Application of Growth Mindset across disciplines on student academic performance

Elizabeth Deimeke
Clark Atlanta University

Annette Teasdale
Clark Atlanta University

Rosalind Arthur
Clark Atlanta University

Danielle Gray-Singh
Clark Atlanta University

Medha Talpade
Clark Atlanta University

ABSTRACT

This study is guided by Carol Dweck's 'Growth Mindset' implicit theory of intelligence, which explains how individuals react to setbacks and why some actively pursue their potential. Those with a 'growth' mindset, as opposed to a 'fixed' one, persist when confronted with challenging tasks and believe that they can develop the necessary skills with effort. In our minority institution, and among black students, where 'stereotype threat' and 'imposter syndrome' undermine academic growth, our study on developing a growth mindset is imperative. In general, research indicates a need for more rigor in reporting the interventions and tangible and consistent outcome evaluations. Thus, this faculty research community at our historically black institution aimed to fill this gap and explored the effects of the growth mindset in their courses on student academic outcomes. The following research questions guided this study: Does infusing a growth mindset in the curriculum impact student academic outcomes? A total of 5 instructors infused growth mindset activities in their courses. Student grades before and after the infusion served to identify the success of the growth mindset intervention. Results were analyzed with parametric statistics, and partial support was indicated across the courses. A thematic analysis of the activities revealed the instructors' usage of Resources, Student Input, and Opportunities as a part of the intervention. These results can be used effectively to initiate positive academic outcomes and a positive classroom climate in our historically black institution.

Keywords: growth mindset, students, curriculum-infusion, black-institution

INTRODUCTION

The study is guided by Carol Dweck's 'Growth Mindset' implicit theory of intelligence (Dweck, 1986), which explains how individuals react to setbacks and why some actively pursue their potential. Those with a 'growth' mindset, as opposed to a 'fixed' one, persist when confronted with challenging tasks and believe that with effort, they can develop the necessary skills. A growth mindset in an academic context has been associated with a lower perceived cognitive load, leading to increased learner motivation and improved performance on retention and transfer tests (Xu et al., 2020). Research on growth mindset interventions in primary schools has shown diverse approaches, including teacher guidelines, integrated frameworks for learning, evidence-based teaching practices (Savvides & Bond, 2021), intrinsic motivation development, skill mastery tools, metacognitive strategies, and assessments of parental mindset and educational environments (Mehmet & Mehmet, 2023; Savvides & Bond, 2021).

In our minority (black) institution, and among black students, where 'stereotype threat' and 'imposter syndrome' undermines academic growth, especially in science and math (STEM), our study on developing a growth mindset is imperative (Wang et al., 2022). Key to developing a growth mindset is strong student-student relationship, student-faculty relations. Research with our student participants indicates that group work and relationships with faculty are deeply valued (Talpade & Talpade, 2020).

In general, research indicates that there is a need for more rigor in reporting the interventions and tangible and consistent outcome evaluations (Savvides & Bond, 2021; Burnette et al., 2022). Currently, we do not know if manipulation of the course framework can initiate a growth mindset. This faculty research community aims to fill this gap and explore the effects of infusion of the growth mindset in their courses, whereby students can change their performance through chances to improve grades as well as have chances to develop their task-related skills through resources and affirmations. Understanding the infusion of the growth mindset in a course and its impact on student academic outcomes and persistence can inform universal teaching and learning practices and outcomes.

LITERATURE REVIEW

This section summarizes current research on the growth mindset, discussing various contexts and methodologies in past studies. Research questions are presented, followed by an overview of the methodologies employed by each instructor.

Growth Mindset Interventions

A review of 53 interventions from 2002 to 2020 indicating an impact on academic performance mental and social functioning showed extreme variance. Another review of interventions in schools and classrooms, from 2018 to 2019 of 131 studies across a range of subject areas indicates that although there is some evidence of the efficacy, there is no rigor in the implementation nor appropriately designed outcome studies (Savvides & Bond, 2021; de Carvalho & Skipper, 2020; Burnette et al., 2022). For example, the efficacy of growth mindset interventions targeting children with special education needs did not show a sustainable increase over the long term, possibly due to the lack of rigor and implementation over time. Most large-scale, school-based interventions show weak or no effects (Xu et al., 2020). Research also

indicates the role of intersectionality, gender, and race on the efficacy of growth mindset on academic performance (Seo et al., 2019), with females having a lower self-concept in math and black adolescent career expectancy and positive self-concept not being related to math achievement. Savvides and Bond (2021) report a positive impact of the interventions, especially on minority students, a finding that was not supported by Brez et al. (2020).

The characteristics of individuals with a growth mindset have also been demonstrated whereby biases such as facial profiling are lower among those with a growth mindset (Madan et al., 2022). On the other hand, the perceived characteristics of those endorsing the growth mindset, that is, student perceptions of the teacher's mindset, are important as well (Kroeper et al., 2021; Seo & Lee, 2020). That is if instructors are perceived as 'believing that everyone can learn; provide an environment conducive for feedback; respond to struggling students with resources and attention; and communicate the importance of learning', students perceive their instructor as endorsing growth mindset beliefs. Seo and Lee (2020) confirmed that when students perceive a fixed mindset from teachers, a stereotype threat emerges, especially among black and Latino students who experience higher levels of this threat in high school math classrooms compared to white students. In general, a 'helpless' approach to learning is cultivated if they consider themselves to be a part of the 'lower-attaining' group, a shift that can occur only if 'judgment' is replaced with 'development' (Hargreaves et al., 2021). Jeffreys and Zoucha (2018) note that the 'fifth' minority- multiracial and multiheritage individuals also experience this 'cultural pain' that must be addressed.

Classroom climate was also recognized as an important component of the growth mindset (Schweig et al., 2022). According to the researchers, classroom climate tends to affect how students interact with each other, work and collaborate with each other, rendering a positive relationship with a student growth mindset if the climate fosters such formalized activities. Classroom climate related to the growth mindset was reflected in the physical environment, instruction process, student feedback, and student-teacher interactions. Similarly, the home environment, especially parental beliefs, expectations, and mindset, indirectly affect the growth mindset of their children (Lee et al., 2022). This study was conducted in elementary school in Korea, and results indicated that perceptions of the importance of the subject (math in this study) moderated the impact of a growth mindset intervention. That is, elementary school students who perceived math as being important were impacted by the growth mindset intervention and, in turn showed higher achievement in math. The shifting of mindsets has also been demonstrated by McKinsey et al. (2023) when comparing a mindset-enhanced trauma education condition to an only trauma education condition, with participants of the mindset-enhanced group being receptive to alternative sentencing for violent crimes.

Other researchers have failed to find such positive effects with growth mindset interventions targeting university students in introductory math and psychology courses (Brez et al., 2020). The sample consisted of minority, Pell-eligible, first-generation college students, and the quasi-experiment manipulated the independent variable (message type—Growth mindset versus Study skills) and studied academic outcomes such as GPA, course grades, retention, and credit hours earned. Glerum et al. (2020) assessed the growth mindset among secondary vocational training students and found that most did not have a growth mindset and that the mindset was unrelated to academic achievement. Understanding the variables associated with the growth mindset for minority students is important to explain the outcomes of a growth mindset intervention. For example, Glover and Li (2022) found that racial-ethnic micro-aggressions tend to lower growth mindset. However, coping mechanisms developed through parental socialization

helped buffer the negative effects of the growth mindset. On the other hand, a 6-week intervention using infographic materials versus class materials in a research methods course in Hong Kong found a significant shift in the student mindset—that is, students exposed to infographics changed their belief about intelligence to be more malleable after the intervention, as compared to before, and also compared to the control group (Cheng et al., 2021).

In summary, there is a consensus among researchers that growth mindset interventions have delivered varied outcomes but are beneficial for student academic outcomes. A growth mindset of both students and teachers impacts student outcomes by affecting motivation to learn and by mitigating psychological barriers for minority students. There have been no attempts to test the impact of such an infusion at a minority institution. This study fills this gap, includes quantitative indices to evaluate the efficacy of the intervention, and tests the infusion of the growth mindset in the curriculum across subjects. Thus, at our historically black institution, faculty across disciplines tested the following research question:

Research Question

Does infusing a growth mindset in the curriculum have an impact on student academic outcomes?

Since 1988, Clark Atlanta University (CAU) has continued a rich tradition of educating Black students. Founded in 1865 as Atlanta University, it was the first Historically Black College in the Southern United States to award graduate degrees to Black students. Clark College, founded in 1869, was the first four-year liberal arts school in the nation serving Black students. CAU alumni include Pinky Cole-Hayes, Marva Collins, Spike Lee, and many others who have excelled. The current challenge of preparing Black students from around the nation has reached extreme proportions given the assault on pedagogy through book banning, teaching critical race theory, and subsequent legislation. At CAU, faculty are employing a growth mindset to meet the needs of students.

The current paper reports the results of this growth mindset infusion by five professors at CAU. All the professors were female; three identified as black, one was white, and one was Asian. The growth mindset was infused in courses such as statistics, biology, Spanish, teacher education, and human physiology.

METHODS

Statistics

Students in four statistics classes, pre-intervention (2011, 2013) and post-intervention (Fall, Spring, 2023) semester, were exposed to a growth mindset intervention. The following describes the participants, measures, procedures, and results.

Participants

Undergraduate students in statistics classes, n (pre-intervention) = 33 and n (post-intervention) = 85, were exposed to a growth mindset intervention at a historically black college in the southeastern part of the U.S. All classes were taught by the same instructor. The majority of the students were black and female.

Measures

Student grade distributions during final grades were assessed. A between-group comparison of grade distributions pre and post-intervention was evaluated. Persistence was defined as the number (%) of students who persisted until the end of the semester after having earned DF grades at midterm without withdrawing. The grades were compared between those achieved at midterm and final course grades.

Procedures

The course activities were expected to help students (1) cultivate their skills and those of others and work towards doing better, (2) students were provided new strategies, resources, and opportunities to think creatively when interacting with the content, (3) develop confidence in solving statistical problems devoid of the stereotype threat associated with 'numbers/math.' The following activities were included in the course to enhance the growth mindset:

- Quizzes every week, with the top 5 quiz scores counting towards the final grade.
- Students could use books/notes/worksheets while taking tests
- Students had worksheets that were instructor-generated and edited with student feedback.
- Students had the opportunity to take one test again during finals to improve their scores. Test examples were drawn from the instructor's manual, and the tests were open-ended (not multiple choice) and taken in class.
- Students worked in groups on problems using the worksheets.
- Students who were doing poorly were paired by the instructor with an in-class peer or a senior student who served as a peer volunteer for tutoring purposes.
- Grade distributions were posted on CANVAS, along with recommendations on how to continue doing well and how to do better. After the grade distributions for A, B, and C grades, the instructor had a row for the score that began the D grade (e.g., below 15) but had the instruction "see me" instead of a D/F.
- Students solved culturally relevant examples (numbers that were developed in class with students) for problem-solving, in addition to problems from the text. Extra credit assignments included problem-solving on CANVAS, with the solution shown via a Zoom recording after the due date.

Results

A comparison of grades in the statistics course pre and post-intervention indicated no significant differences in test scores. Overall scores were not compared pre and post-intervention because students in the post-intervention phase had more opportunities to improve their scores through in-class and practice assignments. A comparison of grades across pre (36%) and post-intervention (46%) revealed significant increases in the percent of As earned post-intervention, $X^2(1, N = 82) = 5.20$, $p = .023$; and pre (46%) and post-intervention (28%) revealed a significant decrease in the percent of Bs earned post-intervention, $X^2(1, N = 74) = 4.49$, $p = .034$.

Within-group comparison of persistence during the Spring 2023 semester indicated 12 students earning a DF grade on a midterm, but only 2 earning a DFW as the final course grade;

$X^2(1, N = 82) = 5.20$, $p = .023$.

Discussion (Statistics)

Results of the growth mindset-infused curriculum in statistics classes indicate that there were no significant differences in the test scores pre and post-intervention. These quantitative, non-significant results are supported by most research on the growth mindset. Additionally, since the same instructor taught all the courses pre and post-intervention, a growth mindset may have been infused without tangible opportunities and resources at our historically black university, where the majority of the students are first-generation students. However, results do indicate that there seemed to be a shift in grade achievement, indicating the use of resources and opportunities by students when given the chance to do so. However, this use of opportunities was limited to those among the high achievers. These results inform us that tailored interventions should be targeted towards the higher risk students. Although recent results indicate that persistence did increase from midterm to final, with fewer students earning DFW grades, there is no comparison data to attribute the persistence to the growth mindset intervention. In general, however, the growth mindset intervention created a better classroom climate, which is indicated by the teacher ratings by students pre and post intervention. Although the threat of maturation cannot be ruled out, it is important to focus on the importance of classroom climate for both students and teachers.

Foreign Language: Spanish

Participants

Students were undergraduates taking the foundational course in the Spanish language and culture in three sections of Elementary Spanish 101(n = 41). The growth mindset was operationalized as an instructional modality to help students understand the material through repetition and practice, performing analyses of similar texts with gradually incremental content. Most of the students were black females.

Measures

Student grade distributions and persistence after midterm grades were assessed. A comparison of grade distribution between grades earned in the Fall 2022 Fall and Fall 2023 were evaluated. Persistence was defined as the number (%) of students who persisted until the end of the semester after having earned DF grades at midterm without withdrawing. Their midterm grades were compared with the final grades of the current semester (Fall 2023).

Procedures

The following activities were infused into the curriculum:

- Group or individual preparation activities (reading, listening to, and repeating vocabulary to aid retention) are evaluated orally in class.
- Students had access to all resources at their disposal: notes, recordings, and text.
- Students were guided through identifying the elemental parts of a sentence and their functions in class.
- Students were provided with a short passage similar to the video script of the Fotonovela and a labeled empty chart with the parts of speech to be sorted and explained. The first row of the chart was filled in to provide an example for the students to ensure they understood what was required.

- Students were asked to fill in the chart sorting through elements from a provided script by identifying and breaking down the parts of speech in preparation for class as a homework activity, guided by a brief video illustration by the instructor.
- In class, students had to explain each row with guidance from the instructor, following a briefly recorded video illustration produced by the instructor. This was a graded assignment for class participation.
- Students were given a second identical assignment covering the current lesson, this time completed individually and explained orally to the instructor for a grade.
- Students with DF grades were offered additional individual tutoring with the instructor, after which they were given a third attempt at the analysis. The grade for the third attempt replaced the previous grade.

Results (Spanish)

A comparison of the Final exam results for Fall 2022 and Fall 2023 indicates a vast improvement in the final exam performance for the latter as follows: Fall 2022: ($M = 68$, $SD = 12.4$, $n = 42$) and for the Fall 2023 ($M = 82$, $SD = 14.7$, $n = 51$). An independent group t-test revealed significant increases in the test scores, $t(91) = 3.97$, $p < .0001$. (The grade distribution shows 2% As in the Fall 2022 to 39% in the Fall 2023, 19% Bs in 2022 to 37% in Fall 2023, 36% for Cs in the Fall 2022 to 7% in the Fall 2023, and 43% DFWs in Fall 2022 down to 17% for Fall 2023, a 26 drop in percentage points. Comparing the midterm with the final exam scores for this activity in Fall 2023, when the growth mindset was practiced, the DF grades dropped down to 2 DFs in the Final exam.

Discussion (Spanish)

Results indicate a significant difference in grade achievement and persistence in the Spanish courses taught by the same instructor. These differences can be attributed to the type of resources made available to the students and the number of opportunities provided. The engagement of the teachers and students with the course material seems to have enhanced the grades as well as the persistence. The student-teacher interactions may also have enhanced the class climate, which in turn delivered optimal outcomes for both students and teachers.

Biological Sciences

Participants

The participants included undergraduate students at an HBCU enrolled in a first-year introductory biological sciences course in the spring and fall of 2023. As the treatment group, students in the fall cohort ($n = 157$) were exposed to growth mindset instructional strategies, while the spring cohort ($n = 144$) served as the control group.

Measures

The two-part analysis focused on a short one-week unit and a multi-week group project. The short unit centered on the structure and function of biological molecules; both groups read

material from the textbook (Phelan, 2021), answered Edpuzzle questions based on an animated summary of biomolecules (Amoeba Sisters, 2016), and completed a case study in groups during class time. The dependent variables were student performance on the unit homework quiz, test, and midterm exam.

The multi-week group project analysis focused on a collection of formative assignments building up to a summative multimedia project. In both semesters, students worked in groups to identify organ systems and diseases of interest to research. Over multiple weeks, students gathered information on organ system structure and function at the molecular, cellular, tissue, and organ system levels, as well as how the selected disease impacts system structure and function. Groups were instructed to organize and submit the gathered information in three provided graphic organizer (GO) templates.

In both the one-week unit and multi-week project, analysis was limited to students who completed all aspects of the work (adaptive quiz, Edpuzzle, case study, GOs, and final project). Independent t-tests on SPSS were used to detect mean score differences in unit homework quizzes, tests, midterm exams, and final project scores. Levene's test for equal variances was used to test the assumption of homoscedasticity.

Procedures

- The case studies differed between semesters such that the spring 2023 cohort completed one that emphasized macromolecule categories and molecular structure (Lee & Jozwick, 2022) over two class periods, while the fall 2023 cohort completed a culturally relevant case study on macromolecule function in the context of hair growth, development, and texture (Gibson, 2019). The fall 2023 participants completed the case study in one class period. However, they were assigned case-study-specific readings, videos, and pre-quiz before the class meeting, as well as a post-class concept check quiz after class.
- In the multi-week group project, the instructor reviewed formative GOs and provided feedback prior to final project submission. Student research, formative GO completion, and final project submission was condensed into a four-week period at the end of the semester for the spring 2023 cohort, with only one week separating the last GO submission and final project deadline. The fall 2023 cohort was given eight weeks for the same tasks, and three weeks separated the last GO submission and the project deadline. The additional time in the fall semester enabled the instructor to review and provide constructive feedback before students began working on the final multimedia project.

Results

In the one-week unit, the mean homework quiz score of students in spring 2023 (n = 78) was 5.7 out of 6 (+/- 0.6 SD) and 5.8 out of 6 (+/- 0.2 SD) for the fall 2023 cohort (n = 101) (Table 1). Variances between the groups were unequal (Levene's test, $F = 9.5$, $p = .002$). An independent t-test showed no significant differences between the groups, $t(95.8) = -1.3$, $p = .18$ (Table 2). Similarly, mean scores on the first test did not differ between cohorts $t(174.4) = 0.06$, $p = .95$ (Table 2); the mean test score of the spring 2023 group was 17.99 (out of 25) (+/- 3.1 SD) and 17.95 (+/- 4.5) for the fall 2023 group (Table 1). Variances between the groups were unequal (Levene's test, $F = 18.1$, $p < .001$). Mean midterm exam scores were different between the spring and fall cohorts $t(175.8) = 2.86$, $p = .002$ (Table 2), with the spring group scoring 37.6 (out of

50) (+/- 5.9 SD) compared to 34.6 (+/- 8.3 SD) for the fall group (Table 1). Variances were unequal among midterm exam scores (Levene's test, $F = 13.7$, $p < .001$).

In the multi-week project, the mean final project score in spring 2023 (n = 125) was 47.1 out of 60 (+/- 6.9 SD) and 48.2 (+/- 8.0 SD) for the fall 2023 cohort (n = 121) (Table 3). The assumption of homoscedasticity was tenable (Levene's test, $F = 3.3$, $p = .069$). An independent t-test showed no significant differences between the groups, $t(244) = -1.2$, $p = .23$ (Table 4).

Discussion (Biological Sciences)

Changing the case study used within the biomolecule unit to incorporate culturally relevant topics and more opportunities for self-tests did not influence mean homework or test scores. Time constraints may have influenced this lack of difference. In both semesters, students spent approximately one week working through the unit material (reading, Edpuzzle, case study, and homework). Without much time for meaningful student reflection on performance and quality instructor feedback, students' metacognitive efforts, such as changing strategies to improve learning outcomes, were likely stunted. Future iterations of this study would benefit from extended time frames, allowing students to experiment with explicit growth mindset suggestions.

Surprisingly, the spring 2023 cohort had a higher midterm exam score even though the instructional approach involved less relevant material and fewer opportunities for self-test. We attribute this change to a difference in exam format. The spring 2023 cohort completed the midterm exam online, and it included multiple choice, matching, figure-labeling, and fill-in-the-blank questions with answer banks. The fall 2023 midterm exam was in-person and on paper, and although it included questions of a similar format, students were not provided with answer banks. It is likely this fall 2023 exam was more challenging and thus resulted in a lower mean score.

The lack of difference in final project scores between the cohorts was surprising, given the difference in work time. The fall 2023 cohort had eight weeks to complete all aspects of the multi-week project compared to four weeks in the spring. Additionally, the formative GOs were spaced out over three weeks in the fall, providing ample time for instructor feedback before final project submission. This design was intended to provide students with the information and time needed to improve the quality of their work prior to final project submission. However, the lack of difference in project scores suggests this was not the case. One potential reason could be the mode by which the feedback was provided. After each GO submission, instructor feedback was provided as text in the assignment submission comments on the LMS. It is possible some students did not see or read the feedback, thereby limiting the effectiveness of this approach in promoting a growth mindset and improving student performance. Direct instruction on reviewing instructor feedback during class time may be a useful growth mindset strategy going forward.

Teacher Education

Participants

The study included five graduate students enrolled in CEDS 591 Nature and Needs of Students with Disabilities.

Measures

Scores prior to and following the growth mindset infusion were compared. Student scores on a research article review (RAR) were used to evaluate the benefits of a culturally responsive growth mindset in a teacher preparation course. This included a comparison of scores on RAR#1 and RAR#2.

Procedures

Students are assigned two RARs that require them to do the following: 1) identify two research studies on learning disabilities published in refereed journals in the last five years; 2) format the RAR according to the established format using APA style; 3) address how this research will help them as a teacher. Because this is an introductory course, students come to the assignment with limited confidence in their ability to do research and, subsequently to analyze a research study. To reframe their approach to these challenges and stay motivated to work to improve their skills in these areas, I scaffolded the assignment. As a group, we consulted with the education librarian from Woodruff on how to access library databases to locate research articles. Together, we worked through a sample learning disability article as a class to create a RAR. Next, we reviewed APA style guidelines. I attempted to encourage a culturally responsive growth mindset approach to learning by modeling, partnering with peer reviewers, and offering constructive feedback.

Assignment Description. Each student had to identify two research studies on learning disabilities published in refereed journals in the last five years. Complete a research article review based on the established format below using APA style. Address how this research will help them become a culturally responsive teacher.

Using the resources from the Robert W. Woodruff Atlanta University Consortium Library, find two research articles on learning disabilities that have been published within the last five years. Acceptable journals for this assignment include but are not necessarily limited to Exceptional Children, Journal of Learning Disabilities, Journal of Special Education, and Learning Disabilities Research and Practice. Instructor magazine, or any other magazine, is not acceptable. The title of the article should be written in the American Psychological Association (APA) style for references. You do not have to submit a copy of the article. Follow the format listed below: Course Objectives #2, 4, 5

- Format of Research Article Reviews
- Title of Article---Include the DOI and APA reference style worth 1 point
- Problem/Purpose of the Study--1 point
- Subjects–Discuss the number, type, age, gender, and IQ of the subjects.
- If any of this information is missing, state that it was not in the article.--1 point
- Method (Procedures) --1 point
- Data Analysis whether descriptive statistics, t-tests, ANOVA, etc., were used.--1 point
- Findings- Discuss the results of the study.--3 points
- Implications (Conclusions)—Discuss the implications of the study.--3 points

Personal Comments- Discuss how this research will help you as a teacher. Focus on how the research results can be applied in practical situations. If you do not think the study will be helpful, explain why not. Please do not tell me that you enjoyed reading the article.--4 points

Results

As indicated in the table below, student scores increased significantly. Students embraced and incorporated the feedback provided. They learned from their peers' reviews. They were able

to understand the process and grow from the limitations they encountered. Based on their experiences, they can translate what they have learned to their own classrooms, serving students with disabilities with a culturally responsive growth mindset. A paired t-test was conducted comparing the student scores on RAR#1 and RAR#2. Results indicated significant differences between the scores pre and post-intervention: $t(4) = -8.77$, $p = .0005$.

Discussion (Teacher Education)

Results thus indicate a significant impact on the academic outcomes in teacher education. As a faculty member who prepares pre-service Special Education teachers, I employ a growth mindset that helps student teachers understand and respond to the world around them (Dweck, 2017). In Fall 2023, as part of the Scholarship of Teaching and Learning faculty learning community, I sought to explore the role of a culturally responsive growth mindset in my CEDS 591 Nature and Needs of Students with Disabilities course. According to Ladson-Billings (1994), culturally responsive teaching is "a pedagogy that empowers students intellectually, socially, emotionally, and politically by using cultural and historical referents to convey knowledge, to impart skills, and to change attitudes" (p.13). Similarly, Gay (2018) defined culturally responsive pedagogy as "the use of cultural knowledge, prior experiences, frames of reference, and performance styles of ethnically diverse students to make learning experiences more relevant to and effective for them" (p. 31). Thus, the results of the guiding research question are as follows: How did the use of a culturally responsive growth mindset improve student outcomes in a teacher preparation course? Indicated significant differences as a result of the infusion.

Human Physiology

Participants

A total of 40 students enrolled in a Human Physiology course participated in this study taught by the same instructor.

Measures

Participants were assessed under two distinct teaching paradigms: A traditional method and a growth mindset approach emphasizing culturally responsive pedagogy.

Procedures

The traditional method included lectures enhanced with presentation software. The growth mindset approach included the following activities:

- Application-Focused Learning: Prioritizing real-world applications of course concepts.
- Gradual Building: Incrementally progressing from basic research literature to complex systems-level understanding.
- Group Work: Facilitating collaborative learning in student groups.
- Peer Feedback: Encouraging feedback exchange to refine learning.

Results

Significant differences in performance were observed between the two teaching paradigms. A one-way Analysis of Variance (ANOVA) was conducted to assess the influence of the teaching method on scores. The ANOVA revealed a notable effect of the teaching method

($F(1, 38) = 12.1419$, $p = 0.00126$), indicating significant variability in scores between the traditional method and the growth mindset approach. Further analysis was performed using independent samples t-tests to compare the average scores between the two teaching paradigms. The t-test supported the findings of the ANOVA, indicating that the growth mindset approach yielded higher average scores than the traditional method ($t(38) = -3.4845$, $p = 0.00126$).

In addition to statistical significance, the effect size was calculated to determine the practical significance of the observed differences. The effect size emphasized the substantial impact of the growth mindset approach on student performance, further highlighting the importance of this teaching paradigm in enhancing learning outcomes in Human Physiology.

Discussion (Human Physiology)

These statistical analyses provide robust evidence for the effectiveness of the growth mindset approach in improving student performance compared to the traditional teaching method. In the ever-evolving landscape of biological sciences, a profound commitment to understanding and engaging with research is crucial. To this end, cultivating an enduring appreciation for primary literature and empowering individuals with the self-efficacy to navigate and apply it are fundamental. Notably, our approach employed culturally responsive, growth mindset pedagogy across four modules in a human physiology course, which holds great potential in science education yet remains an area that has not been systematically examined.

SUMMARY AND CONCLUSIONS

Results of the growth mindset infusion into the curriculum indicate varied results. The hypothesis that the growth mindset infusion in the curriculum would deliver better academic outcomes was partially supported. The non-significant results are evidenced by some researchers (e.g., Xu et al., 2020; Brez et al., 2020). Some researchers found significant effects of the growth mindset intervention when race was considered (Savvides & Bond, 2021). It is important to note that this study controlled the impact of race by exploring the impact at a historically black university.

The growth mindset activities used by all the instructors were analyzed using Atlas-Ti. Activities were coded and the following themes were revealed: Resources (e.g., could use book/notes/worksheets while taking tests, paired by the instructor with an in-class peer or a senior student, homework assignment consisting of a labeled chart of the parts of speech); Student Input (e.g., worksheets edited with student feedback, worked together through a sample learning task, Oral discussions in class); Opportunity (e.g., top 5 quiz scores counting towards the final grade, pre-quiz before the class meeting, as well as a post-class concept check quiz after class, opportunity to take one test again). Results indicated that in the growth mindset infusion, instructors provided resources most often, followed by inviting student input, and finally, but not as frequently, offering students opportunities to improve their grades.

A factor that can explain the varied results is that not all instructors used the same number and extent of growth mindset activities. Although all the activities had components of resources, connecting with the students, and providing opportunities to improve their scores, some instructors provided more resources than chances for student input or opportunities.

Another factor that could explain the varied results could be the race of the instructor. The two instructors who evidenced the non-significant results were both female and non-black.

The three instructors who found significant differences were both female and black. It is possible that pre-intervention, both the non-black instructors were infusing the growth mindset informally and tangentially or the infusion was subject to a lack of closer relationships, as reported by Nguyen and Le (2022). When teacher-student race was matched for kindergarten and elementary school children, minority students tended to have closer relationships when they were taught by a minority teacher (Nguyen & Le, 2022). Thus, an inquiry into how to establish this closeness despite racial incompatibility is an avenue for future research.

An infusion of the growth mindset activities in the curriculum suggests the positive mindset of the instructors, which is important as well (Kroeper et al., 2021; Seo & Lee, 2020). According to Garrison et al. (1999), the educational experience consists of a cognitive presence, a social presence, and a teaching presence. Instructors who provided access to resources who invited student input, were perceived as having a higher teacher presence (Sen-Akbulut et al., 2022). Enhancing the teacher's presence also invites the student to be cognitively present. Using group and peer involvement encourages the social presence in the educational experience. However, the role of providing opportunities to develop a growth mindset needs to be studied further. The present study demonstrated the infusion of such ‘opportunities,’ but this element was included at a lower level than resources or student input.

In conclusion, the above study fills a gap in the research by specifying the activities infused into the curriculum by instructors at our historically black institution and studying the impact on student academic outcomes. The use of objective performance indicators is a strength of this study. The themes captured from the growth mindset activities provide guidance for our learning community to help move the student from the ‘fixed’ to the ‘growth’ mindset.

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APPENDIX A

Table 1

Descriptive statistics by cohort for the one-week unit. Values represent mean +/- standard deviation.

Group	Unit Homework Score (out of 6)	Test 1 Score (out of 25)	Midterm Exam Score (out of 50)
Spring 2023	5.4 (0.92)	17.99 (3.1)	37.6 (5.9)
Fall 2023	5.7 (0.59)	17.95 (4.5)	34.6 (8.3)

Table 2

Independent t-tests for unit homework quiz, test 1, and midterm exam by cohort.

	t	df	p	95% CI of Difference
Unit Homework	-1.3	95.6	.18	-0.24 – 0.046
Test 1	0.06	174.4	.95	-1.1 – 1.1
Midterm Exam	2.9	175.8	0.005	0.94 – 5.1

Table 3

Descriptive statistics by cohort for the multi-week project. Values represent mean +/- standard deviation.

Group	Final Project Score (out of 60)
Spring 2023	47.1 (6.9)
Fall 2023	48.2 (8.0)

Table 4

Independent t-test for final project scores by cohort.

	t	df	p	95% CI of Difference
Final project	-1.2	244	.23	-3.0 – 0.72

Table 5

Student Scores Pre and Post Intervention

Student ID	Student Scores on RAR#1	Student Scores on RAR#2
A	79	93
B	85	96
C	83	95
D	84	91
E	88	97