UNIVERSAL WISER
PUBLISHER

Research Article

Increasing Students' Growth Mindset and Learning Perception by Allowing Online Revision and Resubmission in a Community College

Dorina Tila[*] , **Dawn Levy**

Department of Business, Kingsborough Community College, University of New York, New York, US
Email: Dorina.Tila@kbcc.cuny.edu

Abstract: Although improving students' learning is a universal objective, assessment and evaluation of learning differ among academic institutions and scholars. Instead of focusing on traditional measures of what the instructor or institution consider improvement or success, this study measured students' mindset shifts and perception of online formative assessments that allow multiple revisions and resubmissions. Using various questionnaires to measure perception and mindset, the findings showed that allowing students to revise assignments: 1) yielded a student perception of improved learning, 2) prompted students to review the material prior to resubmission, and 3) increased growth mindset of students who initially had a fixed mindset. While this treatment helped shift the mindset of students with fixed mindset towards a growth mindset, it did not have a similar impact on students who already had a growth mindset prior to the treatment. Future iterations of the study will aim to identify reasons why students are not impacted the in same way and explore other methods that can increase confidence and growth mindset for everyone.

Keywords: growth mindset, growth mindset intervention, online revision, multiple submission, multiple attempts

1. Introduction

There are many traditional ways to assess student learning, including assessment grades, final grades, and course completion (Cain et al., 2022). Instead of focusing on traditional measures of what the instructor or institution consider improvement or success, this article provides a new look at this subject by evaluating the efficacy of online formative assessments that allow for multiple revisions and resubmissions to increase students' mindset as a new dimension of measuring student achievement.

The evolution of technology and its adoption in the classroom has made possible the execution of online assignments through various Learning Management Systems (LMS) such as Blackboard, Canvas, and Moodle (Bulut et al., 2023; Mtshalli et al., 2022; Simon et al., 2023). Faculty can grade multiple-choice tests submitted by students online in a fraction of a second. Blackboard, for example, provides faculty with various features that allow them to 1) observe the time each student spends working on an online test before submitting it; 2) administer a test multiple times; and 3) count the score of the highest, average, or last attempt, etc. This low-cost online test delivery option and immediate grading feature allow for new tools that were not available to faculty until relatively recently. The growing use of these tools has also been correlated with a growing body of literature assessing and evaluating these instruments (Angus & Watson, 2009; Lima et al., 2020; Tinoca & Oliveira, 2013).

This article analyzes the impact of one such tool on students' perceptions of their learning at a community college and measures any changes that such tool may have caused to the students' growth mindset. The specific tool used was to allow students to revise and resubmit their online multiple-choice assignments. Finding that certain tools could improve students' growth mindset, in addition to academic performance, would provide a great opportunity for improving students' performance, experiences, and success.

2. Literature review

We considered the multiple submission of online assignments an interesting pedagogical tool because prior studies have shown that online quizzes are perceived as a valuable learning tool (Marden et al., 2013) and online homework improves study habits (Richard-Babbs, Curtis, & Penn, 2015). Much of the research indicates mixed findings because, while research indicates that such formative assessment opportunities can be significant in enhancing students' learning (Evans et al., 2014; Tila & Levy, 2020), the opportunity to resubmit them might not be beneficial since it might lead to guessing on initial attempts (Rhodes & Sarbaum, 2015; Orchard, 2016).

Orchard (2016) and Rhodes and Sarbaum (2015) analyzed the efficacy of multiple attempts on different students but did not collect any information about students' perception and opinions. In contrast, Tila and Levy (2020) ran a study with students at Kingsborough Community College during Fall 2017 and Spring 2018, allowing students to resubmit some of their online multiple-choice assignments. The findings indicated that the additional attempts yielded better results and that students' perception of multiple submission opportunities was extremely positive, while overall course performance remained the same. The current study builds upon these findings by turning away from traditional performance measures, such as grades, and investigating a new dimension of measuring students' success through measuring shifts or increases in their growth mindset.

According to Dweck (1999; 2006), people with a growth mindset believe that intelligence is flexible and can be developed over time through practice and effort, known as incremental theory, whereas people with a fixed mindset view intelligence as an innate ability that is predetermined and unable to be changed, known as entity theory. In the education context, the consequence is that students with growth mindsets emphasize learning goals, value effort and appreciate failure as an opportunity to learn. They are more likely to put more effort and time into their work and are less likely to be given up under challenging conditions (Dweck, 2006; Dweck & Legget, 1998; Yeager & Dweck, 2012). Students with fixed mindsets, on the other hand, emphasize performance goals, seek favorable judgments of their abilities and see failure as a sign of a flaw in their identity. They are less likely to see the value in expending extra effort in their work and are more likely to avoid academic challenges as threats to their intelligence (Dweck, 2006; Dweck & Legget, 1998; Yeager & Dweck, 2012).

Having this arsenal of literature showing an agreement among researchers on the importance of growth mindset on success, the next question is what educational interventions, mindset training, or pedagogical tools can be used to shift students towards a growth mindset. The most common intervention includes explaining to students about neuroplasticity: the brain's ability to change and grow over time when it engages in learning and challenging activities (Blackwell et al., 2007; Brougham & Kashubeck-West, 2017; Cutumisu, 2019; Yeager & Dweck, 2012). For example, in a study by Cutts et al. (2010), improved scores were seen in students who received mindset training and students who received a unique assignment rubric embedded with a growth mindset message. Results of the same study show that those who were taught about mindset did move more toward a growth mindset, and interestingly, those without the mindset training shifted to more of a fixed mindset over time (Cutts et al., 2010). Not only are growth mindset interventions effective, but they seem to be even more so for the lowest achievers (Mills & Mills, 2018), and therefore, Mills & Mills (2018) posited that developmental math classes should benefit from growth mindset intervention. According to Mills and Mills (2018), Dweck's research aims to identify "the beliefs that embolden some people to persevere and others to give up" (Mills and Mills, p. 1064), particularly when they are faced with adversity. This is especially relevant for non-traditional community college students who often face numerous obstacles to degree completion, including the fact that they are often adults, parents, people with full-time jobs, and people returning to school after years away (Carey, 2017). Many are first-generation college students who come from low-income backgrounds (Pizzolato et al., 2017) and many are under-prepared academically for college-level work who require academic remediation in several areas (Chen, 2016).

Mills & Mills (2018) note that approximately sixty percent of community college students being required take at least one remedial course, many of these students may already start college questioning their intelligence and being skeptical about their chances of completing their degree. The ability of growth mindset interventions to bolster resilience and inspire "productive persistence" (Mills and Mills, 2018, p. 1050) is significant for these students. Despite the proponents of growth mindset in the last decades, researchers are reevaluating the meaning and importance of growth mindset and effectiveness of the interventions. Very recently, Macnamara and Burgoyne (2023) argued that growth mindset interventions did not yield meaningful effect sizes, after performing a meta-analysis including sixty-three studies. In response to this, Yan and Schuetze (2023) offered possible solutions in moving forward with supporting growth mindset by developing better measurements, developing broader spectrum interventions, etc.

The current study aims to add to the research in this area by investigating whether offering business students in a community college the opportunity to correct mistakes can encourage them to exercise a growth mindset and practice the skill of learning from failure and adversity. Many studies look at student performance as a measure of growth mindset after students are subjected to typical growth mindset interventions. In this study, the sole intervention was the feedback and revision opportunity itself and the measures of performance were students' change in growth mindset and their perception of their learning, rather than grades. As shown in Figure 1, this study aimed to introduce a tool that would increase student performance through practice and effort, and, thereby, increase their growth mindset. The underlying idea is that by persevering and revising assignments multiple times they will learn that practice and effort really do pay off. This in turn will help them see the value of learning from mistakes, see their intelligence as changeable and be less likely to give up under challenging conditions. These are desirable attributes of a growth mindset. Future iterations of the study may investigate the impact of adding other more traditional interventions as well.
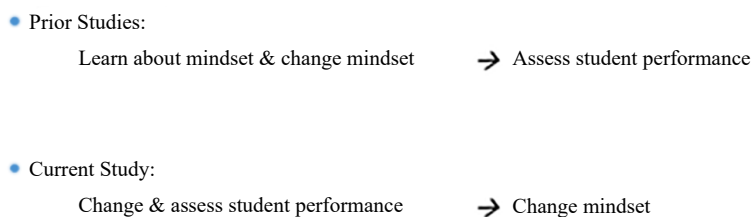
- Prior Studies:
  Learn about mindset & change mindset → Assess student performance

- Current Study:
  Change & assess student performance → Change mindset

Figure 1. Mindset and experience pathways

Additionally, the current study acknowledges the importance of instructors maintaining their own high growth mindsets in relation to their student's intelligence and abilities. By allowing students to resubmit certain assignments multiple, and potentially, an infinite number of times, the investigators in the current study were essentially telling their students that they believe in them and that with effort the sky is the limit. This is particularly relevant since the participants were community college students who traditionally exhibit higher levels of persistence and resilience challenges.

3. Materials and methods

This study ran with five sections of Principles of Macroeconomics and four sections of Fundamentals of Business during Spring 2018 and Fall 2018. Principles of Macroeconomics and Fundamentals of Business are introductory survey courses in the Department of Business Associate of Applied Science (AAS) degree program at the City of New York (CUNY) Kingsborough Community College. Data was collected from 219 students enrolled in hybrid or technologically enhanced courses and participated in several questionnaires in order to collect students' perceptions about the educational tools exercised in these courses and their effects on students' mindsets.

Faculty teaching these courses provided students with an environment that could affect students' educational experiences, which in turn could affect students' mindset, as shown in Figure 1. Students were given several online

assignments that could be revised and resubmitted an unlimited number of times until the deadline, with the highest score counting towards the students' grade on the assignment. Such an environment allows students to re-attempt and change their academic success in the course. To investigate whether students' growth mindset changes when given the chance to revise their online multiple-choice assignments, two mindset questionnaires were administered to students, one at the beginning and one at the end of the semester after students had been allowed to resubmit online assignments throughout the semester. Also, to analyze students' perception of their opportunity to resubmit assignments, a third questionnaire was administered at the end of the semester, asking students particular questions about their experience and behavior given the opportunity to revise assignments.

Students accessed the online assignments by logging into their Blackboard accounts. The students had the option of resubmitting the online assignments, potentially, an infinite number of times, and only the highest scored attempt would be counted towards their final course grade. After each attempt, students received their score, indicating how many questions they missed but were not told which ones they missed. Students were provided with an answer key after the deadline, but during their trial period while they could resubmit the assignment they were encouraged to find and correct their mistakes on their own. This searching and correcting process was designed to encourage active learning by having learners discover their mistakes because "… when learn [ers] commit errors and are given corrective feedback, the errors are not learned" (Brown et al., 2014; p. 90).

3.1 *Consent form*

An oral consent was administered in class during the first two weeks of the semester and a digital copy was also uploaded on Blackboard to be accessed by students throughout the semester. The consent form presented the goals of the research, described the anonymous aspect of the data collection, and the voluntary participation.

3.2 *Online assignments*

Students were given four (4) to ten (10) online multiple-choice assignments throughout the semester. All online assignments were administered via Blackboard and counted towards 20-25 percent of the final grade, making them relatively important to the student grade and incentivizing students to work on them. Each online assignment was untimed and contained 10 to 25 multiple choice questions. After each attempt, students were able to see their score and how many questions they answered incorrectly, but they had to identify the incorrect answers on their own and resubmit. After the deadline, all correct answers were identified but students were no longer able to resubmit the assignment. The students were not provided with information about their mistakes during the trial period because they were encouraged to review all the questions and to search for the mistakes on their own. This was designed intentionally to encourage active learning by having learners discover their mistakes and learn from the errors. Corrective feedback was provided only after the deadline of the assignments and end of the trial period.

3.3 *Growth mindset questionnaire*

Students were asked to complete a mindset questionnaire twice, once in the first two weeks of the semester and a second time in the last two weeks. This questionnaire, as shown in Appendix A, aimed at assessing students' positions on the fixed/growth mindset spectrum. It was initially retrieved from the New York City (NYC) Department of Education website on January 9, 2018, and permission for its use was received from the creator, Mindset Works Inc. This Mindset Questionnaire has been part of the SchoolKit, which was "CODiE Awards Finalist for Best Instructional Solution in Other Curriculum Areas" in 2013 and is highlighted as a "provider of recommended growth mindset programs in the U.S. DoED's National Education Technology Plan" (Mindset Works, Inc. 2023). There is no indication as to how this questionnaire was crafted and its psychometric properties. However, it is considered appropriate to incorporate it in this study as it since it was crafted based on Carol Dwecks research and has a history of extensive use by other educational institutions (Mindset Works, Inc. 2023).

Participation was anonymous and voluntary. Table 1 shows the student participation during the anonymous questionnaires administered at the beginning and end of the semester.

Table 1. Number of students participating during spring 2018 and fall 2018

Courses	Questionnaire 1 (Beginning of the semester)	Questionnaire 2 (End of the semester)
Fundamentals of business	84	61
Principles of macroeconomic	135	118
Total	219	179

Students who chose to participate were asked to write down a personally selected code, which they would use again when completing the same questionnaire at the end of the semester. This unique code ensured anonymity while still allowing the pairing of the two surveys completed by the same student without linking them to the identity. Table 2 shows that out of 219 students who participated at the start of Spring 2018 and Fall 2018, only 114 students' surveys were paired, after discarding any questionnaire that was not able to be paired. The loss of the data was due to the inability of pairing the beginning and end surveys, which resulted from various reasons, such as students withdrawing the class, being absent and unable to take the second questionnaire, opting out, or simply forgetting the code that enabled the pairing. The code was chosen individually and allowed the questionnaire to be anonymous, which also was a requirement for the exemption application with the Institutional Review Board (IRB). Despite the loss of half of the data, the pairing was considered a necessary tool in disaggregating and analyzing the data as it will be shown.

Table 2. Mindset questionnaire participation

Semester	Course & Section	Mindset questionnaire
Spring 2018	Principles of macroeconomics-Section 3	21
Spring 2018	Principles of macroeconomics-Section 4	13
Spring 2018	Principles of macroeconomics-Section 6	16
Spring 2018	Fundamentals of business-Section 3	6
Spring 2018	Fundamentals of business-Section 14	5
Fall 2018	Principles of macroeconomics-Section 5	17
Fall 2018	Principles of macroeconomics-Section 10	13
Fall 2018	Fundamentals of business-Section 12	9
Fall 2018	Fundamentals of business-Section 14	14
-	Total number of students whose mindset questionnaire were paired	114

3.4 *Perception questionnaire*

To capture students' perception of their ability to correct and resubmit an online assignment, an additional questionnaire was administered at the end of the semester along with the mindset questionnaire. Students were informed that their participation was anonymous, voluntary, and unrelated to their coursework and grading for the courses. This questionnaire shown in Appendix A was only administered during Fall 2018 and the student participation is shown in Table 3.

Table 3. Perception questionnaire participation

Semester	Course & Section	Mindset questionnaire
Fall 2018	Principles of macroeconomics-Section 5	31
Fall 2018	Principles of macroeconomics-Section 10	19
Fall 2018	Fundamentals of business-Section 12	13
Fall 2018	Fundamentals of business-Section 14	19
-	Total number of students	82

4. Results

4.1 *Positive student perception*

Table 4 and Figure 2 show the results of the perception questionnaire, indicating that most students felt that their learning was enhanced significantly when allowed to revise and re-attempt the online multiple-choice assignments.

Table 4. Perception questionnaire regarding revision and multiple attempts (Fall 2018)

| Questions (N = 82)	Strongly agree or agree N (Mean, Std. Dev.)	Not agree or not disagree N (Mean, Std. Dev.)	Strongly disagree or disagree N (Mean, Std. Dev.)
Q1: I reviewed my notes or textbook materials before I submitted my first attempt at the online assignments.	62 (76%, 0.43)	10 (12%, 0.33)	10 (12%, 0.33)
Q2: When I was allowed multiple attempts, I reviewed my notes or textbook materials in between submissions.	64 (78%, 0.42)	13 (16%, 0.37)	5 (6%, 0.37)
Q3: I submitted assignments multiple times when I was given the opportunity to do so.	61 (74%, 0.44)	12 (15%, 0.36)	9 (11%, 0.31)
Q4: I improved my score when I was allowed to submit multiple times.	69 (84%, 0.37)	10 (12%, 0.33)	3 (4%, 0.19)
Q5: I learned the material better when I was allowed to submit multiple times.	66 (80%, 0.40)	13 (16%, 0.37)	3 (4%, 0.19)
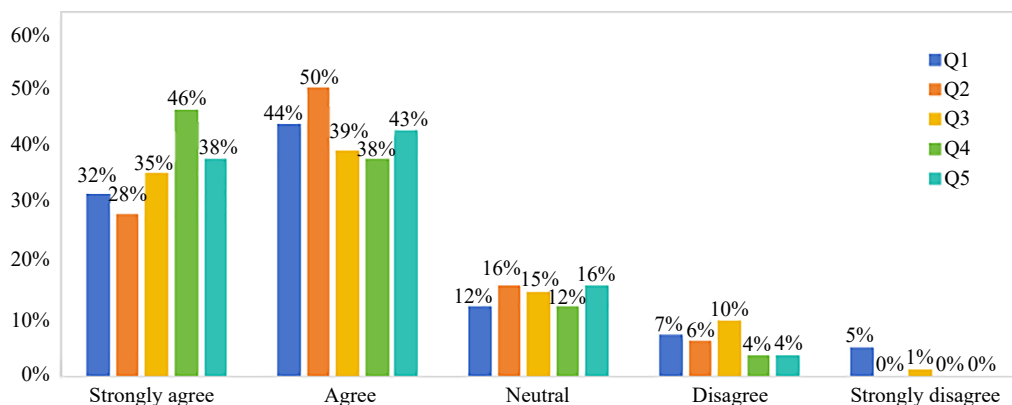
Figure 2. Students' perception on revision and multiple attempts (Fall 2018)

Unlike other studies (for example, Rhodes & Sarbaum, 2015; Orchard, 2016) suggesting that multiple attempts may lead to guessing behavior, this study shows that students deny engaging in this type of behavior. Table 4 shows that only 5 to 10 percent of the students disagreed with question 1 and 2, respectively, while over 76 percent of the students stated that they reviewed their notes either before the first attempt or other multiple attempts. Since the survey was anonymous, it is unlikely that students misrepresented their behavior.

These findings are consistent with the prior study of Tila and Levy (2020) finding that 91 percent of students enrolled in Spring 2017 and 2018 reported in their perception questionnaires that they reviewed the material before resubmitting the assignment. In the prior study, however, the questionnaire only requested that students provide a yes/ no answer as to whether they reviewed their notes. This might account for the potential overstatement of students' optimism. The perception questionnaire delivered during Fall 2018 provided students with the additional opportunity to provide a more detailed answer through a Likert scale designed with five options as well as space for an open-ended response whereby students could explain their behavior in between attempts in their own words. The students' qualitative responses did not indicate any guessing behavior, and this is consistent with the quantitative data.

4.2 *Growth mindset profile*

At the beginning of the semester, an eight-question mindset questionnaire was administered to students. Each question provided the student with six possible answers ranging from one side of the spectrum of "Disagree A Lot" (corresponding to one), to the other side of the spectrum of "Agree A Lot" (corresponding to six). This questionnaire was retrieved from the NYC Department of Education website on January 9, 2018. It was designed by Mindset Works Inc., which granted us access. The questionnaire along with directions on how to calculate the profile number is shown in Appendix B. Once the points are added from all the eight questions, each participant would have a profile number that provides an indication of the one's growth mindset. This questionnaire maps ten possible profiles, F5-F1 as a variety of fixed mindsets and possible profiles G1-G5 as a variety of growth mindsets. Figure 3 provides the detailed description of the ten possible mindset profiles.

If your profile number fallsinto this range:	Then your MAP (Mindset Assessment Profile)group is:	People in this MAP group usually believe the following things:
8-12	F5	You strongly believe that your intelligence is fixed-it doesn't change much. If you can't perform perfectly you would rather not do something. You think smart people don't have to work hard.
13-16	F4	
17-20	F3	You lean toward thinking that your intelligence doesn't change much. You prefer not to make mistakes if you can help it and you also don't really like to put in a lot of work. You may think that learning should be easy.
21-24	F2	
25-28	F1	You are unsure about whether you can change your intelligence. You care about your performance and you also want to learn, but you don't really want to have to work too hard for it.
29-32	G1	
33-36	G2	You believe that your intelligence is something that you can increase. You care about learning and you're willing to work hard. You do want to do well, but you think it's more important to learn than to always perform well.
37-40	G3	
41-44	G4	You really feel sure that you can increase your intelligence by learning and you like a challenge. You believe that the best way to learn is to work hard, and you don't mind making mistakes while you do it.
45-48	G5	

Figure 3. Mapping the student profile number to the profile description

Students were only provided with eight questions and were not informed of any additional information, including

a description of profiles, calculation of profile number, or growth and fixed mindset theory. Students were only asked to provide the answer for each question without adding or calculating the profile number. The exact same questionnaire was provided at the beginning and at the end of the semester, asking students to write their personally selected code but not their names. A personally selected code was used to later pair the questionnaires submitted by the same student while keeping the process anonymous.

4.3 *Growth mindset shifts and findings*

This study's most important focus and significant difference from other studies was use of more traditional growth mindset interventions and the turning away from the use of traditional performance measures, such as grades, and instead investigating a new dimension of measuring students' success through measuring shifts or increases in their growth mindset using new growth mindset intervention tool. In other words, does the way students view the world, in terms of whether they can change their level of intelligence, shift when they are allowed to revise their online assignment and get rewarded for their efforts in doing so? Figure 4 compares the range and frequency of profile types between the beginning and end of the semester during the period of investigation, including nine course sections during Spring and Fall 2018. This data suggest a slight shift to the right, meaning that students tend to shift towards a growth mindset by the end of the semester, after having been given the opportunity to revise their work.
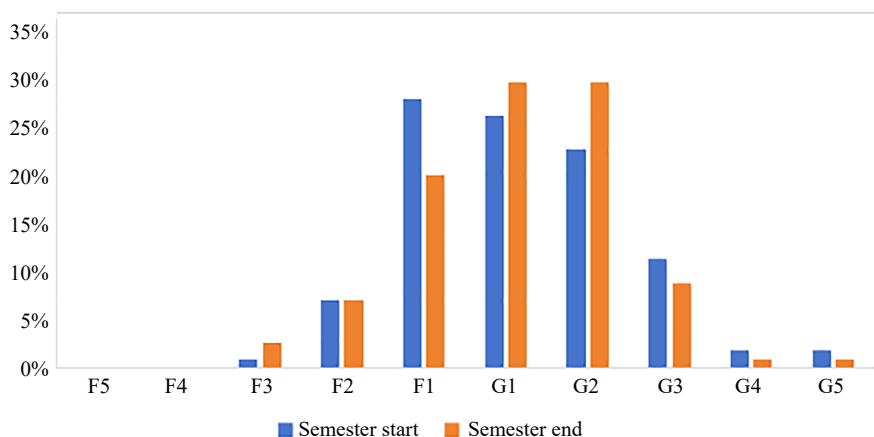

Figure 4. Range and frequency of profile types at the beginning and end of the semester spring 2018 and fall 2018

Figure 5 shows the changes that occurred by type and adjusted for each type. For example, 47 percent and 16 percent of the students who started with a profile F1, meaning a fixed mindset at the margins and one step away from moving towards a growth mindset, experienced an increase or no change in their mindset by the end of the semester, respectively. However, 47 percent increase relates only to the starting profile type F1, who represented 28 percent of the samples size. So, the increase in profile adjusted for such proportion of F1 types on the total sample would be an adjusted increase of 13 percent (e.g., 47% × 28%), as shown in Figure 5. For detailed calculations, please visit Appendix C. Figure 5 suggests that most of the students who started with a marginally fixed growth mindset (e.g., profile types of F2, F1) experienced growth in their mindset while, students who started with a marginally growth mindset (e.g., profile G1 and G2), experienced no change or a slight decrease in their growth mindset. This data suggests that this tool had different effects on different students, and it was mostly efficient on the students who need the most help, those with marginally fixed mindset.
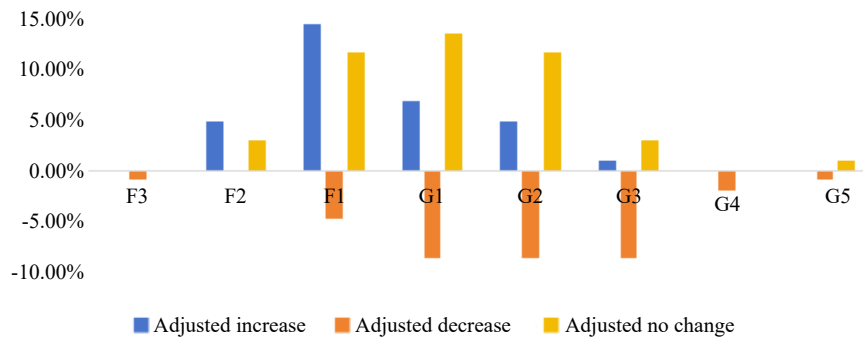
Figure 5. Adjusted changes at the end of the semester by profile types at the start of the semester spring 2018 and fall 2018

To establish whether the shifts in Figures 4 and 5 are statistically significant, further testing was performed. An ANOVA test was conducted with the null hypothesis that there is no difference between the average mindset profiles of students during the beginning and end of the semester. The ten possible mindset profile types ranging from F5, as the most fixed mindset, to G5 as the most growth mindset were converted to a score from 1 to 10 to match the profile type from F5 to G5, as described in Figure 3. The average mindset profile of the students shows to be about 6.1 which corresponds to profiles G1-G2 whereby students on average seem to think that intelligence is something they can increase (G2) but do not know how to do that (G1). To understand whether students' growth mindset increased during the semester, the paired two sample t-test was conducted comparing beginning and end of semester responses. The results in Table 5 show that the null hypothesis is not rejected concluding that there is no statistical difference in the mindset profile type of all the students. However, as Figure 5 suggests, this treatment had a different impact based on the initial type of the students. When the sample is split in two sample groups, fixed mindset students (i.e., profile types F5 through F1) and growth mindset students (i.e., profile types G1 through G5), the results of the paired two sample t-test, two tail and one tail, provide a low p-value of 0.001, hence, suggesting a statistically significant impact. The findings show that 36 percent of the students (i.e., 41 out of 114) started with a fixed mindset with an average profile type of 4.76 corresponding to F1 and experienced a growth of 13.33 percent moving them to profile type G1 with an average of 5.39. These results are statistically significant and suggest that the treatment used during the semester helped the fixed mindset students to move to growth mindset, but it was not efficient for already growth mindset students, who even though they experienced a slight decline, they remained within the growth mindset profile.

Table 5. Results of paired two sample t-test of mindset profile (two tail & one tail)

Variable	Observations	Mean	Variance	t-test P	z-score P	Mann whitney test P
Types: F5-G5 with score 1-10	-	-	-	-	-	-
Beginning of the semester	114	6.13	1.76	< 0.44	-	-
End of the semester	114	6.11	1.59	-	-	-
Fixed mindset start: F5-F1 (1-5)	-	-	-	-	-	-
Beginning of the semester	41	4.76	0.24	< 0.001*	-2.6246	< 0.008*
End of the semester	41	5.39	1.34	-	-	-
Growth mindset start: G1-G5 (6-10)	-	-	-	-	-	-
Beginning of the semester	73	6.90	0.95	< 0.001*	-0.2751	< 0.779
End of the semester	73	6.52	1.28	-	-	-

The t-test is a parametric test that assumes the sample is drawn from a normal distribution. If such an assumption is relaxed, then a nonparametric test should be performed. The Mann-Whitney U test is the nonparametric equivalent of

the independent t-test (Leech et al., 2005). The data are independent because the scores of students do not affect those of other students within and across the treatments. The data is ordinal scale of measurement fulfilling the conditions for conducting a nonparametric test (Brace et al., 2006). The results are similar to those of the parametric test: a statistical difference was to the mindset of the students who initially started with fixed mindset, to the 5% level.

The data from the perception and mindset questionnaires help put together some pieces of the puzzle: 1) students like to have the opportunity to resubmit their online assignments; 2) students do take advantage of this revision opportunity; 3) students perceive that such revision opportunity not only improves their scores but also improves their learning; 4) students review their notes prior to submitting the first and consecutive times while not engaging primarily in guessing behavior; and 5) findings suggest that providing students with a revision opportunity positively impact students in need, the ones who start with a fixed mindset.

5. Conclusions

This study grounds itself in the work of Dweck (1999; 2006) on mindset in the educational context. More specifically, students with growth mindsets emphasize learning goals, value effort, and appreciate failure as an opportunity to learn. As a result of such a view, according to Dweck (1999; 2006), students with growth mindsets expect to put more time and effort into their work and are more persistent in achieving their goals even under challenging conditions. The literature converges on the same conclusion that a growth mindset, which considers intelligence as moldable rather than fixed, would lead students to achieve results through practice and effort, which is a desirable characteristic. Prior studies have acknowledged the benefits of growth mindset by intervening various interventions and using assessments to measure the degree of change in students' performance. However, recognizing that mindset and experience feed on each other, this study focused on the reverse direction by directly measuring students' mindset before and after introducing the assessment tool that was designed to increase growth mindset. Instead of using assessments and course experience as a measure of mindset change, and instead of using grades as a measure of student success, this study used the mindset as an odometer to measure the learning environment's success. In other words, rather than focusing on traditional measures of what the instructor or institution consider improvement or success, this study evaluates the efficacy of a pedagogical tool, in this case revision and resubmission of assignments, through students' mindset and students' perception.

The study shares the findings from a study on 217 community college students enrolled in Economics and Business courses that were allowed to revise and resubmit online assignments. The findings show 1) positive student perception of improved score and improved learning; 2) prompted students to review the material prior to resubmitting, as per students' statements, undermining the arguments of guessing behavior from prior studies; and 3) helped the students with fixed mindset to move towards growth mindset. Capturing students' statements in anonymous questionnaires showed that students not only revised and resubmitted their online work, but they also undertook an extensive revision process by reviewing their notes prior to resubmission, rather than guessing as it was suggested in prior studies. This multiple attempt opportunity did indeed change students' behavior by making them retry and by increasing their positive perception and it also helped the students in need who started with a fixed mindset. However, this tool did not seem to be efficient for students who already had a growth mindset. This could be due to the short period of time with one semester being insufficient to measure a change of the students' view of the world and their intellectual abilities. In addition, there might have been other courses and experiences that may have affected the students that could not be isolated in this data analysis, or simply had no possible impact. To get a better view of this picture, further research needs to be conducted. Future research will be geared towards understanding the learning process of learn-by-reworking, how to measure any changes in a growth mindset over a period longer than one semester, and what tools work better for students with fixed mindset and the ones who already have shifted into the growth mindset spectrum.

Continued research in growth mindset is particularly significant for community college students. In light of the fact that approximately sixty percent of community college students are required to take at least one remedial course, many of these students may already start college questioning their intelligence and being skeptical about their chances of completing their degree (Mills & Mills, 2018). The ability of growth mindset interventions to bolster resilience and inspire "productive persistence" (Mills and Mills, 2018, p. 1050) is significant for these students. This study confirms

that even simple tools that encourages students to revise and resubmit work can shift fixed mindset students towards growth mindset. It is even more important to look at other methods of increasing growth mindset, as compared to the traditional methods and tools for impacting mindset, because recent studies have shed doubt on the efficacy of traditional interventions to show a true cause and effect upon performance. For example, Macnamara and Burgoyne (2023), in a meta-analysis of many growth mindset studies, argue that due to other variables that might be impacting achievement and that no systematic evaluation of the quality and quantity of growth mindset interventions, the current evidence does not support claims that growth mindsets are beneficial for students' academic achievement. Similarly, the same researchers posit that the mindset questionnaire often used in mindset studies "appears to assess an individual's need for cognition and goal orientation more than mindset (Macnamara & Burgoyne, 2023). Thus, this study's use of the revision opportunity as an untraditional mindset intervention tool could prove even more promising for future research in the field.

Acknowledgement

Conflict of interest

The authors declare no competing financial interest.

References

Angus, S. D., & Watson, J. (2009). Does regular online testing enhance student learning in the numerical sciences? Robust evidence from a large data set. *British Journal of Educational Technology, 40*(2), 255-272.

Blackwell, L. S., Trzesniewski, K. H., & Dweck, C. S. (2007). Implicit theories of intelligence predict achievement across an adolescent transition: A longitudinal study and an intervention. *Child Development, 78*(1), 246-263.

Brace, N., Kemp, R., & Snelgar, R. (2006). *SPSS for psychologists: A guide to data analysis using SPSS for Windows* (3rd ed.). Lawrence Erlbaum Associates Publishers.

Brougham, L., & Kashubeck-West, S. (2017). Impact of a growth mindset intervention on academic performance of students at two urban high schools. *Professional School Counseling, 21*(1), 1-9.

Brown, P. C., Roediger III, H. L., & McDaniel, M. A. (2014). *Make it stick: The science of successful learning.* Cambridge, Massachusetts: The Belknap Press of Harvard University Press.

Bulut, O., Gorgun, G., Yildirim, E. S. N., Wongvorachan, T., Daniels, L. M., Gao, Y., Lai, K. W., & Shin, J. (2023). Standing on the shoulders of giants: Online formative assessments as the foundation for predictive learning analytics models. *British Journal of Educational Technology, 54*(1), 19-39.

Cutts, Q., Cutts, E., Draper, S., O'Donnell, P., & Saffrey, P. (2010). Manipulating mindset to positively influence introductory programming performance. *Proceedings of the 41st ACM Technical Symposium on Computer Science Education*, 431-435. https://doi.org/10.1145/1734263.1734409

Cain, J., Medina, M., Romanelli, F., & Persky, A. (2022). Deficiencies of traditional grading systems and recommendations for the future. *American Journal of Pharmaceutical Education, 86*(7), 908-915.

Carey, K. (2017, October 31). *Revised data shows community colleges have been underappreciated.* The New York Times. https://www.nytimes.com/2017/10/31/upshot/revised-data-shows-community-colleges-have-been-underappreciated.html

Chen, X. (2016). *Remedial course-taking at U.S. public 2- and 4-year institutions: Scope, experiences, and outcomes (NCES 2016-405).* Washington, DC: National Center for Education Statistics.

Cutumisu, M. (2019). The association between feedback-seeking and performance is moderated by growth mindset in a digital assessment game. *Computers in Human Behavior, 93*(1), 267-278.

Dweck, C. S. (1999). *Self-theories: Their Role in Motivation, Personality and Development.* Philadelphia, PA: Psychology Press.

Dweck, C. S. (2006). *Mindset: The New Psychology of Success*. New York, Random House Digital, Inc.

Dweck, C. S., & Leggett, E. L. (1988). A social-cognitive approach to motivation and personality. *Psychological Review, 95*(2), 256-273.

Evans, D. R., Zeun, P., & Stanier, R. A. (2014). Motivating student learning using a formative assessment journey. *Journal of Anatomy, 224*(3), 296-303.

Leech, N., Barrett, K., & Morgan, G. (2015). *SPSS for Intermediate Statistics: Use and Interpretation* (5th ed.). Routledge Publishers.

Lima, K. R., das Neves, B. H. S., Ramires, C. C., dos Santos Soares, M., Ávila Martini, V., Lopes, L. F., & Mello-Carpes, P. B. (2020). Student assessment of online tools to foster engagement during the COVID-19 quarantine. *Advances in Physiology Education, 44*(4), 679-683.

Mills, I. M., & Mills, B. S. (2018). Insufficient evidence: Mindset intervention in developmental college math. *Social Psychology of Education, 21*(5), 1045-1059.

Macnamara, B. N., & Burgoyne, A. P. (2023). Do growth mindset interventions impact students' academic achievement? A systematic review and meta-analysis with recommendations for best practices. *Psychological Bulletin, 149*(3-4), 133-173.

Marden, N. Y., Ulman, L. G., Wilson, F. S., & Velan, G. M. (2013). Online feedback assessments in physiology: Effects on students' learning experiences and outcomes. *Advances in Physiology Education, 37*(2), 192-200.

Mtshali, N. G., Harerimana, A., Mdunge, V. N., & Mthembu, S. Z. (2022). Postgraduate students' experiences with learning management systems at a selected nursing education institution in KwaZulu-Natal Province. *African Journal of Health Professions Education, 14*(2), 89-97.

Mindset Works Inc (2023). The Mindset Works Story: From an Idea to a Movement. https://www.mindsetworks.com/about-us/our-history

Orchard, R. K. (2016). Multiple attempts for online assessments in an operations management course: An exploration. *Journal of Education for Business, 91*(8), 427-433.

Pizzolato, J., Olson, A., & Monje-Paulson, L. (2017). Finding motivation to learn: Exploring achievement goals in California Community College CalWORKS students. *Journal of Adult Development, 24*(4), 295-307.

Rhodes, T. M., & Sarbaum, J. K. (2015). Online homework management systems: Should we allow multiple attempts? *American Economist, 60*(2), 120-131.

Richards-Babb, M., Curtis, R., Georgieva, Z., & Penn, J. H. (2015). Student perceptions of online homework use for formative assessment of learning in organic chemistry. *Journal of Chemical Education, 92*(11), 1813-1819.

Simon, P., Jiang, J., & Fryer, L. K. (2023). Measurement of higher education students' and teachers' experiences in learning management systems: A scoping review. *Assessment & Evaluation in Higher Education*, 1-12. https://doi.org/10.1080/02602938.2023.2266154

Tila, D., & Levy, D. (2020). Revising online assignments and the impact on student performance at a community college. *Community College Journal of Research and Practice, 44*(3), 163-180.

Tinoca, L., & Oliveira, I. (2013). Formative assessment of teachers in the context of an online learning environment. *Teachers & Teaching, 19*(2), 221-234.

Yan, V. X., & Schuetze, B. A. (2023). What is meant by "growth mindset"? Current theory, measurement practices, and empirical results leave much open to interpretation: Commentary on Macnamara and Burgoyne (2023) and Burnette et al (2023). *Psychological Bulletin, 149*(3-4), 206-219. https://doi.org/10.1037/bul0000370

Yeager, D., & Dweck, C. (2012). Mindsets that promote resilience: When students believe that personal characteristics can be developed. *Educational Psychologist, 47*(4), 302-314.

Appendix A

QUESTIONNAIRE
ECO 1200, ECO 1300, BA 11

This questionnaire asks your opinion about your experience submitting online assignments in this class. Your answers are anonymous and will not affect your grade in this class.

1. I reviewed my notes or textbook materials before I submitted my FIRST attempt at the online assignments.

5	**4**	**3**	**2**	**1**
Strongly Agree	**Agree**	**Neither Agree Nor Disagree**	**Disagree**	**Strongly Disagree**

2. When I was allowed MULTIPLE atteinpts, I reviewed my notes or textbook materials in berween submissions.

5	**4**	**3**	**2**	**1**
Strongly Agree	**Agree**	**Neither Agree Nor Disagree**	**Disagree**	**Strongly Disagree**

3. I submined assignmencs MULTTPLE tmes when I was given the opportnity to do so.

5	**4**	**3**	**2**	**1**
Strongly Agree	**Agree**	**Neither Agree Nor Disagree**	**Disagree**	**Strongly Disagree**

4. I improved my score when I was allowed to submir mnlriple times.

5	**4**	**3**	**2**	**1**
Strongly Agree	**Agree**	**Neither Agree Nor Disagree**	**Disagree**	**Strongly Disagree**

5. I learned the material better when I was allowed to submit multiple times.

5	**4**	**3**	**2**	**1**
Strongly Agree	**Agree**	**Neither Agree Nor Disagree**	**Disagree**	**Strongly Disagree**

6. When you submitted multiple times, what strategies or tools did you use in between submissions to help improve your score?

_____

_____

7. What changes, if any, would you suggest be made to the mulriple submission of assignments?

_____

_____

8. Would you want the opportuniry to resubmit assignments in all your classes? Why or why nor?

_____

_____

CUNY
University Integrated IRB
Protocol: 2016-0342

Appendix B

Growth mindset questionnaire

Mindset Works© EducatorKit-Module 1 Toolkit

MINDSET ASSESSMENT PROFILE   Name: _____

This is NOT a test! It is an opinion survey about beliefs and goals regarding ability and performance. It is very important that you give your honest opinion, not what you believe someone else would think best. Read each statement, decide how much you agree or disagree with the statement, and circle your answer.

Do you Agree or Disagree?	Disagree A Lot	Disagree	Disagree A Little	Agree A Little	Agree	Agree A Lot	Profile Number
1. No matter how much intelligence you have, you can always change it a good deal.	1	2	3	4	5	6	
2. You can learn new things, but you cannot really change your basic level of intelligence.	1	2	3	4	5	6	
3. I like my work best when it makes me think hard.	1	2	3	4	5	6	
4. I like my work best when I can do it really well without too much trouble.	1	2	3	4	5	6	
5. I like work that I'll learn from even if I make a lot of mistakes.	1	2	3	4	5	6	
6. I like my work best when I can do it perfectly without any mistakes.	1	2	3	4	5	6	
7. When something is hard, it just makes me want to work more on it, not less.	1	2	3	4	5	6	
8. To tell the truth, when I work hard, it makes me feel as though I'm not very smart.	1	2	3	4	5	6	
MINDSET ASSESSMENT PROFILE NUMBER							

Mindset Works® EducatorKit

Creating Your Mindset Assessment Profile

1. First, determine your Profile Number for each question.
● For questions with odd numbers (1, 3, 5, 7), write the number of your answer into the boxes in the right column.
● For questions with even numbers (2, 4, 6, 8), use the table below to fill in the gray boxes in the right column.

If you chose this answer:	Then write this number in the gray box on the right (Profile Number).
Disagree A Lot (1)	6
Disagree (2)	5
Disagree A Little (3)	4
Agree A Little (4)	3
Agree (5)	2
Agree A Lot (6)	1

2. Now, add up all your Profile numbers.
● Add up all the numbers in the Profile column on the right, and write the total in the last box in the bottom right corner.

3. What does your Mindset Profile Number mean?
● Find the group that includes your number in the chart below and circle it.
● Now, read what it says about your MAP group.

If your profile number falls into this range:	Then your MAP (Mindset Assessment Profile) group is:	People in this MAP group usually believe the following things:
8-12	F5	You strongly believe that your intelligence is fixed-it doesn't change much. If you can't perform perfectly you would rather not do something. You think smart people don't have to work hard.
13-16	F4	
17-20	F3	You lean toward thinking that your intelligence doesn't change much. You prefer not to make mistakes if you can help it and you also don't really like to put in a lot of work. You may think that learning should be easy.
21-24	F2	
25-28	F1	You are unsure about whether you can change your intelligence. You care about your performance and you also want to learn, but you don't really want to have to work too hard for it.
29-32	G1	
33-36	G2	You believe that your intelligence is something that you can increase. You care about learning and you're willing to work hard. You do want to do well, but you think it's more important to learn than to always perform well.
37-40	G3	
41-44	G4	You really feel sure that you can increase your intelligence by learning and you like a challenge. You believe that the best way to learn is to work hard, and you don't mind making mistakes while you do it.
45-48	G5	

4. Do you think the description under your MAP group matches the
   your school work? Which parts are true for you and which are not

CUNY
University Integrated IRB

Protocol: 2016-0342
Approved: 03/09/2016

Appendix C

Growth mindset changes disaggregated by starting profile type data shown in Figure 5.

Type Start	% Type Start	% Increase	% Decrease	% No Change	Adjusted Increase	Adjusted Decrease	Adjusted No Change	Total Adjusted Change
-	a	b	c	d	(a × b)	(a × c)	(a × d)	(a × b) + (a × c) + (a × d)
F5	0%	0%	0%	0%	0%	0%	0%	0%
F4	0%	0%	0%	0%	0%	0%	0%	0%
F3	1%	0%	100%	0%	0.00%	0.88%	0.00%	1%
F2	7%	63%	0%	38%	4.39%	0.00%	2.63%	7%
F1	28%	47%	16%	38%	13.16%	4.39%	10.53%	28%
G1	26%	23%	30%	47%	6.14%	7.89%	12.28%	26%
G2	23%	19%	35%	46%	4.39%	7.89%	10.53%	23%
G3	11%	8%	69%	23%	0.88%	7.89%	2.63%	11%
G4	2%	0%	100%	0%	0.00%	1.75%	0.00%	2%
G5	2%	0%	50%	50%	0.00%	0.88%	0.88%	2%
-	100%	-	-	-	28.95%	31.58%	39.47%	100%