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# Student perceptions of standards-based grading in a required, introductory transportation engineering course

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# Student Perceptions of Standards-based Grading in an Introductory Transportation Engineering Course


## Abstract

Alternative grading has received much attention in academics with the publication of books such as Nilson's "Specifications Grading" [1], Blum's "Ungrading" [2], and Clark & Talbert's "Grading for Growth" [3]. One type of alternative grading is standards-based grading (SBG). The goal of SBG is to help students focus on understanding and learning over grades and to allow students to learn and correct from mistakes. Final course grades are determined by students' accomplishments in a hierarchy of "assignment bundles". The purpose of this study is to determine how students perceive SBG in one section of a required, introductory transportation engineering course offered in the spring 2023 semester. A mixed-methods study using a paper-based survey and semi-structured interviews was used. Twenty-five students participated in the paper-based survey. Two students participated in the semi-structured interviews. The results of this study found that students felt that SBG made grading expectations clear, helped them improve their assignments, promoted grading consistency, upheld them to high academic standards, motivated them to learn, and discourage them from cheating. Overall, students preferred SBG to traditional point-based grading.


## Introduction

Alternative grading refers to a set of non-traditional methods for assessing student learning that prioritize feedback, student agency, and the learning process itself, often moving away from solely relying on numerical grades and focusing more on demonstrating mastery of learning objectives through various assessment strategies. Examples of alternative grading include contract grading, mastery-based grading, standards-based grading, and ungrading. More detail on these alternative grading methods can be found in Nilson [1]and Blum [2]. This paper presents a use of standards-based grading (SBG) in an introductory transportation engineering paper and a study to determine how students perceived SBG.

Standards-based grading is an alternative grading method that sets standards that students need to meet for each assessment. Grades are assigned on whether students have met specific criteria for each assignment, regardless of how well other students perform. Sometimes SBG is referred to as specifications-based grading. Clark and Talbert [3] define four key principles of SBG:

1. All individual work is graded on a "meets expectations" or "needs revision" basis. The bar for meeting expectations is generally set at about the level of B work and the expectations are set using a grading rubric that is shared with students prior to them attempting the work.
2. All work not meeting expectations can be revised and resubmitted for re-evaluation at least once.
3. Assignments and assessments are designed to demonstrate that students must achieve the course's specific learning goals.
4. Final course grades are determined by students' accomplishments in a hierarchy of assignment bundles.

The goal of this study is to understand how students in this course perceived SBG. Specifically, the study sought to understand how students in the course perceived SBG in terms of

1. Effectively measuring student learning,
2. Providing clear grading expectations,
3. Improving course grading consistency, and
4. Minimizing conflict between students and faculty over grading.

This study closely replicates the work done by Norton et al [4] in the area of clinical education for nursing students.

The following section explains how SBG was used in the introductory transportation engineering course that was delivered in 2023. The study design and how it was conducted is described next. This is followed by the results of a mixed methods study and a discussion of the results.

## Methods

### Context

The course where SBG was used is a three-credit survey course of transportation engineering. This is part of the required curriculum for civil engineering majors at the University of Nebraska-Lincoln, a public university which is located on a metropolitan campus. Students typically take this course at the end of their second year or in their third year.

The assessments in this course include approximately 10 weekly quizzes, a final exam, start of class exercises, and weekly homework assignments. Before moving to SBG, this course had switched from two high stakes midterm exams and a final exam to weekly quizzes and a final. The weekly quizzes are given during the first 15 minutes of class on the second meeting day of the week (this course meets twice a week for 75 minutes). Ten 15-minute quizzes is the equivalent testing time of two 75-minute midterm exams. So, the testing time is the same but the weekly format lowers the risk for any one assessment.

### Implementation of SBG

This part describes how SBG was implemented in the introductory transportation engineering course based on Clark and Talbert's [3] four key principles for SBG.

*Principle 1: All individual work is graded on a "meets expectations" or "needs revision" basis. The bar for meeting expectations is generally set at about the level of B work and the expectations ore set using a grading rubric that is shared with students prior to them attempting the work.*

For each assessment, a rubric was developed based on standards for the assessment. Quizzes, the final exam, and homework assignments had the standards classified as essential or not. Essential standards focused on concepts and the other standards focused on correct computations and correct identification of values in tables. For each assessment, the number of essential and other standards needed to "meet expectations" for the entire assessment to "meet expectations" was determined. An example of this is shown in **Figure *1***.

CIVE 361
Quiz 5 (Covers Module 5-Vertical Alignment) Name_____

1. A curve has an initial grade of +1.8%, a final grade of -2.1% and a length of 800 ft.
    a. How much sight distance is provided by the geometry of the curve?
    b. What is the maximum recommended speed limit for the curve?

2. A curve has an intial grade of -1.4% and a final grade of +2.3%. The speed limit is 75 mph.
    a. What stopping sight distance should be provided for this curve?
    b. Determine the minimum length of curve so that it provides adequate sight distance for a speed of 75 mph.

(a)

**Quiz 5 Rubric:** **Meets Expectations (ME)** **Needs Revision (NR)**

Passing criteria: 4/5 essential criteria questions (E) meet expectations AND
7/9 criteria meet expectations

| Question | | Concept | ME | NR |
|---|---|---|---|---|
| 1a | E | Used crest curve equations | | |
| 1a | E | Sight distance provided by the geometry of the curve correctly found | | |
| 1a | | Computations are correct | | |
| 1b | E | Speed limit correctly determined | | |
| 1b | | Exhibit 3-1 from the Green Book used | | |
| 2a | | SSD found from Exhibit 3-1 or correctly computed | | |
| 2b | E | Used sag curve equations | | |
| 2b | E | Sight distance provided by the geometry of the curve correctly found | | |
| 2b | | Computations are correct | | |
| Essential ME | | | | |
| Total ME | | | | |

(b)

**Figure 1-Example assessment (a) with corresponding rubric (b)**

*Principle 2: All work not meeting expectations can be revised and resubmitted for re-evaluation at least once.*

All assessments were designed for students to get feedback and then be allowed to revise and resubmit their work. For the weekly quizzes, each quiz could be retaken up to two times. Students scheduled retake quizzes, and the course graduate teaching assistant managed and proctored the retake quizzes including keeping track of how many times each student had retaken a quiz. The retake quizzes used the same grading rubrics as the initial exam, but the retake

quizzes were slightly different from the initial quiz. Quizzes could be retaken after the initial quiz was graded and returned. The rubric and the meets expectations/needs revision grading allowed for more time spent on comments and feedback during grading and less time spent on determining how many points to award or deduct for work.

The final exam was given in two parts during the last week of the semester (prep or dead week). This is allowed at the University of Nebraska-Lincoln as long as it is announced at the beginning of the semester and is included in the syllabus. The retakes of the final exam were given during the scheduled final exam week during the scheduled final exam time. Grading of the final exam included three levels – excellent, meets expectations, and needs revision. The excellent level was set at approximately the level of an A.

Any accommodations needed by students for quizzes and exams was handled similarly to how these accommodations would be handled in a traditionally graded course.

Homework assignments also had grading rubrics developed like those for the weekly quizzes. As with the weekly quizzes, the rubric and the meets expectations/needs revision grading allowed for more time spent on comments and feedback during grading and less time spent on determining how many points to award or deduct for work.

The start of class exercises had no official retakes and resubmittals. Instead, after the initial 5 minutes spent by students answering the short questions, the start of class exercises were reviewed in class and students were encouraged to correct their answers if needed before turning them in. Typically, the review included a type of think-pair-share work. After students answered the questions by themselves, they were encouraged to turn to a neighbor and compare and discuss their answers. After 2 minutes of this "pair", the instructor then called on pairs of students to "share" their answers with the class. Then the rest of the class was encouraged to either agree or disagree with why. Grading was done as meets expectations if turned in and needs revision if not turned in. The purpose of the start of class exercises was to encourage students to do the readings prior to coming to class and to encourage attendance.

*Principle 3: Assignments and assessments are designed to demonstrate that students must achieve the course's specific learning goals.*

To meet principle 3, each assessment and its rubric was specifically tied to a course learning outcome. Figure 2 shows how the example quiz (Figure 1b) is tied to a course learning outcome.

*Principle 4: Final course grades are determined by students' accomplishments in a hierarchy of assignment bundles.*

The determination of course grades was done by bundling the assessments as is shown in Figure 3. During the semester, ten weekly quizzes were given, one final exam was given, ten homework assignments were given, and twelve start of class exercises were given.

Quizzes and the final exam were used to determine the course letter grade and the homework assignments and start of class exercises were used to determine the +/- grade. For the course letter grade, students needed to finish all items at or above the specified grade level. For example, a student with 7 quizzes that meet expectations and an excellent final exam would receive a course letter grade of a B.

For the +/- adjustments, it was possible for a student to receive a ++ adjustment. An A++ is equivalent to an A. A B++ is equivalent to an A-. A B+- is equivalent to a B. It was also possible for a student to end up with an A+++ which again is equivalent to an A+.

Course learning outcomes

- Describe challenges currently facing transportation professionals
- Define and apply the concepts the concepts of stopping sight distance to design safe roadways
- Define the main components of highways and use stationing to reference points along a highway
- Discuss how cross section design elements vary by functional classification and traffic accommodated
- Define and apply horizontal and vertical curve parameters & formulas to design roadways that are safe and comfortable
- Define traffic variables and use them to describe traffic flow
- Analyze the operations of traffic in terms of level of service and capacity
- Develop a signal timing plan for an isolated signalized intersection
- Describe the concept of complete streets and explain why modes other than automobile need to be included in designs

**Quiz 5 Rubric:** **Meets Expectations (ME)** **Needs Revision (NR)**

Passing criteria: 4/5 essential criteria questions (E) meet expectations AND
7/9 criteria meet expectations

| Question | | Concept | ME | NR |
|---|---|---|---|---|
| 1a | E | Used crest curve equations | | |
| 1a | E | Sight distance provided by the geometry of the curve correctly found | | |
| 1a | | Computations are correct | | |
| 1b | E | Speed limit correctly determined | | |
| 1b | | Exhibit 3-1 from the Green Book used | | |
| 2a | | SSD found from Exhibit 3-1 or correctly computed | | |
| 2b | E | Used sag curve equations | | |
| 2b | E | Sight distance provided by the geometry of the curve correctly found | | |
| 2b | | Computations are correct | | |
| Essential ME | | | | |
| Total ME | | | | |

**Figure 2-Course learning outcomes with highlighted outcome tied to example quiz.**

To earn a particular grade in the course, you need to finish **all** items at or above the specified grade level.

**Course Grading-A, B, C, D & F**

| Assessment | A+ | A | B | C | D | F |
|---|---|---|---|---|---|---|
| # of Quizzes that "Meet Expectations"* | n | n-1 or n-2 | n-3 | n-4 | n-5 | n-6 or less |
| Final Exam | Excellent | Excellent | Meets Expectations | Meets Expectations | Revisions Needed | Revisions Needed |

n = total number of quizzes; I expect that n~12
* Quizzes can be retaken a maximum of two times.

**+/- Grades:** Homework and Start of Class exercises will be used to determine +/- portion of your course grade.

**Homework grade adjustment**

| Grade adjustment | Homework Assignments (n=total # of homework assignments; n~14) |
|---|---|
| + | n-2 to n homework assignments with a grade of "meets expectations" |
| No change | n-5 to n-3 homework assignments a grade of "meets expectations" |
| - | <n-5 homework assignments a grade of "meets expectations" |

**Start of Class exercises grade adjustment**

| Grade adjustment | Start of class exercises (n=total # of start of class exercises; n~14) |
|---|---|
| + | n-2 to n start of class exercises with a grade of "completed" |
| No change | n-5 to n-3 start of class with a grade of "completed" |
| - | <n-5 start of class with a grade of "completed" |

**Figure 3-Assignment bundles used to determine final course grade.**

Study design

The goal of this study is to understand how students in this course perceived SBG. Specifically, the study sought to understand how students in the course perceived SBG in terms of

1. Effectively measuring student learning,
2. Providing clear grading expectations,
3. Improving course grading consistency, and
4. Minimizing conflict between students and faculty over grading.

This study closely replicates the work done by Norton et al [4] in the area of clinical education for nursing students. A mixed-methods study was used that included a paper-based survey of students in the course followed by semi-structured interviews with two student volunteers. This study including the research methods and surveys was approved by the University of Nebraska-Lincoln's Institutional Review Board (IRB).

The paper-based surveys included seven demographic questions, 13 questions on the use of SBG in the course, and three open-ended questions. The survey questions are shown below.

Demographic Questions

1. What year in college are you? 1st, 2nd, 3rd, 4th, 5th or more
2. What age category best describes you? 18 or younger, 19-20, 21-22, 23-26, 27 or older
3. What is your major?
4. How many hours a week do you work in a job including work-study, research assistant or teaching assistant? 0-I don't have a job this semester, 1-10 hrs/wk, 11-20 hrs/wk, 21-30 hrs/wk, 31-40 hrs/wk, more than 40 hrs/wk
5. What gender do you identify with? Male, non-binary, female, prefer to self-describe
6. Race/ethnicity: American Indian or Alaskan Native, Asian, Black or African American, Hispanic, Native Hawaiian or Other Pacific Islander, Two or more races, US Nonresident, Unknown race and ethnicity, White[1]
7. Did one or more of your parents or guardians complete a 4-year university degree? Yes, No

SBG Questions (Likert scale-5 levels: Strongly agree to strongly disagree)

8. The course supported my achievement of the course learning outcomes.
9. The course assignments effectively measured my achievement of the course learning outcomes.
10. The standards-based grading system used in the course made assignment grading expectations clear.
11. The standards-based grading system grading rubrics used in the course provided me with the feedback that I could use for assignment improvement.
12. The course orientation information clearly outlined the standards-based grading criteria.
13. The standards-based grading system used in the course promoted course grading consistency.
14. Standards-based grading improved my accountability as a student for the grades that I received in the course.

[1] Note that these categories are those used by the US Department of Education although they have changed since this survey was administered.

15. The standards-based grading system upheld me to high academic standards.
16. I would recommend standards-based grading as compared to traditional points-based grading system for this course.
17. The standards-based grading system used in this course minimized conflict between the faculty and the student in this course.
18. The standards-based grading system used in the course motivated me to learn.
19. The standards-based grading system used in the course discouraged students from cheating.
20. Would you recommend standards-based grading as compared to a traditional point-based grading system?

Open-ended Questions

21. What are the strengths of the grading system used in this course?
22. What are the limitations of the grading system used in this course?
23. Please provide additional feedback and comments on the grading system used in this course.

Nine semi-structured interview questions were used. These are shown below:

1. What is your first and last name? Please spell your first and last name.
2. How were you oriented to standards-based (specifications) grading?
3. Was the orientation adequate?
4. Were the course assignment bundles appropriate for the final (letter) grade that you received?
5. How did you feel about the use of standards-based grading in the course?
6. What did you perceive as the differences between standards-based grading as compared to a traditional points-based grading system?
7. Would you recommend standards-based grading as compared to traditional points-based grading system? Why or why not?
8. How did the standards-based grading effect course communication between the instructor and students?
9. Would you recommend standards-based grading for other courses? Why or why not?

Procedure

The paper-based survey was administered during the last week of the course (the week before prep or dead week). A faculty member not associated with the course administered the survey. Students for the semi-structured interview were recruited from those students completing the paper-based surveys.

The paper-based surveys were entered into a spreadsheet for analysis. The semi-structured interviews were recorded and then transcribed. Genderless alternative names selected by the participants were used to identify the interviewed participants instead of their actual names.

## Results

Of the 33 students in the course, 25 completed the paper-based survey. Two students from these 25 were subsequently recruited for the semi-structure interviews. After conducting, transcribing, and doing an initial analysis of the semi-structured interviews, it was decided to not use the semi-structured interviews as both students were highly positive of SBG in the course. The goal was

to recruit one student favoring SBG and one student not favoring SBG. Additionally, interviewer bias may have been present as the instructor of the course conducted the semi-structured interviews. The following presents the results from the paper-based survey.

## Demographics

Figure 4 presents the demographic information reported in the paper-based survey responses. All respondents reported being civil engineering majors. While most respondents were in their 2nd or 3rd years, some were in their 4th or 5th years (Figure 4a). Most of the students were between the ages of 19 and 22 with a good number non-traditional older students (Figure 4b). Most of the respondents worked at a job with many working more than 21 hours a week (Figure 4c). Both the age distribution and the number of hours worked are not unusual for metropolitan campus settings. Most of the respondents were men (Figure 4d). The respondents' self-reported race and ethnicity is shown in Figure 4e. Lastly, nearly half of the respondents were 1st generation college students (Figure 4f). Note that not all respondents answered every question.

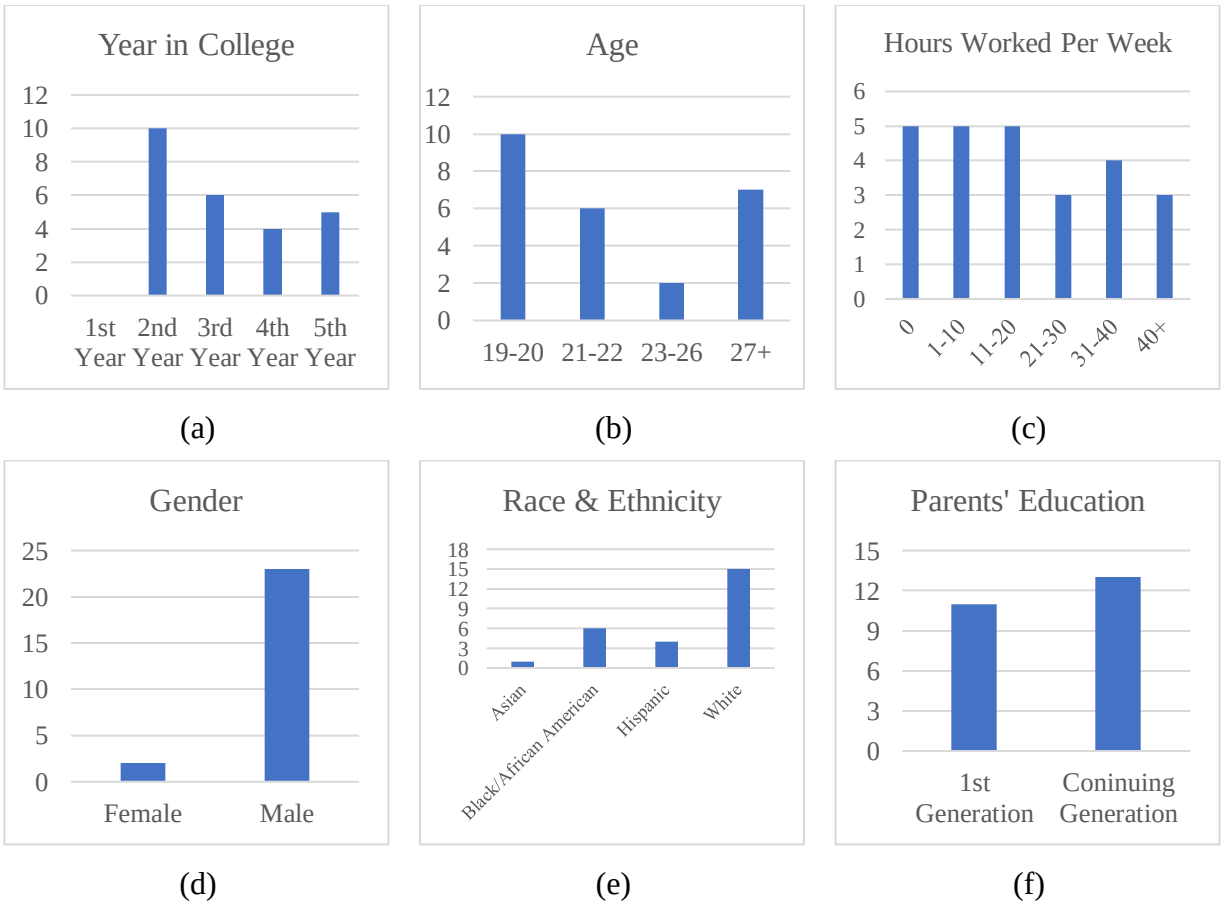


**Figure 4-Demographic information reported by respondents: (a) year in college, (b) age, (c) hours worked per week, (d) gender, (e) race and ethnicity, and (f) parents' education.**

Perceptions of SBG

The survey questions related to perceptions of SBG asked respondents to use a five-level Likert-based scale from strongly agree to strongly disagree. The results of the survey responses are shown in Figure 5.

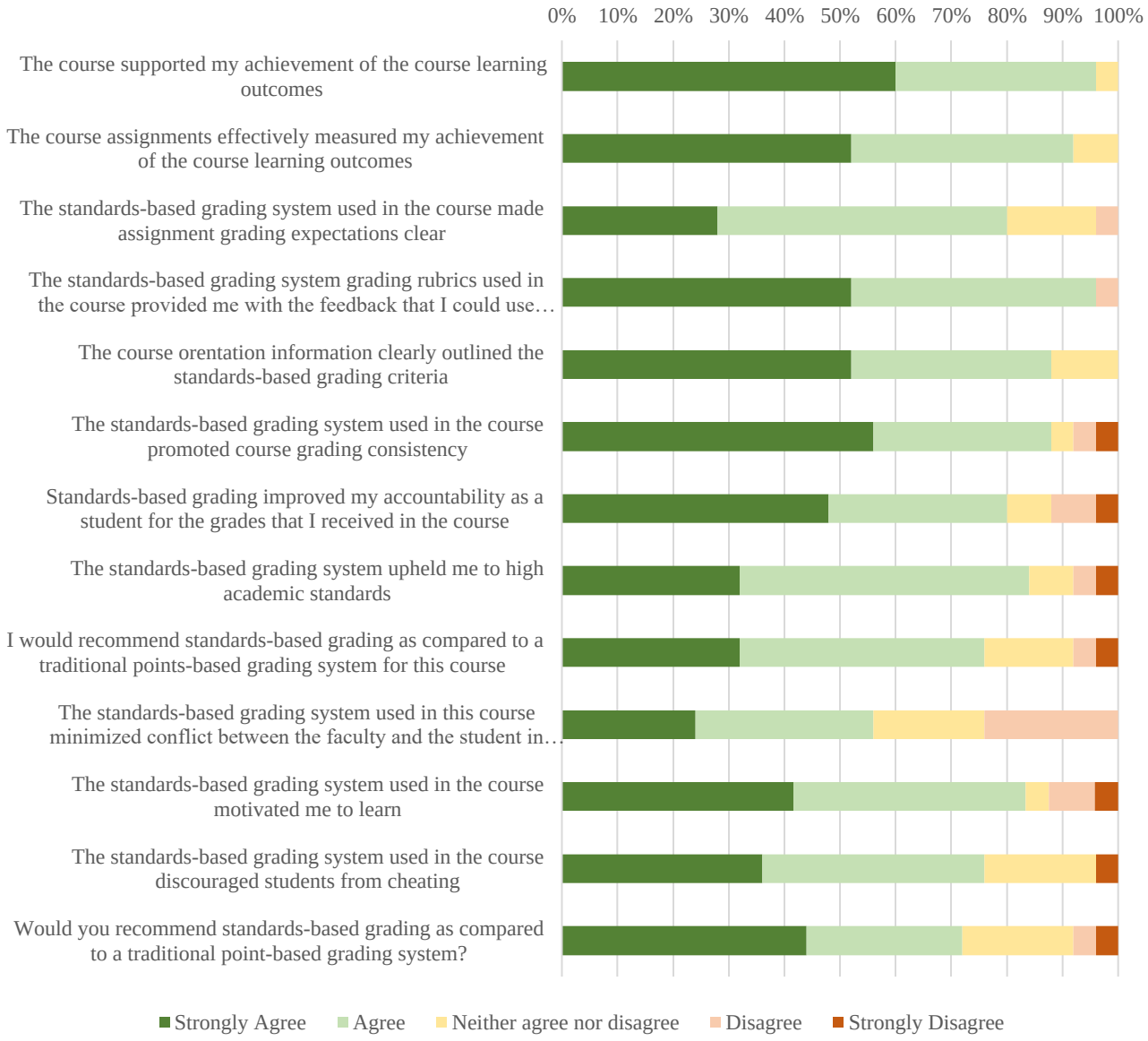


**Figure 5-Perceptions of SBG**

The overall perception of SBG by students was very favorable as can be seen in Figure 5. All but one of the questions about perceptions of SBG had over 70% of the students either agree or strongly agree. The only question that received less than 70% of agree or strongly agree was "The standards-based grading system used in this course minimized conflict between the faculty and the student in this course". Over 50% of the students did either agree or strongly agree with this statement. Students might not have understood that this question was related to students

coming in to argue about marking or grades in the course. Or they might have felt that it increased conflict as some students did not like SBG, as can be seen in Figure 5. While not every student liked SBG, most did: over 70% would recommend SBG as compared to traditional point-based grading.

Open-ended Questions

The open-ended questions provide more understanding of the strengths and limitations of SBG. Representative responses to "What are the strengths and limitations of standards-based grading?" are shown in Figure 6.

| Strengths of SBG | Limitations of SBG |
|---|---|
| • "That I do not have to be planning what I can do just to barely pass the assignment. This make me absolutely want to learn the material instead of just doing the homework for a grade"<br>• "It made expectations very clear. It made class more about learning than grades. It made me look back at course work and not just say "that grade is good enough"<br>• "It allows students to see their mistakes and fix them without hurting their grades. This helps with learning the material."<br>• "The strengths of the grading system used in this course were that you didn't really have to [be] worried about a percentage since the grading it's meet expectations or need revision." | • "Students are hesitant to learn a new grading scale this late in the game (especially this group of students)"<br>• "Missing multiple parts on a quiz or homework required it to be redone otherwise it did not meet expectations."<br>• "Overwhelmed by backlog of things to fix."<br>• "Can at times make it feel like you have a lot to do if you need to redo homework to get the point"<br>• "It doesn't allow for partial credit." |

**Figure 6-Strengths and limitations of SBG**

The limitation quotes indicate that some students may not be comfortable with change in grading systems. They also indicate that students who may not be good with time management and/or have busy lives (80% of the respondents indicated they worked during the week in addition to school).

The strengths quotes indicate how the students felt that SBG allowed them to focus more on learning than on grades. Part of the reason that SBG was used was its focus on learning so that students felt this as well seems to be an important outcome.

## Discussion

The goal of this study was to understand how students in this course perceived SBG. Specifically, the study sought to understand how students in the course perceived SBG in terms of:

1. Effectively measuring student learning,
2. Providing clear grading expectations,
3. Improving course grading consistency, and
4. Minimizing conflict between students and faculty over grading.

The survey results support that students felt that SBG effectively measured their learning. They also support that students felt it provided clear grading expectations, improved course grading consistency, and minimized conflict between students and faculty over grading.

Instructor Perspectives

From the instructor side, the author felt the benefits of SBG included:

- Easier grading as less time and effort was spent trying to be fair with points and more time was available to comment on student work, both good work and where mistakes were.
- SBG felt like there were more and better interactions with students with fewer of these interactions arguing about grading and more about concepts
- SBG seems to hold students to a higher standard but a standard that is achievable by most students

And there were some limitations of SBG for the instructor. These included:

- Time needed to develop the standards and rubrics although the author believes her course is a better course because of this.
- Time needed to bring the course's graduate teaching assistant (GTA) up to speed with SBG and how to grade homework assignments with SBG, including the need to encourage the GTA to include more comments on the student work.
- Time needed to generate extra quizzes for retakes and the time needed to grade the retaken quizzes. This was not much extra time in the larger scheme and may have added about and extra 30 minutes a week to the work needed by the instructor for this course.
- The learning management system used (Canvas) doesn't handle SBG well. A spreadsheet was used to help students understand where they were regarding working towards the grade they wanted in the course (Figure 7). This took extra time to set up (about 2 hours) and then to update and distribute every other week (about 1 hour every other week). Others (Clark and Talbert [3]) suggest providing students with their own worksheet for them to keep track of their own progress in the course. This seems to be an excellent suggestion to reduce time for the instructor and/or GTA.

Overall, this author will continue to use SBG based on the student responses and on the benefits that the author found.

Limitations

This study has several limitations. First is it from one class with only 25 students participating in the survey. The recruitment for the semi-structured interviews needs more diversity of opinion, needs better recruitment, and should be done by someone other than the course instructor.

Conclusion

Students in general liked SBG but not all students liked it. The instructor and GTA found that grading was easier and more satisfying due to the ability to spend time commenting on how to improve and what was good about a student's work. Lastly the instructor felt that her interactions with students were overall better with SBG than with traditional point-based grading.

**References**

[1] Nilson, L.B., *Specifications Grading: Restoring Rigor, Motivating Students, and Saving Faculty Time*, Routledge, 2014.

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