
Brown & Ryan, 2003	1	1. I could be experiencing some emotion and not be conscious of it until some time later.	Unconscious emotion
"	3	2. I find it difficult to stay focused on what’s happening in the present.	Difficulty focus
"	5	3. I tend not to notice feelings of physical tension or discomfort until they really grab my attention.	Unconscious tension
"	9	4. I get so focused on the goal I want to achieve that I lose touch with what I’m doing right now to get there.	Lose touch
"	13	5. I find myself preoccupied with the future or the past.	Preoccupied
"	14	6. I find myself doing things without paying attention.	Inattention

To measure test anxiety for high school students, two well-known scales were utilized, and six test anxiety-specific questions were adapted from the following scales. The Westside Test Anxiety Scale Validation (WTASV), a 10-item scale, helped to identify students experiencing test anxiety and those who could benefit from interventions aiding the reduction of it. With a rather high coefficient of validity of 0.44, this has been shown to be a reliable and valid measure of test anxiety across a wide range of different population samples (Driscoll, 2007). The second measurement utilized is the Test Anxiety Inventory for Children and Adolescents (TAICA), a 45-item measure that accesses anxiety and cognitive states that can negatively impact performance. With a volunteer sample of 206 children and adolescents, their TAICA scores were examined, and results indicate that TAICA scores had strong to very strong ($r = 0.70-1.00$) internal consistency, reliability, and validity. (Lowe et al., 2008). The combination of both test anxiety scales creates a multidimensional measure that includes a total test anxiety scale, facilitating test anxiety scale, lie scale, and four debilitating test anxiety subscales (cognitive obstruction, inattention, physiological hyperarousal, social humiliation, and worry). In the meditation program survey, the total test anxiety scale, cognitive obstruction, inattention, social humiliation, and worry subscales were utilized to better fit the context of high school students.

The questions for this pre-meditation program survey were modified from the original two test anxiety scales; they were also altered in the post-meditation program survey to suit the context of final exams. Additionally the researcher and her advisor had also come up with four questions to assess stress and nervousness levels of students, which do not have anything in their “citation” or “original item” cells. The full table of all ten questions are shown below:

Table 2. Measurements for test anxiety in pre- and post-meditation surveys

Citation (Author(s) last name, Year)	Original Item	Modified Item in Pre-meditation Survey	Modified Item in Post-meditation Survey	Keyword(s)
-*	- (total test anxiety)	1. I get stressed before tests.	1. I was stressed before the final.	Stress
-	- (cognitive obstruction)	2. I make mistakes on tests because I am too nervous.	2. I made mistakes on the final because I was too nervous.	Nervous mistakes
-	- (inattention)	3. I make mistakes on tests because I am not careful enough.	3. I made mistakes on the final because I was not careful enough.	Careless mistakes
Driscoll, 2007	1. The closer I am to a major exam, the harder it is for me to concentrate. (total test anxiety)	4. The closer I am to a test, the harder it is for me to concentrate on the material.	4. The closer I got to the final, the harder it was for me to concentrate on the material.	Concentration difficulty
Lowe et al., 2008	10. I forget the material I know when taking a test. (cognitive obstruction)	5. I forget material that I've learned when taking a test.	5. I forgot material that I've learned when taking the final.	Forget material

Driscoll, 2007	3. During important exams, I think that I am doing awful or that I may fail (social humiliation)	6. During tests, I worry that I will not perform as well as I expect.	6. During the final, I worried about not performing as well as expected.	During-exam worry
-	- (cognitive obstruction)	7. Due to nervousness, I cannot quickly recall the concepts needed to solve problems.	7. Due to nervousness, I could not quickly recall the concepts needed to solve problems on the final.	Recall inability
Driscoll, 2007	6. I worry so much before a major exam that I am too worn out to do my best on the exam. (worry)	8. I worry so much before a major test that I am too worn out to do my best on the test.	8. I worried so much before the final that I was too worn out to do my best on it.	Worn out
Lowe et al., 2008	17. My mind wanders when I am taking a test. (cognitive obstruction)	9. I feel that my mind sometimes wanders when I am taking important tests.	9. I felt that my mind sometimes wondered when I was taking the final.	Wander
Driscoll, 2007	9. After an exam, I worry about whether I did well enough. (worry)	10. After a test, I worry about whether I did well enough.	10. After the final, I worry about whether I did well enough.	During-exam worry

*Specific measurement item created by researcher and advisor for research project

Experimental Procedure

Survey

A finalized 16-item “Mindfulness and Test Anxiety” survey that was given out to the students included two sections. The first section was a six-item general scale measuring one’s mindfulness, adapted from the MAAS. The second section was a ten-item regarding experiences with test anxiety, with original questions created by the researcher and her advisor, as well as scales adapted from the WTASV and TAICA. All 60 students then participated in the two-week meditation program, led by the vice president of the Meditation Club and supported by the school’s Wellness Center staff. The program will be described in greater detail in the following section.

Meditation Program

After the first phase (pre-meditation) of surveying was completed, a two-week meditation program was introduced to all the students. Throughout the course of the program, the students followed a five-minute guided meditation video (audio only), which was adapted from the original “20 Minute Guided Meditation with Jon Kabat-Zinn PhD” on Youtube (posted by No Nonsense Meditation). This meditation was chosen due to its rather high view count of more than 700,000 views; the credibility of Jon Kabat-Zinn was another factor, as he was the founder of mindfulness-based stress reduction (1979), incorporating ancient Buddhist meditation practices. The researcher created a five-minute version of Kabat-Zinn’s guided meditation due to the shorter time commitment from students and to better accommodate complete beginners to meditation. Five minutes of practice would also be easier for a vast majority of students to make time for amidst their busy high school schedules.

In the adapted video, Kabat-Zinn says phrases such as, “giving your full care and full attention to each in-breath... and to each out-breath” and “gently bringing [your thoughts] to the present [...] just being fully here, fully aware”. (Kabat-Zinn, 2021).

All students were instructed to meditate with the video at the beginning of every class period over the course of two weeks; they were also highly encouraged to meditate by themselves every night before going to bed. By individually practicing meditation before bedtime, students could feel more relaxed going to sleep after a busy day. Additionally, regular before-bed meditation sessions help with the enhancement of the desirable effects of the meditation program, specifically increasing mindfulness and reducing anxiety.

Data Collection

The Mindfulness and Test Anxiety survey was given out to the students twice: once before the start of the two-week meditation program, and the second time right after taking the final exam. Although the general objectives for each time the survey was distributed remained similar, the questions on the pre-meditation program survey applied to the students’ everyday mindfulness experiences and overall experience with tests in general. On the other hand, the questions on the post survey were framed in consideration of the Algebra 2 Honors final exam specifically.

The names of participants were not collected throughout all aspects of the program, and the students were informed that all information they put on the surveys will be kept confidential. In addition, due to lack of compelling incentives, the practice of meditation every night before going to sleep was not required, but highly encouraged for all students. If the students decided to meditate before bed, they were asked to fill out a one, yes or no question check-in form, either right after the meditation at night or in the following morning. The only question asked, “Did you practice the 5 minute guided meditation tonight/yesterday night?”

Results

Comparing results from the pre- and post-meditation surveys shows how the meditation program has affected students’ general mindfulness, as well as their test anxiety levels leading up to, during, and after important exams like the Algebra 2 Honors final. From the raw data, charts and tables were created in order to better understand the effects of the program on the entire sample of 60 students. Overall, an increase in concentration and decrease in everyday worry and stress was depicted in the results for general questions such as, “I find it difficult to stay focused on what’s happening in the present”, “I tend not to notice feelings of physical tension or discomfort until they really grab my attention”, and “I find myself preoccupied with the future or the past”. Moreover, there was also a decrease in test-related nervousness, distraction, and forgetfulness; this was shown in comparing the results for many questions such as, “I made mistakes on the final because I was too nervous”, “I forgot material that I’ve learned when taking the final”, and “I felt that my mind sometimes wondered when I was taking the final”.

The raw data from all 60 participants were grouped under two categories: those who only practiced meditation during class periods (in-class only participants: ICP; $n = 24$), and those who also practiced before going to bed (in-class and before-bed participants: IC + BBP; $n = 36$). It would be important to note that before-bed participation was only accounted for if the student meditated individually for one or more nights.

Analysis

To examine the effects of meditation on mindfulness and test anxiety, a total of four comparison column charts were graphed. The means of the results from ICP and IC + BBP for each item of both the pre- and post-meditation surveys were calculated and represented through the four charts. The data for corresponding items from the pre-meditation program and post-meditation program surveys are compared adjacently to one another on each chart, allowing one to visually see how much the meditation has affected mindfulness and test anxiety levels. Additionally, when looking at corresponding ICP and IC + BBP charts (same shades of color), the differences show how participating in before-bed meditation sessions can further benefit mindfulness and reduce test anxiety levels, as opposed to meditating in-class only.

Furthermore, a series of paired, two-tailed t-tests were conducted to test for significant results in terms of decrease in non-mindfulness and test anxiety levels in both groups of students, ICP and IC + BBP, before versus after the meditation program. From these data, two comparison tables were constructed. The percentage change and p-value of every item were calculated based on the results of the pre- versus post-meditation program surveys. The percentage changes for items from the general mindfulness scale and test anxiety scale are placed on their respective tables, and the differences between ICP and IC + BBP can be observed. P-values calculated from comparing the before and after results are not shown explicitly, but rather, a value's significance ($p < 0.05$) is indicated using asterisks. These tables reveal how much the meditation affected the mindfulness and test anxiety levels for ICP and IC + BBP, as well as the significance of the results.

Effects on General Mindfulness

The charts, Figure 1 and Figure 2, compare changes in the students' mindfulness based on data from the pre- and post-meditation program surveys, respectively. The empirical results on each chart show a visible reduction in one's non-mindful behavior for both ICP and IC + BBP.

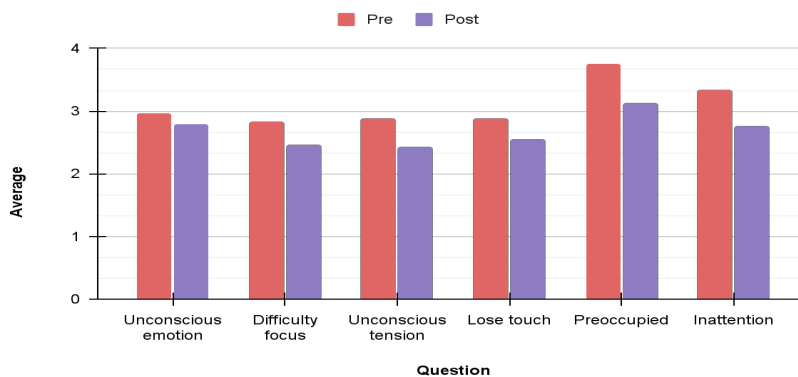


Figure 1. For ICP only ($n = 24$), pre- versus post-meditation program survey results: comparison of means of responses for general mindfulness questions.

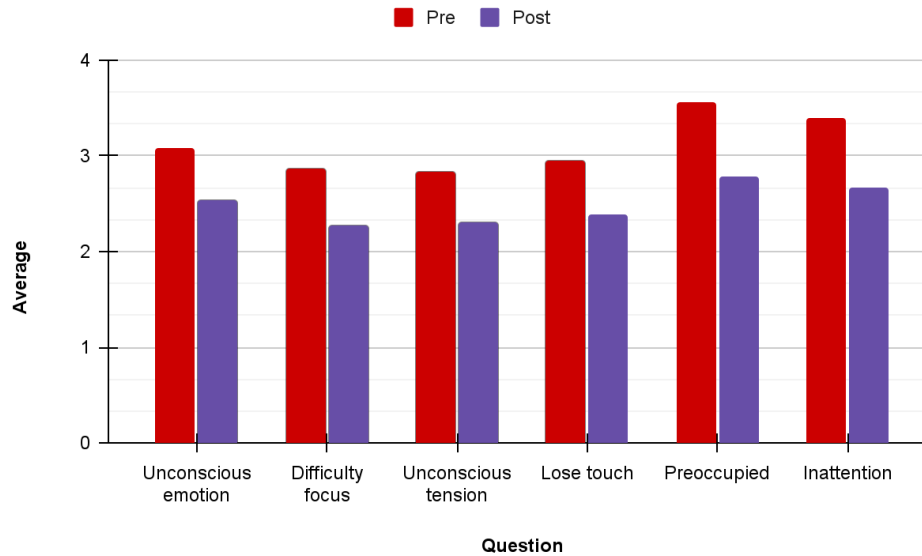


Figure 2. For IC + BBP (n = 36), pre- versus post-meditation program survey results: comparison of means of responses for general mindfulness questions.

The percentage change (decrease in non-mindfulness) was found by comparing the mean of the post-meditation program survey results with the mean of the pre-meditation program results. Then, the percentage changes of survey results from ICP versus the decrease for IC + BBP were placed vertically next to each other on the tables. The higher percentage change is indicated with the italicized value in each column, and the asterisks denote levels of significance. To clarify, larger numbers on the table refer to a greater improvement of one’s mindfulness. For example, “18.0**” in the bottom left of Table 3 indicates that the IC + BBP experienced a significant reduction in their “Unconscious emotion” by 18.0% after participating in the meditation program; this change is also significant at better than the $p = 0.01$ level.

From Table 3, regarding general mindfulness, one can observe that for all six (6 out of 6) items, IC + BBP results portray a greater percentage decrease in terms of general stress and inattention, as well as a far higher level of significance based on p-values from the t-tests conducted. 33.3% of ICP results had shown significance, while 100% of IC + BBP results do so.

Table 3. Percentage decrease — reduction of non-mindfulness (i.e. improvement of mindfulness) — between pre- and post-meditation program survey results (in %).

	Unconscious emotion	Difficulty focus	Unconscious tension	Lose touch	Preoccupied	Inattention
ICP	5.6	13.2	15.9	13.4	16.7**	17.5*
IC + BBP	<i>18.0**</i>	<i>20.4**</i>	<i>18.6**</i>	<i>18.9*</i>	<i>21.8***</i>	<i>21.3***</i>

* $p < 0.05$. ** $p < 0.01$. *** $p < 0.001$

Effects on Test Anxiety

The charts, Figure 3 and Figure 4, compare changes in the students’ test anxiety levels based on data from the pre- and post-meditation program surveys, respectively. The empirical results on each chart show a visible reduction in one’s non-mindful behavior for both ICP and IC + BBP. The only somewhat ambiguous comparison is for the item, “The closer I got to the final, the harder it was for me to concentrate on the material” (labeled as “Concentration difficulty”).

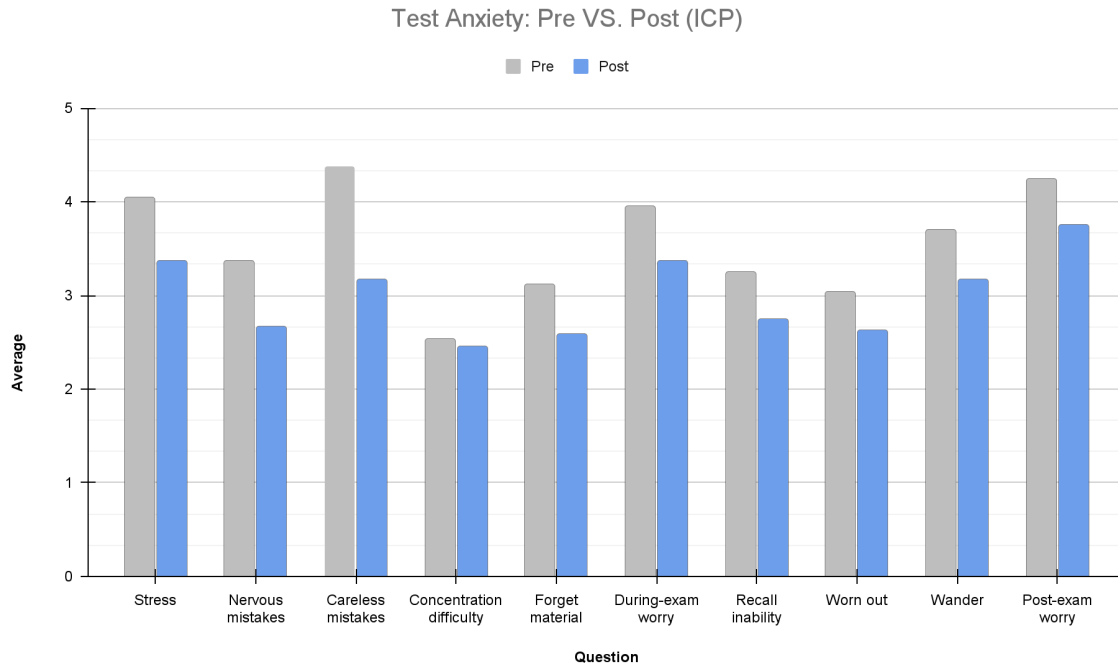


Figure 3. For ICP only (n = 24), pre- versus post-meditation program survey results: comparison of means of responses for test anxiety-specific questions.

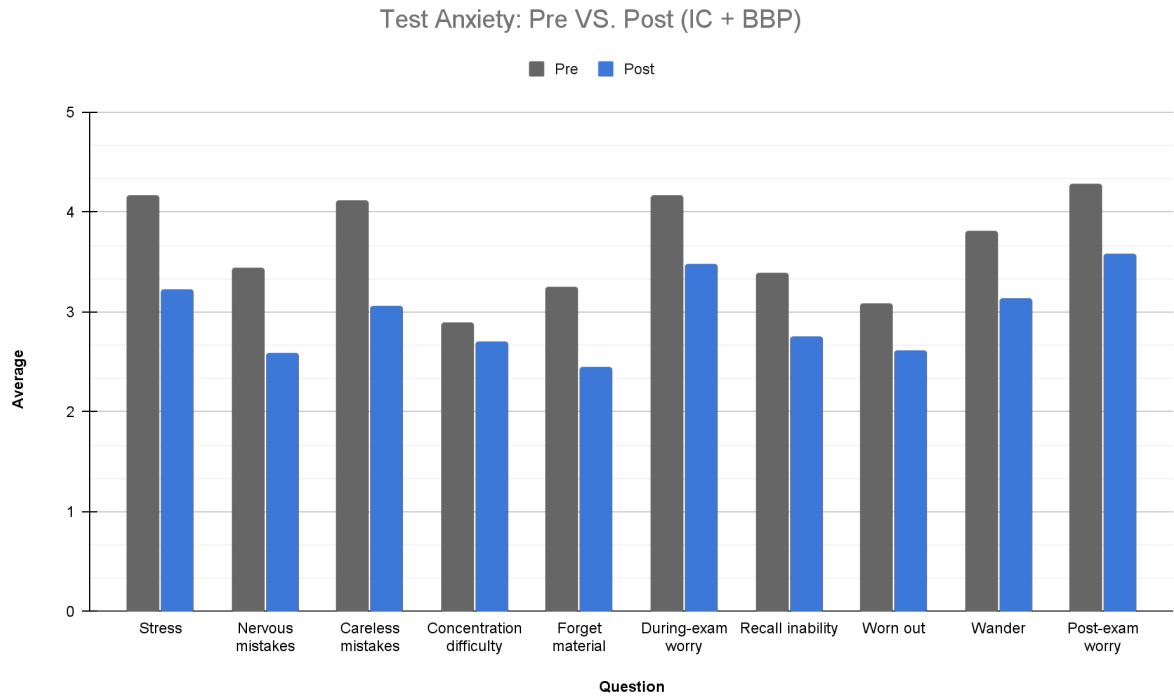


Figure 4. For IC + BBP (n = 36), pre- versus post- meditation program survey results: comparison of means of responses for test anxiety-specific questions.

From Table 4, regarding test anxiety specifically, one can observe that for nine out of ten items, IC + BBP results portray a larger percentage decrease in terms of general non-mindfulness. Additionally, 70% of ICP results had shown significance, while 90% of IC + BBP results do so.

Table 4. Percentage decrease — decrease in test anxiety levels — between pre- and post-meditation program survey results (in %):

	Stress	Nervous mistakes	Careless mistakes	Concentration difficulty	Forget material	During-exam worry	Recall inability	Worn out	Wander	During-exam worry
ICP	16.5*	21.0*	27.6***	3.3	17.3	14.7*	15.4*	13.7	14.6*	11.8*
IC + BBP	22.7***	25.0***	25.7***	6.7	24.8***	16.7**	18.9***	15.3*	17.5***	16.2***

* $p < 0.05$. ** $p < 0.01$. *** $p < 0.001$

Discussion

From the results displayed in the charts and tables, even those who only participated in the in-class meditation sessions showed significant ($p < 0.05$) improvement for two out of the six mindfulness scales and 6 out of the ten test anxiety scales. Practicing both in-class and before-bed meditation led to more prominent results in improving both the students’ overall mindfulness skills and reducing test anxiety, as IC + BBP displayed greater

percentage changes and more significant results compared to ICP. Those who participated in the in-class sessions, along with at least one before-bed session, depicted significant results on all six mindfulness scales and nine out of ten of the test anxiety scales. It can be inferred that reducing stress and anxiety levels requires changes in one's behavior, as well as the habitual practice of meditation.

The improved results of IC + BBP could be supported using previous research that examined the importance of how one goes to bed — the final state of the mind before falling asleep. Psychiatry and Behavioral Sciences assistant professor, Buenaver, Ph.D, says that relaxation activities “help by reducing the release of the stress hormones cortisol and adrenaline and by slowing your heart rate and breathing” (Buenaver, 2021). For that reason, practicing the five-minute guided meditation before bed helps one's body and mind to calm down and carry this peaceful mindset as they go to sleep.

The only result that was uncertain and insignificant from the survey data is related to the difficulty of concentration: “The closer I got to the final, the harder it was for me to concentrate on the material.” This item was labeled as “concentration difficulty” in the chart and table corresponding to test anxiety questions. Though there was a slight decrease in concentration difficulty, 3.3% for ICP and 6.7% for IC + BBP, the results were ultimately insignificant for both groups. One possible reason for this could be that concentration is a habit and a skill that requires a long time to develop, and two weeks of periodic, five-minute meditation sessions would be insufficient. Additionally, the final contains more comprehensive concepts than normal tests do, so it is understandable that the students found it more difficult to concentrate when studying and trying to understand such a substantial amount of material.

From a broader perspective, although this research study only sampled students taking the Algebra 2 Honors course, the meditation program can also be employed by other students. As discussed previously in the literature review section, there is a concept of “mathematics anxiety”, defined as test anxiety that specifically arises in math-related situations. Despite this, research has shown that math anxiety and test anxiety are likely non-distinct concepts (Kazelskis et al., 2000). Test anxiety was consequently used as a general term, encompassing math anxiety, for purposes of this research project about the effects of meditation on test anxiety levels. Thus, taking this generalization into account, students studying all disciplines should also be able to achieve successful results with participation in a similar meditation program. This program has not only helped many high school students with improving mindfulness, but also aided in the reduction of test anxiety, calming their state of mind as they immersed themselves in a week of final exams.

Research Limitations

From the overall results of this study, one can see that not all of them were significant. The reason for students who did not experience benefits from the two-week meditation program was most likely because they either did not take the meditation sessions seriously, or they found it difficult to follow the meditation program and implement it into their schedules. Additionally, during the first in-class meditation session, the researcher observed that there were a very small number of students with their eyes open, looking around, and not concentrating on the meditation audio. This could be because some students were new to meditation, uninterested in, or uncomfortable with meditating with people around them. For purposes of future research, the degree of engagement in the class meditation sessions should be controlled by either the teacher of the class, or the researcher herself.

Another factor that likely negatively affected the results could be the somewhat low degree of involvement in the before-bed meditation portion of the program. Only 60% (36 out of 60) of the students decided to practice the before-bed meditation during the nights leading up to the final exam. Although this is a slight majority, from the results of this research study, doing additional meditation sessions have been shown to improve overall mindfulness and decrease test anxiety, based on the results of the 36 IC + BBP. Thus, if more students — ideally all 60 of them — consistently practiced the five-minute meditation before bed, for at least a

couple nights leading up to the final exam, it is expected that the pre- versus post-program results would have depicted a higher amount of significant values. The general lack of participation in individual meditation sessions before bed could have presumably been due to the lack of convincing incentives for the students. The researcher originally suggested that the Algebra 2 Honors class's teacher give five points of extra credit to the final exam score of students who practiced before-bed meditation for more than three times. However, the teacher later did not agree to this, as the students already had multiple extra credit opportunities throughout the school year, so it was decided that small pastries were to be given out to those who have done at least one session of meditation before going to bed.

Conclusion

Walking into their respective classrooms, the 60 Algebra 2 Honors students were aware that their participation in the two-week meditation program would not only help them during their math final, but also guide them to an overall success in all their classes.

The two-week meditation program implemented throughout this research project has shown significant results that reveal the benefits of mindfulness meditation on everyday mental health and anxiety levels. Furthermore, the outcomes of this study can help to fill the gap in literature about how test anxiety among high school students can be reduced through meditation. Due to the significant results from this program, implementing meditation in similar environments for students of different age groups and students studying different subjects in the future could greatly improve mindfulness and general well-being in a broader perspective.

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References

- Brown, K. W., & Ryan, R. M. (2003). Mindful Attention Awareness Scale. *PsycTESTS Dataset*. <https://doi.org/10.1037/t04259-000>
- Buenaver, L. F. (2021). Sleepless Nights? Try Stress Relief Techniques. *Johns Hopkins Medicine*. <https://www.hopkinsmedicine.org/health/wellness-and-prevention/sleepless-nights-try-stress-relief-techniques>
- Driscoll, R. (2007). *Westside Test Anxiety Scale Validation*. <https://files.eric.ed.gov/fulltext/ED495968.pdf>
- Fleischmann, R., & Posner, M. (2020). Meditation for Increased Mindfulness and Memory: An Analysis on the Impact of Meditation on Mindfulness and Working Memory Capacity in High School Students. *Journal of Student Research*, 9(2). <https://doi.org/10.47611/jsrhs.v9i2.1079>
- Ghandour, R. M., Sherman, L. J., Vladutiu, C. J., Ali, M. M., Lynch, S. E., Bitsko, R. H., & Blumberg, S. J. (2019). Prevalence and Treatment of Depression, Anxiety, and Conduct Problems in US Children. *The Journal of Pediatrics*, 206, 256–267. <https://doi.org/10.1016/j.jpeds.2018.09.021>

Goleman, D. (1976). Meditation and Consciousness: An Asian Approach to Mental Health. *American Journal of Psychotherapy*, 30(1), 41–54. <https://doi.org/10.1176/appi.psychotherapy.1976.30.1.41>

Hanfesa, S., Tilahun, T., Dessie, N., Shumet, S., & Salelew, E. (2020). Test Anxiety and Associated Factors Among First-Year Health Science Students of University of Gondar, Northwest Ethiopia: A Cross-Sectional Study. *Advances in Medical Education and Practice, Volume 11*, 817–824. <https://doi.org/10.2147/amep.s275490>

Kabat-Zinn, J. & No Nonsense Meditation. (2021, October 4). *20 Minute Guided Meditation with Jon Kabat-Zinn PhD* [Video]. YouTube. <https://www.youtube.com/watch?v=1H2Cgc60UIU>

Kazelskis, R., Reeves, C., Kersh, M. E., Bailey, G., Cole, K., Larmon, M., Hall, L., & Holliday, D. C. (2000). Mathematics Anxiety and Test Anxiety: Separate Constructs? *The Journal of Experimental Education*, 68(2), 137–146. <https://www.jstor.org/stable/20152623>

Lluch-Sanz, C., Galiana, L., Doménech-Vañó, P., & Sansó, N. (2022). The Impact of the COVID-19 Pandemic on Burnout, Compassion Fatigue, and Compassion Satisfaction in Healthcare Personnel: a Systematic Review of the Literature Published during the First Year of the Pandemic. *Healthcare*, 10(2), 364. <https://doi.org/10.3390/healthcare10020364>

Lowe, P. A., Lee, S. W., Witteborg, K. M., Prichard, K. W., Luhr, M. E., Cullinan, C. M., Mildren, B. A., Raad, J. M., Cornelius, R. A., & Janik, M. (2008). The Test Anxiety Inventory for Children and Adolescents (TAICA): Examination of the Psychometric Properties of a New Multidimensional Measure of Test Anxiety Among Elementary and Secondary School Students. *Journal of Psychoeducational Assessment*, 26(3), 215–230. <https://doi.org/10.1177/0734282907303760>

National Center for Complementary and Integrative Health. (2022). *Meditation and Mindfulness: What You Need To Know*. NCCIH. <https://www.nccih.nih.gov/health/meditation-and-mindfulness-what-you-need-to-know>

Ross, D., & Driscoll, R. (2006). Test Anxiety: Age Appropriate Interventions [Review of *Test Anxiety: Age Appropriate Interventions*]. In *American Counseling Association Southern Region Leadership*. <https://files.eric.ed.gov/fulltext/ED493897.pdf>

Rehman, S. U., Javed, E., & Abiodullah, M. (2021). *Effects of Test Anxiety on Academic Achievement at Secondary School Level in Lahore*. 43(3), 67–80. <https://files.eric.ed.gov/fulltext/EJ1340720.pdf>

Yin, O., Parikka, N., Ma, A., Kreniske, P., & Mellins, C. A. (2022). Persistent anxiety among high school students: Survey results from the second year of the COVID pandemic. *PLoS ONE*, 17(9), e0275292–e0275292. <https://doi.org/10.1371/journal.pone.0275292>