

# Students Self-Assessing Their Class Notes Builds Critical Thinking Skills

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Instructors expect students to take notes during class, but students are often unfamiliar with effective notetaking strategies. I study whether teaching students to take notes using self-assessments helps to improve student notetaking ability and aids students in understanding how to accurately evaluate their own notes. I designed a class notes assignment wherein students learned how to take notes and self-assessed their performance twice throughout an academic term. Using class notes and self-assessments from nine introduction to American politics courses with this assignment ( $N=194$ ), I show that students' notetaking ability improved during the course. Student self-assessments did tend to differ from notes grades, though the amount of improvement measured by self-assessed and graded notes was similar. The results suggest that instructors should think carefully about their expectations for student notetaking ability and consider incorporating opportunities for students to develop and assess their own notetaking strategies as part of course assignments.

Keywords: notetaking, self-assessment, assignments, writing skills.  
(6,384 words)

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As colleges and universities become increasingly focused on helping students transition into and be successful in post-secondary education, many institutions have created dedicated first year or transfer student centers. These centers produce guides, deliver workshops, and may even staff courses aimed at teaching students skills fundamental to their success in college and their careers. Notetaking is a popular topic with how-to-documents, self-assessment checklists, and tips filling center websites and first-year course curricula. Self-assessment criteria range from “Are you able to find your notes when you need them?” (University of Redlands) to more theoretical concepts like “Have you ever tried to tweak or revamp your note-taking style?” (Texas A&M).

The focus on teaching students’ notetaking skills is supported by a long line of research that reiterates the importance of good notetaking in all manner of measures of college success (e.g., Kobayashi 2006; Williams and Eggert 2002). While notetaking is a common topic for student resources and self-assessment checklists, Crowell (2015) finds that only one third of students engaged in any form of self-assessment during college. Further, students simultaneously have high confidence in their notetaking ability and about 20% of students report usually taking notes verbatim, which is not a notetaking best practice (Jansen, Lakens, and IJsselsteijn 2017; Witherby and Tauber 2019). Therefore, providing resources to aid in notetaking are clearly not reaching all students. Students largely do not know how to take effective notes (Van Der Meer 2012). Providing resources to aid in self-assessing notetaking assumes a baseline level of notetaking knowledge that often does not exist or may exist only in students with high levels of high school achievement (Carrier, Williams, and Dalgaard 1988).

For all of the emphasis on teaching notetaking, an under-explored opportunity is to do so as part of an assignment in a disciplinary course. This is likely because instructors take

notetaking skill as given, even though students are unfamiliar with how to take notes (Friedman 2014; Van Der Meer 2012). Indeed, Reed, Rimel, and Hallett (2016) find evidence of few classroom-based notetaking interventions. Such an intervention ensures that all students in the course are exposed to instruction about notetaking and provides a grade-based incentive for a student to seriously consider how they take notes. It can also help students understand when to take notes, a topic that is difficult to teach outside the context of a course environment (Morehead et al. 2019).

I describe a term-length notetaking assignment integrated into an introductory American politics course. The assignment relies heavily on students developing and assessing their own notetaking with the goal of helping students understand and develop effective notetaking strategies. Using student notes, self-assessments, and course grades across nine courses taught by the same instructor at a medium-sized public university in the Deep South, I examine both notetaking improvement over the term and the relationship between student self-assessments and graded notetaking performance. Student notetaking ability significantly improved over the course of the term. While students tend to assess their notes as higher in overall quality compared to graded performance, students do detect and meaningfully reflect on changes in notetaking performance, usually for the better, but also when their performance worsens. The results suggest that teaching notetaking skills in a disciplinary course can benefit all students --- not just first year students --- and reinforce course content such that adding such an assignment may be beneficial in many introductory courses.

## Course and Institution

I included a notetaking assignment (herein “class notes”) in nine introductory American politics courses that I taught during academic years 2021 to 2023.<sup>2</sup> The courses were taught at a medium-sized public university in the Deep South with about 8,600 undergraduate students. Courses are taught by faculty members; there are no teaching assistants. Though the course is fundamentally about American politics, it also serves as an introduction to political science for primarily non-majors, as it is the only introductory course offered in political science.<sup>3</sup> One faculty member consistently taught this course. The course has a typical enrollment of between 40 and 80 students for each section, and it is typically taught twice per term. Students in the course were overwhelmingly not political science majors; apart from being required for several social science-related majors, both nursing and education majors are required to take this course.

Class sessions occur in-person and include a mix of small group activities and discussion. Course content covers typical topics in American politics like local and federal institutions, civil rights and liberties, and political behavior. Also included are topics that introduce political science as a discipline like the social science research method, international politics, comparisons to other country contexts, and a lesson on political theory. Reoccurring assignments include using social annotation software to read and annotate political science journal articles before class, in-class short writing assignments, and a group civic engagement project. Students also complete a three-part scaffolded research memo assignment. The research memo is an abbreviated version of a research article wherein students identify a research question,

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<sup>2</sup> This project was approved by the Institutional Review Board (HUC-22-029). Replication data are provided on the author’s website. Copies of student class notes are withheld to protect student privacy.

<sup>3</sup> This is relatively standard in the discipline (Hierman 2021).

summarize relevant scholarly literature, develop a theoretical argument and hypothesis, propose a research design to test the hypothesis, and discuss policy implications.

## Class Notes Assignment

The class notes assignment is introduced on the first day of the term. The assignment is framed as helping students learn how to effectively take notes. As there are no exams in this course, the incentives for students to take notes beyond the fact that class notes are graded are two-fold: first, students use their notes during class for different activities, particularly concept mapping. Second, students need good class notes to understand how to complete the research memo and civic engagement project parts of the course. During the first few class sessions, I provide students with dedicated time to work on class notes. Students also talk with peers and compare class notes during in-class activities that occur before notes are due to be submitted.

Though I provide a general model for how students could approach notetaking, students are welcome to complete their class notes in whatever way they wish, provided that they meet the below described criteria that are listed in the syllabus. The suggested notetaking method is to take handwritten notes in an organized fashion with a header for each class. Students can then start their notes by listing objectives as they are discussed at the beginning of the class. I then suggest a generic framework for breaking course content into key terms and bulleted sections, emphasizing the relatively limited utility of copying from the slides used during class (e.g., Witherby and Tauber 2019). In fact, the three things I stress about class notes are organization, effective paraphrasing and detecting important concepts, and returning to notes after a class session to add items that may have been missed and to add a reflection thinking about what the

point of the class was and why the student might care about that point (Williams and Eggert 2002).

As many students remark that they have never taken notes before in either a high school or a college course, I encapsulate the above framework into a basic visual depiction that I place, alongside all other information about class notes, in the syllabus:

### **September 25: Introductory Class**

Objectives: [bulleted list of objectives]

Key Terms: [bulleted list of at least two key terms from class]

Notes: [numbered list with each topic/discussion/activity from class followed by detailed notes. Be sure not to just copy from the slides, as that is not very helpful!]

Reflection: [two sentence reflection on that day's class]

I am not an expert on different notetaking methods, and the purpose of this activity is for students to practice notetaking in a relatively low-stakes environment. Since so many students have never taken notes before, I opt to provide this guidance (essentially the outline method), encouraging anyone with more experience or familiarity with a particular notetaking method to use what works best for them (i.e., Cornell method).

Class notes are due twice: once about 40% of the way through the term and once at the end of the term. On a given due date, students submit the class notes that they have completed up to that point on the learning management system (Moodle) either by uploading a document or taking pictures of their notes. During class, students complete a notes self-assessment and engage in a concept mapping activity to review what has been learned thus far in the course. The self-assessment contains questions copied verbatim from the syllabus and reviewed several times earlier in the term, so students are not surprised by the evaluation criteria. The questions are:

1. My class notes are organized. Each class day is labeled with a heading, and I have used a consistent system to organize my notes.
2. My class notes are my own work. Copying notes from other students without appropriate attribution is considered plagiarism.
3. My class note entries are complete and sufficiently detailed and include notes from each class (including any I may have missed). Taking good notes involves summarizing, paraphrasing, and re-stating in your own words. My notes entries contain enough detail that a friend who is not in the class could use them to study for a quiz or test (and get a good grade!). In general, each entry should be 200+ words.<sup>4</sup>
4. If you were to evaluate your class notes on a grading scale from A to F with the majority of the grade being based on the “complete and sufficiently detailed” criterion, what grade would you assign and why? Please provide your self-assigned grade and a few sentences of explanation.

Effective notetaking of any type in a classroom-setting requires that these criteria are adhered to. Of notetaking methods, adhering to these criteria is most difficult using the concept map method. Students did not use this method for their class notes (and generally state that they dislike when we do concept mapping in class), though it would be possible to draw a concept map for each class period and add a reflection, thereby meeting the criteria. Question 1 requires students to organize the notes so that someone else could identify the class session a given set of notes is from. That is, I expect one set of notes from each class session. This is because students who are absent are responsible for still taking notes from classes that they miss utilizing resources like the slides provided on Moodle, conversations with friends in the class, and office hours. Of the criteria, students have disagreed with this criterion the most. Disagreement is rare, but a few students have stated that they prefer to write in a stream of consciousness style that makes organization unnecessary. Question 2 emphasizes that class notes are students’ own work, and that no two sets of class notes will be the same because students will not engage in the same

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<sup>4</sup> From Winter 2022 to Fall 2022, this was broken up into two questions: complete and detailed. I combined these questions to emphasize that they should constitute the majority of the grade self-evaluation in question (4).

activities or have the same responses to the class. While I ask students to provide an explanation for the other three questions, they are invited to simply state that the notes are their own work for this question.

Question 3 attempts to set a standard for detail in class notes. This is, of course, difficult because a student paraphrasing may do so more succinctly compared to a student copying from slides. Hence, the “give to a friend” criterion is included along with a minimum word count. With class sessions running 1 hour and 50 minutes, a 200 word paragraph is easy to achieve. Many class sessions involve group work, and I remind students that they can take effective notes about this work as well by discussing what occurred, their thoughts, and their reflections in notes that they might add after the class session is over.

Each class notes assignment is worth 5% of students’ grades. Grades are derived from question 4, where my intention is to match student self-assessments if at all possible. Student explanations for their self-assigned grade are often more informative, as they will discuss strengths and weaknesses of their notes and plans to improve (or how notes have improved) throughout the term. Using student self-evaluations, I assign grades and provide students with feedback. For the first set of notes, if students are assigned a grade that differs from their self-assessed grade, I discuss why the discrepancy occurred and suggest ways to improve notes going forward. Discrepancies typically involve the level of detail in the notes. Students will acknowledge that their notes are not sufficiently detailed, but then assess their performance as still at a high level. Detail is subjective (Siegel 2018), which is why I include a suggested minimum word count and I err on giving students the benefit of the doubt. One or two days of notes that are not detailed enough is not a reason to deviate from students’ self-assessed grades, but a pattern of little detail clearly differs from the established criteria. I received no complaints



about assessed class notes grades, though students did come by student office hours after the first class notes assignment to discuss strategies for improving their class notes.

This assignment generally follows the modeling, practicing, evaluating, and reinforcing method Stahl, King, and Henk (1991) designed. I provide students with a model structure, they practice notetaking with peers, they evaluate their first class notes assignment using the self-assessment, and notetaking best-practices are reinforced by the opportunity to submit a second set of class notes.

## Research Questions and Measurement

In evaluating class notes, I had two primary research questions. First, did students' notes improve between the first and the second class notes assignment? Improvement in this context can mean one of two things. *Assessed improvement* is the difference in the letter grade that students gave themselves for the second class notes assignment compared to the first assignment. *Graded improvement* is the difference in the letter grade that students received on the second class notes assignment compared to the first assignment. I expect that assessed and graded improvement will be statistically similar and will both show that students' class notes improved throughout the term. Since the class notes self-assessment asks students to intentionally reflect on their own work, they should be able to detect differences in their class notes between the first and second submission, adjusting accordingly to improve performance (Van Meter, Yokoi, and Pressley 1994). And, unless their first class notes submission was perfect, students will be motivated to improve their class notes both to earn a higher grade on the second submission and because class notes are emphasized as an important part of the learning process in this course (Strong, Davis, and Hawks 2004).

While student grades are points, not letter grades, students self-assessed their class notes using letter grades, so I converted all points to letter grade equivalents. Importantly, this means that a student whose self-assessed grade on the first class notes assignment was “a low A” and self-assessed grade on the second class notes assignment was “a 100%” is recorded as having not improved.<sup>5</sup> Focusing on letter grades eliminates the artificial precision associated with relying on differences in points. I compare both graded and self-assessed improvement. I also convert letter grades into a point scale (A=4, F=0) and conduct paired *t*-tests between the first and second class notes assignments. Additionally, I compare graded and actual improvement among students and conduct a *t*-test comparing the two types of improvement. I then use a linear regression model to predict graded improvement based on student classification, the college housing their major, term, and class time. A full description of the assignment, descriptive statistics, robustness checks, and a list of coded variables is in the Supplemental Information (SI).

The second research question considers what I call calibration. To what extent did students’ self-assessments match graded assessments in each class notes assignment? Since most students had not engaged in self-assessment prior to this activity, we might expect that they have a general sense of their class notes performance, but that there will be a noticeable gap in assessed and graded performance for the first class notes assessment, with students rating their performance higher than graded performance. This expectation follows results from Bonner and Holliday (2006) who found discrepancies between a standard set of class notes and student produced notes. After students have received feedback and become more familiar with the nature of the assignment, it is reasonable to expect that the calibration gap decreases on the second class

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<sup>5</sup> Further, there is a statistical bias against finding improvement because students who earned an “A” on the first class notes assignment cannot improve on the second assignment.

notes assignment (Panadero, Jonsson, and Botella 2017). On the other hand, the second class notes assignment occurred at the end of the term when students are typically more aware of their current course performance and have few remaining opportunities to improve their course grade. Therefore, it is possible that students continue to err on the side of rating their performance higher, meaning that the calibration gap continues (see Strong, Davis, and Hawks 2004).

I compare assessed and graded performance by taking their difference, where a positive difference indicates students' overrating their performance and a negative difference indicates students' under-rating their performance. I then compare the calibration gap between the first and second class notes assignments. I use linear regression models to predict the difference in actual and expected notes performance based on student classification, the college housing their major, term, and class time.

In investigating these research questions, I also look to students' actual notes to determine whether there are any systematic reasons that may encourage improvement or result in a calibration gap. I take particular interest in class sessions that were focused on simulations and group activities, as these class sessions require a notetaking strategy that may be less familiar to students.

## Improvement

Table 1 provides general information about student graded and self-assessed performance on both class notes assignments. Most students earned either an "A" or a "B" on the class notes assignment and evaluated themselves similarly. This is unsurprising because students had full access to the grading criteria at the beginning of the term, meaning that those students who took the assignment seriously and followed the criteria were almost guaranteed a good grade. In terms

of improvement, there were more “A” and “B” grades for the second notes assignment and substantially more self-assessed “A” grades for the second notes assignment.

Table 1: Class Notes Grades

|   | Notes 1 |      | Notes 2 |      |
|---|---------|------|---------|------|
|   | Graded  | Self | Graded  | Self |
| A | 0.29    | 0.33 | 0.36    | 0.54 |
| B | 0.38    | 0.40 | 0.42    | 0.38 |
| C | 0.18    | 0.22 | 0.13    | 0.06 |
| D | 0.07    | 0.04 | 0.03    | 0.02 |
| F | 0.08    | 0.01 | 0.06    | 0.01 |

Note: Percentage of students receiving given grades on each notes assignment along with their self-assessments.

Table 2 focuses on improvement by displaying the percentage of students who earned a certain grade on the first notes assignment and their corresponding grade on the second assignment along with a similar table for self-assessed performance. Starting with graded performance (left table), 52% of students’ notes did not improve between notes 1 and notes 2. Of course, 23% of students earned an “A” on both assignments, so improvement for those students was not possible, meaning that 29% of students who could have improved their class notes performance had the same performance in the second notes submission. However, almost a third of students, 32%, did improve their notes performance, while 16% of students’ performance worsened. Therefore, there was a 16% net increase in student performance between the two assignments. The most common change in performance was a one letter grade change.

Table 2: Improvement in Graded and Self-Assessed Performance

|   |   |   |   |   | Notes 2 |   |               |   |   |
|---|---|---|---|---|---------|---|---------------|---|---|
|   |   |   |   |   | Graded  |   | Self-Assessed |   |   |
| A | B | C | D | F | A       | B | C             | D | F |

|                                            |   |      |      |      |      |      |                   |      |      |      |      |
|--------------------------------------------|---|------|------|------|------|------|-------------------|------|------|------|------|
| Notes 1                                    | A | 0.23 | 0.05 | 0.01 | 0.01 | 0.01 | 0.30              | 0.03 | 0.00 | 0.01 | 0.00 |
|                                            | B | 0.10 | 0.23 | 0.05 | 0.01 | 0.00 | 0.19              | 0.20 | 0.02 | 0.00 | 0.01 |
|                                            | C | 0.01 | 0.10 | 0.04 | 0.01 | 0.02 | 0.05              | 0.13 | 0.04 | 0.01 | 0.00 |
|                                            | D | 0.01 | 0.03 | 0.02 | 0.00 | 0.01 | 0.00              | 0.02 | 0.01 | 0.00 | 0.00 |
|                                            | F | 0.01 | 0.02 | 0.01 | 0.00 | 0.02 | 0.00              | 0.00 | 0.00 | 0.00 | 0.00 |
| $t=2.99, p=0.003$                          |   |      |      |      |      |      | $t=5.93, p=0.000$ |      |      |      |      |
| Graded vs. Self-Assessed $t=1.11, p=0.268$ |   |      |      |      |      |      |                   |      |      |      |      |

Note: Percentage of students with a given notes 1 and notes 2 grade for graded and self-assessed notes. *t*-tests shown comparing notes 1 and notes 2 graded and self-assessed performance and the difference between graded and self-assessed performance.

Moving to self-assessed performance, 54% of students felt that their notes did not improve, though 30% of students self-assessed their performance as an “A” on both self-assessments, meaning that 24% of students who could have self-assessed improved performance did not do so. Fully 40% of students self-assessed improved performance compared to only 7% who stated that their second notes assignment was worse than their first. This led to a 33% net increase in self-assessed performance, with the most common change again being a one letter grade self-assessed increase or decrease.

Both graded and self-assessed performance increased by a statistically significant amount. Paired *t*-tests comparing the first and second class notes assignments based on graded performance ( $p=0.003$ ) and self-assessed performance ( $p=0.000$ ) show statistically significant increases in performance. Further, there was no difference in the detected change in graded performance compared to the change in self-assessed performance ( $p=0.268$ ). Therefore, while there appear to be some differences in graded and self-assessed performance (see below), as expected, both indicators demonstrate that students significantly improved their class notes from the first to the second assignment.

A natural follow-up question focuses on who improves the most? In a linear regression model predicting improved graded performance (see SI.3), students in classes taught during the

winter quarter (November to March) improved their performance statistically significantly more compared to the reference category of students taking the class during the fall quarter (September to November). Though speculation, there are several possible reasons for this finding. Students could be more into the rhythm of the academic year during winter quarter, as it is before students set their sights on summer break and after the start of the year. Winter quarter is interrupted by a two-week winter break, with the first class notes assignment due shortly after the break.

A less optimistic interpretation of this finding is that students in winter quarter tend to perform poorly on the first class notes assignment because it is due shortly after break. While the assignment is designed to be completed during and shortly after class sessions, some students do try to finish notes for several class sessions at the last minute. Indeed, only 25% of students in winter earned an “A” on the first class notes assignment, compared to 28% in spring and 36% in fall. On the other hand, fully 56% of students in winter earned an “A” on the second assignment, substantially higher than fall or spring. While the impacts of academic term on class notes improvement are worthy of future study, this result suggests that the initially low performance prompted, in part, by the winter break resulted in students making a more substantial effort to improve their class notes for the second assignment.

In reviewing the comments students’ left in their self-assessments, 33 of the 170 (19%) second notes self-assessments explicitly mentioned that the student felt they had improved from the first notes assignment. Recall that the self-assessment does not ask about improvement --- the same questions are on the first and the second assessment --- so it is notable that many students volunteered that they felt that their notes had improved. Students mostly discussed improvement in terms of more detailed notes in the second submission compared to the first one.

## Calibration

Both graded and self-assessed performance indicate that class notes improved throughout the term, but Table 3 shows that there are differences when comparing graded and self-assessed performance. Graded and self-assessed performance were the same for 63% of students on the first notes assignment and 57% on the second notes assignment. While 25% of students overrated their performance and 11% under-rated it for the first notes assignment, the percentage overrating increased to 33% for the second assignment, with 10% under-rating. Combining the two assignments, graded and self-assessed performance were the same 43% of the time. 40% of students overrated their performance at least once, whereas 17% of students under-rated their performance at least once. The average calibration gap is 0.60, which is equivalent to overrating by 60% of a letter grade. The calibration gap is statistically significant for both the notes 1 ( $p=0.000$ ) and notes 2 ( $p=0.000$ ) assignments.

Table 3: Calibration Between Graded and Self-Assessed Performance

|               |   | Notes 1           |      |      |      |      | Notes 2           |      |      |      |      |
|---------------|---|-------------------|------|------|------|------|-------------------|------|------|------|------|
|               |   | A                 | B    | C    | D    | F    | A                 | B    | C    | D    | F    |
| Self-Assessed | A | 0.24              | 0.08 | 0.01 | 0.01 | 0.00 | 0.31              | 0.14 | 0.07 | 0.02 | 0.01 |
|               | B | 0.05              | 0.25 | 0.05 | 0.02 | 0.03 | 0.05              | 0.25 | 0.07 | 0.00 | 0.01 |
|               | C | 0.01              | 0.05 | 0.11 | 0.02 | 0.03 | 0.00              | 0.04 | 0.01 | 0.00 | 0.02 |
|               | D | 0.00              | 0.00 | 0.01 | 0.03 | 0.01 | 0.00              | 0.01 | 0.00 | 0.00 | 0.01 |
|               | F | 0.00              | 0.00 | 0.00 | 0.00 | 0.01 | 0.00              | 0.00 | 0.00 | 0.00 | 0.01 |
|               |   | $t=4.01, p=0.000$ |      |      |      |      | $t=5.10, p=0.000$ |      |      |      |      |

Note: Percentage of students with self-assessed and graded performance for notes 1 and notes 2.  $t$ -tests shown comparing graded and self-assessed performance for notes 1 and notes 2.

Again, I am interested in the characteristics of students who exhibited a greater calibration gap (see SI.3). Examining the overall gap combining both notes assignments, students

in the winter quarters were significantly more likely to under-rate their performance. This effect was concentrated in the second notes assignment, implying that the lower grade that students tended to receive on the first class notes assignment prompted them to evaluate the second class notes assignment lower, *even though there was substantial improvement*.

Students who earned “B” course grades tended to overrate their performance compared to students who earned “A” course grades, indicating that students who earned lower course grades may be less accurate at calibrating their performance.<sup>6</sup> To see whether this is the case, I turn to survey questions included on beginning and end-of-term surveys asking students their expected grade in the course.<sup>7</sup> Among students who earned an “A” in the course, 81% correctly assessed their eventual performance in the beginning survey. This dropped to 54% correctly assessing performance in the end survey with 46% under-estimating how well they would do even though the end survey occurred when students had approximately 80% of their final grade already completed with the final ungraded assignment due the day of the end survey. By contrast, students who did not earn an “A” in the course moved from 49% correctly assessing performance in the beginning survey to 68% in the end survey. In all cases, students tended to be off by one letter grade in either direction, though it is notable that 16% of students who did not earn an “A” over-assessed their performance by two letter grades in the beginning survey and 9% who stated in the beginning survey that they would earn an “A” failed the course.<sup>8</sup> In short,

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<sup>6</sup> Final course grades are post-treatment and so should be interpreted with caution. They are indicative of actual student performance, as most students performed consistently well (or poorly) throughout the term.

<sup>7</sup> These questions were only asked during Winter 2023 and Spring 2023.

<sup>8</sup> This is worth further investigation. The course has all grades always available online and includes a grade calculator that we discuss during class, but anecdotally students are hesitant to use it, fearing that they will make a mistake. Students prefer to go through the calculator during office hours.



students who earned lower course grades were not worse at calibrating their course grades, just their class notes grades. Thus, it seems more likely that students who earned lower course grades inflated their class notes grades to compensate for assignments on which they performed poorly.<sup>9</sup>

One important factor contributing to the calibration gap was how students approached notetaking during group activities. The course incorporated group activities in each class session in two varieties: several activities tied together and one class-long activity. Most class sessions fell into the first category. Class would start with an introduction, followed by a small group activity, a discussion, another small group activity, a break, an individual activity, another discussion, and a closing. Students concentrated on taking notes during the introduction, discussion, individual activity, and closing. Most students would describe the group activities in terms of what they did, but they devoted less space to what they learned doing these activities other than what we talked about during ensuing discussions. Students who followed the suggested notes format did typically use the reflection section to say something more generally about group activities. Therefore, in this class format, group activities were less represented in class notes, but were not completely excluded.

The second class variety was a class-long group activity with a short introduction and conclusion. Class-long activities involved groups working on their civic engagement project, a whole-class simulation, or partner work on students' research memos. I discussed appropriate notetaking for these activities in class, suggesting that students devote most all of their notes to observations about how the class went, notes and reminders to themselves about tasks, and

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<sup>9</sup> Andrade and Ariely (2009) recommend self-assessment as formative, not determining a student's grade, partially for situations like this. However, the self-assessment in this course was designed to be similar to a contract in contract grading --- students who met the set criteria earned the grade.

reflection. On research memo workdays, students typically followed this format. During our simulations and civic engagement project work, however, students tended to write that they worked on the simulation or project and let that be the notes entry for the class session. Further, students were aware that they were doing this, remarking in their self-assessments that they had notes that were more than 200 words except for project days, or some similar comment. This tendency to take few, if any, notes during class-long group activities contributes to the calibration gap because students seemed to feel that these classes did not require notes when, in fact, notetaking could have been helpful.

## Discussion and Conclusion

Students can learn how to effectively take notes during class when notetaking is incorporated into a class assignment. Students accurately assess their improvement as they learn how to take better class notes, though there is a calibration gap between self-assessed letter grades and earned letter grades. Asking students to take and assess their class notes provides a valuable opportunity to teach study skills while also reinforcing course content. The self-assessment portion of the assignment solidifies best practices and, more importantly, teaches students to critically evaluate their notes so that they can continue to practice successful notetaking strategies even when doing so is not a graded class assignment.

Effective notetaking is a critically important part of success in college. Even if notetaking is discussed in an orientation or first year “welcome to college” course, students lack the opportunity to practice notetaking in a disciplinary environment. Further, with so many students never taking notes in high school, one introductory discussion of notetaking is likely not enough

to teach effective notetaking skills, meaning that introducing notetaking in a disciplinary course can help to make up for study skills that may not have been taught in high school.

This notetaking assignment is portable across disciplines and types of classes. I require the same type of assignment in my senior-level quantitative research course where taking notes during class is absolutely necessary for successfully using statistical software and understanding methodological concepts. Future research should investigate integrating class notes self-assessments into courses with traditional exams. The advantage of asking students to take notes in a course without exams is that they have the space to develop notetaking skills without major consequences if those skills are ineffective. In courses with exams --- especially those that rely heavily on content from traditional lectures --- students are expected to be good notetakers on the first day of the course. While teaching notetaking will still be useful, instructors should think carefully about how to structure summative assessments during the first half of the course, when students may still be developing notetaking skills. More generally, students with better notetaking skills have an inherent advantage in lecture-based courses, and instructors should consider how this advantage contributes to student success in their course.

Two major areas of the class notes assignment are worthy of future research and innovation. First, students struggled to take notes during group activities. Second, while students generally improved at this, many students were unfamiliar with the idea of taking notes after a class session ended or adding content to notes beyond what was written on the board or a slide (e.g., Morehead et al. 2019). I addressed both of these areas directly in class and encouraged students to think of class notes as encompassing both content and reflections. In fact, the class notes assignment was originally called a “class journal” to try to impart that holistic notetaking idea. Since I use a class notes assignment in both lower division and some upper-division major

required courses, I can anecdotally say that students exposed to the class notes assignment several different times did improve in their understanding of what can and should be included in class notes.

One potential factor contributing to this notetaking disconnect is class setting. Eight of the nine sections of this course included in this study were taught in either a 150 or 180 person lecture hall. While the course structure did not resemble a traditional lecture, the setting did. The dynamic of such courses is different in a lecture hall, even when the lecture hall only had 30 students in it. Future work that examines class notes assignments in other disciplines will hopefully do so in settings more amenable to reflection and discussion. Existing first year or student success center self-assessments may need to be revised to reflect the holistic nature of notetaking, as an overwhelming number of such resources refer to notetaking occurring during or after “lectures” instead of describing how notetaking can be useful in many course formats.

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# Supplemental Information: Students Self-Assessing Their Class Notes Builds Critical Thinking Skills

|                                     |   |
|-------------------------------------|---|
| SI.1: Class Notes Assignment.....   | 1 |
| SI.2: Demographic Information ..... | 2 |
| SI.3: Model Tables.....             | 5 |
| SI.4: Variables.....                | 8 |

## SI.1: Class Notes Assignment

Below is the full text of the class notes assignment from Spring 2023. The self-assessment consisted of the evaluation questions copied verbatim into a Moodle “quiz.”

Students learn and make connections between different course concepts by taking notes and referring to them throughout the quarter. The class notes assignment is meant to help encourage you to take effective notes and to teach effective notetaking.

To complete your class notes, take notes either in a physical notebook or in a computer file. I encourage you to take notes by hand, as doing so improves retention.<sup>1</sup> The dates when the class notes are to be submitted are marked on the syllabus. If you are taking notes in a physical notebook, you should create an electronic copy of your class notes (scan or take pictures) to submit on the indicated class days. In order to earn an “A,” your class notes must meet all of the self-assessment criteria listed below.

Please remember that your class notes must be your own work. If you are absent, talk to a friend about what happened in class, view the slides, and create your own notes for that class period. You are free to collaborate with other students as long as you write the entirety of your class notes. Copying notes from other students without appropriate attribution is plagiarism.

Students often struggle to organize their notes and ask for suggestions to help. There is no one-size-fits all organizational method or process. I recommend the following process:

1. Create a header for each class section before class.
2. As class starts, list the day’s objectives.
3. Begin taking notes in the notes section. Each topic, discussion, or activity should have its own item in a numbered list. Fill in detailed notes --- phrases, ideas, and descriptions --- as class proceeds. Key tip: good notes are not just copying words from the slides. You need to write in your own words.

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<sup>1</sup> Smoker, Timothy J, Carrie E. Murphy, and Allison K. Rockwell. 2009. “Comparing Memory for Handwriting versus Typing,” *Proceedings of the Human Factors and Ergonomics Society Annual Meeting* 53(22):1744-1747.

4. **Important!** After class is over, go back to your notes and the slides from the class. Fill in key terms, additional notes that you missed, and write a brief reflection. This process should take about 15 minutes per class.

Following this process will result in notes that meet the criteria and will look like this template:

### May 9: Introductory Class

Objectives: [bulleted list of objectives]

Key Terms: [bulleted list of at least two key terms from class]

Notes: [numbered list with each topic/discussion/activity from class followed by detailed notes.

Be sure not to just copy from the slides, as that is not very helpful!]

Reflection: [two sentence reflection on that day's class]

Evaluation: Twice during the quarter, I will ask you to submit your class notes. Your class notes should be submitted to Moodle before class.

We will conduct an in-class activity with your class notes where you will complete a self-assessment; if you are not in class on that day, you must complete the self-assessment before class time. I will read your self-assessment and reserve the right to adjust the grade you give yourself. Your self-assessment will include the following questions exactly as written. This means that your class notes should meet all the criteria listed below.

1. My class notes are organized. Each class day is labeled with a heading, and I have used a consistent system to organize my notes.
2. My class notes are my own work. Copying notes from other students without appropriate attribution is considered plagiarism.
3. My class note entries are complete and sufficiently detailed and include notes from each class (including any I may have missed). Taking good notes involves summarizing, paraphrasing, and re-stating in your own words. My notes entries contain enough detail that a friend who is not in the class could use them to study for a quiz or test (and get a good grade!). In general, each entry should be 200+ words.
4. If you were to evaluate your class notes on a grading scale from A to F with the majority of the grade being based on the “complete and sufficiently detailed” criterion, what grade would you assign and why? Please provide your self assigned grade and a few sentences of explanation.

## SI.2: Demographic Information

In this section, I compare demographic information of students who chose to participate in this study to students who chose not to participate. I present tables describing various demographic information collected by the university registrar about participants and non-participants.

Choosing to participate is not randomly assigned, so I do not conduct randomization or balance tests. Table SI.2.1 shows student participation by quarter.



Table SI.2.1: Student Participation by Quarter

|             | No | Yes |
|-------------|----|-----|
| Winter 2022 | 51 | 42  |
| Spring 2022 | 38 | 47  |
| Fall 2022   | 52 | 46  |
| Winter 2023 | 37 | 43  |
| Spring 2023 | 9  | 16  |

Note: Two sections taught in all but Spring 2023. Students categorized as participating in the study or choosing not to participate. Non-participants includes students who withdrew from the course and had no opportunity to agree to participate.

Table SI.2.2 shows student participation by classification. Students classified as freshmen made up a larger percentage of those students who chose not to participate (48%) whereas students classified as sophomores made up a larger percentage of those students who chose to participate (43%). While the course typically attracted freshmen, a number of true freshmen were classified as sophomores by credit hours. This difference is likely reflected here in the fact that first year students with more credit hours were more willing to participate. One reason for this is that they were less likely to withdraw from the course.

Table SI.2.2: Student Participation by Classification

|           | No   | Yes  |
|-----------|------|------|
| Freshman  | 0.48 | 0.36 |
| Sophomore | 0.28 | 0.43 |
| Junior    | 0.19 | 0.15 |
| Senior    | 0.05 | 0.07 |
| Total     | 187  | 194  |

Note: Students categorized as participating in the study or choosing not to participate. Non-participants includes students who withdrew from the course and had no opportunity to agree to participate. Students classified by credit hour, which is often different from when students expect to graduate.

Table SI.2.3 shows that the percentage of students from a given major who chose to participate was similar to the percentage who chose not to participate in most cases. Business majors disproportionately chose not to participate, as did sociology majors, though many sociology majors withdrew from the course, meaning that they did not have the opportunity to participate.

Table SI.2.3: Student Participation by Major

|                       | No   | Yes  |
|-----------------------|------|------|
| Architectural Studies | 0.02 | 0.02 |
| Biology               | 0.02 | 0.04 |
| Business              | 0.09 | 0.04 |

|                           |      |      |
|---------------------------|------|------|
| Computer Science          | 0.10 | 0.10 |
| Education                 | 0.11 | 0.15 |
| Engineering               | 0.16 | 0.15 |
| History                   | 0.03 | 0.06 |
| Interdisciplinary Studies | 0.10 | 0.09 |
| Nursing                   | 0.10 | 0.11 |
| Other                     | 0.06 | 0.07 |
| Political Science         | 0.07 | 0.09 |
| Psychology                | 0.08 | 0.05 |
| Sociology                 | 0.07 | 0.03 |

Note: Students categorized as participating in the study or choosing not to participate. Non-participants include students who withdrew from the course and had no opportunity to agree to participate.

Table SI.2.4 shows student participation based on their final course grade. Since students who withdrew from the course did not earn a final grade and could not agree to participate in the study, the third and fourth column remove these students and only compare participation among those students who were able to choose whether to participate or not. Of those 303 students, 194 chose to participate for a participation rate of 64%. Students who chose to participate had a higher distribution of “A” grades and a substantially lower distribution of “F” grades. The most likely reason for this major discrepancy in “F” grade participation is that students were invited to participate in the study during class about 60% of the way through the term. An overriding percentage of students who earned an “F” in the course either never attended a class session during the term or attended a few class sessions at the beginning of the term and then stopped attending. At this university, some students were advised to either sign up for courses that they did not intend on attending or to choose to earn an “F” instead of withdrawing because of various implications on their financial aid.

Table SI.2.4: Student Participation by Final Grade

|       | Withdraws |      | No Withdraws |      |
|-------|-----------|------|--------------|------|
|       | No        | Yes  | No           | Yes  |
| A     | 0.19      | 0.49 | 0.33         | 0.49 |
| B     | 0.12      | 0.27 | 0.21         | 0.27 |
| C     | 0.10      | 0.15 | 0.17         | 0.15 |
| D     | 0.03      | 0.05 | 0.06         | 0.05 |
| F     | 0.14      | 0.03 | 0.24         | 0.03 |
| W     | 0.42      | 0.00 |              |      |
| Total | 187       | 194  | 109          | 194  |

Note: Students categorized as participating in the study or choosing not to participate. First two columns include non-participants who withdrew from the course. Second two columns do not include those non-participants.

## SI.3: Model Tables

Table SI.3.1: Main Results

|                | <i>Dependent variable:</i> |                         |                     |
|----------------|----------------------------|-------------------------|---------------------|
|                | Actual Improvement         | Expected – Actual Notes | Grade               |
|                | (1)                        | (2)                     | (3)                 |
| Junior         | -0.598**<br>(0.282)        | -0.618<br>(0.402)       | -0.716<br>(0.581)   |
| Senior         | -0.188<br>(0.352)          | -0.527<br>(0.517)       | -1.066<br>(0.947)   |
| Sophomore      | -0.047<br>(0.206)          | 0.184<br>(0.290)        | 0.481<br>(0.412)    |
| Course Grade B | 0.158<br>(0.196)           | 1.043***<br>(0.274)     | 0.921**<br>(0.400)  |
| Course Grade C | 0.338<br>(0.262)           | 0.860**<br>(0.384)      | 0.563<br>(0.512)    |
| Course Grade D | 0.199<br>(0.506)           | 2.451***<br>(0.874)     | 2.132**<br>(1.040)  |
| Course Grade F | -1.892*<br>(1.126)         | 1.958<br>(1.516)        | 2.059<br>(1.769)    |
| Class Time 8AM | -0.086<br>(0.182)          | 0.086<br>(0.255)        | 0.032<br>(0.420)    |
| Spring 2022    | 0.222<br>(0.247)           | -0.226<br>(0.355)       | -0.031<br>(0.581)   |
| Spring 2023    | 0.030<br>(0.343)           | -0.321<br>(0.479)       | -0.688<br>(0.690)   |
| Winter 2022    | 0.910***<br>(0.254)        | -1.104***<br>(0.356)    | -1.277**<br>(0.547) |
| Winter 2023    | 0.864***<br>(0.256)        | -0.683*<br>(0.359)      | -1.082**<br>(0.534) |
| Business       | -0.339<br>(0.474)          | -0.686<br>(0.647)       | -1.326<br>(0.926)   |
| Education      | -0.099<br>(0.263)          | -0.069<br>(0.366)       | 0.230<br>(0.575)    |
| Engineering    | -0.408<br>(0.268)          | -0.473<br>(0.374)       | -0.541<br>(0.557)   |
| Liberal Arts   | -0.239<br>(0.271)          | -0.560<br>(0.385)       | -0.679<br>(0.565)   |
| Constant       | 0.100<br>(0.313)           | 0.923**<br>(0.450)      | 1.308*<br>(0.698)   |
| Observations   | 176                        | 159                     | 99                  |

\*p&lt;0.001; \*\*p&lt;0.05; \*\*\*p&lt;0.01

Note: Linear regression models. Reference categories are freshman, course grade of an “A,” class time 10AM, term Fall 2022, and college of natural sciences. Model 3 is just students not earning an “A” on the class notes assignment.

Table SI.3.2: Robustness Check Models

| <i>Dependent variable: Expected – Actual Notes Grade</i> |                     |                      |                     |                      |
|----------------------------------------------------------|---------------------|----------------------|---------------------|----------------------|
|                                                          | All                 |                      | No “A” Notes Grades |                      |
|                                                          | Notes 1             | Notes 2              | Notes 1             | Notes 2              |
|                                                          | (1)                 | (2)                  | (3)                 | (4)                  |
| Notes 1                                                  |                     | 0.438***<br>(0.078)  |                     | 0.540***<br>(0.104)  |
| Junior                                                   | -0.503**<br>(0.223) | -0.036<br>(0.221)    | -0.342<br>(0.298)   | -0.215<br>(0.306)    |
| Senior                                                   | -0.220<br>(0.288)   | -0.320<br>(0.281)    | -0.051<br>(0.507)   | -0.948*<br>(0.496)   |
| Sophomore                                                | -0.025<br>(0.161)   | 0.124<br>(0.158)     | 0.248<br>(0.216)    | 0.133<br>(0.217)     |
| Course Grade B                                           | 0.520***<br>(0.156) | 0.309**<br>(0.154)   | 0.520**<br>(0.212)  | 0.099<br>(0.217)     |
| Course Grade C                                           | 0.573***<br>(0.206) | 0.025<br>(0.214)     | 0.515*<br>(0.272)   | -0.229<br>(0.273)    |
| Course Grade D                                           | 0.877***<br>(0.322) | 0.092<br>(0.492)     | 1.399***<br>(0.440) | -0.360<br>(0.570)    |
| Course Grade F                                           | 1.069**<br>(0.527)  | 2.057**<br>(0.824)   | 0.082<br>(0.953)    | 1.952**<br>(0.927)   |
| Class Time 8AM                                           | -0.027<br>(0.142)   | 0.037<br>(0.139)     | -0.005<br>(0.224)   | 0.016<br>(0.220)     |
| Spring 2022                                              | -0.153<br>(0.193)   | -0.070<br>(0.193)    | -0.175<br>(0.297)   | 0.170<br>(0.304)     |
| Spring 2023                                              | -0.178<br>(0.266)   | -0.256<br>(0.260)    | -0.218<br>(0.361)   | -0.402<br>(0.362)    |
| Winter 2022                                              | -0.398**<br>(0.197) | -0.677***<br>(0.195) | -0.287<br>(0.291)   | -0.841***<br>(0.288) |
| Winter 2023                                              | -0.247<br>(0.201)   | -0.498**<br>(0.196)  | -0.397<br>(0.283)   | -0.476*<br>(0.283)   |
| Business                                                 | -0.457<br>(0.359)   | -0.157<br>(0.353)    | -0.611<br>(0.495)   | -0.309<br>(0.490)    |
| Education                                                | -0.060<br>(0.207)   | -0.077<br>(0.199)    | 0.200<br>(0.309)    | -0.087<br>(0.302)    |
| Engineering                                              | -0.337<br>(0.209)   | -0.041<br>(0.205)    | -0.375<br>(0.297)   | 0.030<br>(0.294)     |
| Liberal Arts                                             | -0.379*<br>(0.211)  | -0.277<br>(0.210)    | -0.199<br>(0.301)   | -0.364<br>(0.297)    |
| Constant                                                 | 0.515**<br>(0.242)  | 0.476*<br>(0.246)    | 0.336<br>(0.372)    | 0.814**<br>(0.367)   |
| Observations                                             | 177                 | 159                  | 104                 | 99                   |

\*p&lt;0.001; \*\*p&lt;0.05; \*\*\*p&lt;0.01

Note: Linear regression models. Reference categories are freshman, course grade of an “A,” class time 10AM, term Fall 2022, and college of natural sciences.

## SI.4: Variables

Variables described in the analysis are listed below. Student responses and text of class notes redacted to protect student privacy.

- Quarter: Winter 2022, Spring 2022, Fall 2022, Winter 2023, Spring 2023
- AY: Academic year
- Term: Fall, winter, or spring quarter
- Class Time: Either 8-9:50AM or 10-11:50AM
- Response: 1 if student responded to the beginning and end of term surveys
- Grade: Recorded final grade. Institution does not use + or – grades
- Dropped: 1 if student withdrew from the course
- HUC: In the demographic data, 0=did not agree to participate in the study and 1=agreed to participate in the study. Demographic information for both participants and non-participants is from registrar records
- Exp\_InitialCoded: Student self-assessed expected grade at the beginning of the term. From survey response took the lowest mentioned grade
- Exp\_InitialActual: Difference between expected initial grade and actual grade. Positive indicates over-estimate, negative indicates under-estimate
- Exp\_FinalCoded: Student self-assessed expected grade at the end of the term. From survey response took lowest mentioned grade
- Exp\_FinalActual: Difference between expected final grade and actual grade. Positive indicates over-estimate, negative indicates under-estimate
- Exp\_CourseGradeImprovement: Difference between expected final grade and expected initial grade
- College: COLA=liberal arts, COES=engineering, CANS=natural science, COB=business, COE=education
- Class: Classification based on credit hours
- Major: Student major
- MajorCoded: Student majors combined into relevant groups (i.e., all education grades combined)
- Notes1\_Points: On 100 point scale, the graded notes 1 grade. Note that Winter 2023 and Spring 2023 were graded on a 50 point scale and converted to this 100 point scale for comparability
- Notes2\_Points: On 100 point scale, the graded notes 2 grade. Note that Winter 2023 and Spring 2023 were graded on a 50 point scale and converted to this 100 point scale for comparability
- Notes1: Notes 1 points converted into letter grade
- Notes2: Notes 2 points converted into letter grade
- ActualImprovement: Difference between notes 2 and notes 1 grades. Positive indicates improvement, negative indicates worse notes 2 grade compared to notes 1
- Exp\_Notes1Coded: Expected notes 1 grade from student self-assessment. From self-assessment response took lowest mentioned grade

- Notes1Exp\_Actual: Difference between expected (self-assessed) notes 1 grade and actual grade. Positive indicates over-rating of performance. Negative indicates under-rating
- Exp\_Notes2Coded: Expected notes 2 grade from student self-assessment. From self-assessment response took lowest mentioned grade
- Notes2Exp\_Actual: Difference between expected (self-assessed) notes 2 grade and actual grade. Positive indicates over-rating of performance. Negative indicates under-rating
- Exp\_Improvement: Difference between expected notes 2 and expected notes 1 grades. Positive indicates expected improvement. Negative indicates expected worse grade