A Preliminary Exploration of Student Attitudes about a Continuous Grade Point Average Scheme

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Wan Kyn Chan is a undergraduate student in Purdue University currently pursuing his Bachelors in Mechanical Engineering and will be graduating in Spring 2019. Beyond academic courses he is engaged with, he also pursues research in the areas of Color Changing Metamaterials and Engineering Education. Coming from the Singapore, a country with high educational rigor, the latter area of research has been an interest and passion of his since high school as he always seeks new ways to the improve the education system in order to maintain students' passion and interest towards areas of study.

Apart from academic and industrial pursuits, Wan Kyn also has a passion for Fine Arts and Design which has allowed him to gain a diverse range of experiences that have influenced him to develop creative and out-of-the-box solutions to problems beyond engineering. He has also been in numerous local and international exhibition displaying his artworks that seek to bring together art and engineering to create a harmonious hybrid.

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(WIP) A preliminary exploration of student attitudes about a continuous grade point average scheme

Introduction

This Work-in-Progress (WIP) paper explores student attitudes about and impact of different GPA schemes. Grades have always been a large area of research because development of a fair and transparent grading system to communicate a student's mastery is critical for students, instructors, universities, and employers or graduate schools. As implied in recent literature, employers have recently adopted GPA as a means of thresholding [1] for a student's academic competencies and future potential [2]. Currently, most institutions employ a cumulative Grade Point Average (GPA), a weighted system familiar to many in higher education. The two primary variants are the `straight' scale (i.e. A, B, C, D, F) and the somewhat more granular `plus/minus' scale (i.e. A+, A, A-, B+, etc.), both used widely. Despite research on cumulative GPAs, grade inflation, and academic performance, there is a dearth of research correlating grading systems directly to students' passion, interest, or motivation toward their coursework.

In this work, we consider another GPA system using a continuous scale in which students' numerical course grade (0-100%) would map directly to their course GPA (0-4). The approach allows the GPA to provide infinite grade differentiation among peers. No prior literature has considered student attitudes about such a scheme, and we believe this new method for GPA calculation could provide greater accuracy in judging students' competency while enhancing interest in their coursework. Using course data from undergraduate students at our institution, as well as results from an attitudinal survey (n = 152), this research explores the academic and motivational effects of these grading systems.

Literature

Undergraduate GPA captures or is a proxy for: content mastery, academic motivation, self-worth and self-esteem, future job potential [3] - [5], and many other non-cognitive or affective factors (conscientiousness, grit, etc.). These motivational factors are also affected by issues such as grade inflation [6] or a student's drive to achieve greater grade differentiation between them and their peers [3], [5]. Researchers report that the plus/minus system counteracts grade inflation by lowering the average course GPA [3] - [5] and assisting low achieving students [3], [4]. Despite progress in understanding the *academic* implications of grading systems [5], [7], research rarely considers how these systems affect students' passion or interest towards studying engineering. Even studies that considered student perceptions of their grades (e.g., [8]) neglect a more holistic view of the grades' roles in motivating students to greater passion for engineering or higher academic achievement.

Furthermore, with many large companies moving toward a computer-based screening system that sets a threshold on minimum GPA to determine the potential of new employees [2], [5], [9] students who do not perform well academically may be left out on future job prospects for which they would otherwise be good candidates. To companies, GPA is not only an indicator of academic success, but an indicator of future success [9] and institutional integration [10], with

91% [1], [2] of all companies having a GPA threshold of 3.0 or higher, including 63% [1], [2] of larger corporations.

Methods

Gradebook Studies – Simulated and Actual Data

One part of this study focuses on quantitative details of differences among grading scales. For these studies, we used two data sources: (i) simulated data using several distributions (uniform, normal) of final course averages, and (ii) actual student gradebook data with final course average in the range 0-100%. In each case, the three candidate GPA calculation schemes (straight, plus/minus, and continuous) were applied to the datasets to determine quantitative differences in GPA outcome for individual students and for grade differentiation across students. For simulated data, we did not simulate final course GPA across the entire 0-100% range, and instead chose the highest failing numerical grade (≈55%) and lowest A grade (≈88%) for each semester as the lower and upper boundaries respectively. This allowed for a linear transformation, giving an increment of about 0.118 on the GPA scale for each percentage within that range.

Surveys Study – Student Attitudes and Motivation

In order to understand the student's perspective of various GPA systems and their impact on passion, interest and motivation, surveys were distributed to undergraduate engineering students. The distribution of this survey consisted of both public and private channels such as email and class announcements. The survey (Appendix I) consisted of questions on their opinions and attitudes of the various grade systems currently in place and the proposed continuous GPA scheme. In addition to multiple choice questions that asked if students believed that their cumulative GPA was an adequate representation of their academic competency, and if their motivation increased or decreased through their academic career, short response questions were also introduced, allowing them to justify their answers to the multiple-choice questions. In total, more than 150 responses were received across all academic levels and 11 engineering majors.

Data Analysis and Results

Gradebook Data Analysis

We first conducted an exploratory study using simulated data to understand differences in outcomes of the three GPA calculation schemes in a preliminary way, and to verify our analysis algorithms. Numerical simulations showed minor differences in calculated GPA across the two grade distributions used (uniform, normal) and the three GPA calculation schemes. This exercise gave us confidence that our numerical procedures were functioning properly.

We next used actual (de-identified) gradebook data from a sophomore-level course over 20 recent semesters (total $n = 3262$ students). This data contained final course averages on a 0-100% scale, distributed according to the actual performance of the students in the courses. We used the algorithms developed in the exploratory study to calculate GPA outcomes using this gradebook

data and the three GPA schemes considered here. In general, we found that the differences in calculated GPA between the straight and plus/minus schemes (i.e., diff = $GPA_{str} - GPA_{p/m}$) were small, with a roughly equal number of positive and negative differences. However, difference between either of these two approaches and the continuous approach were more dramatic, with six semesters showing higher GPAs and ten showing lower GPAs when calculated using the continuous scheme. This resulted in a higher mean GPA of 2.54 with a standard deviation of 0.318 for the continuous scheme as opposed to a mean GPA of 2.49 with a standard deviation of 0.288 for the plus/minus scheme.

Survey Data About Student Interest and Motivation

Table 1 shows a subset of survey results related to student perceptions and motivations around grades and their GPA.

Table 1: Selected survey results about attitudes concerning current GPA and proposed (continuous) schemes. Full survey questions can be found in Appendix I.

Survey item	Yes/ Increased	No/ Decreased
GPA is an adequate way of determining students' knowledge of a course and overall competency from university. (Yes/No)	61	91
Has your motivation for studying your course work increased or decreased over the past few semesters? (Increased/Decreased)	83	69
Do you believe that grades (e.g. projects, lab work, homework and numerical grades from examinations) and interest, passion and motivation are intrinsically related? (Yes/No)	103	49
Does knowing that you will not be able to cross into a higher-grade boundary undermine your motivation to study for your finals or complete any related coursework given? (Yes/No)	111	41
A continuous GPA system with a greater differentiation between grade boundaries will give more motivation to study harder and I will have more opportunities to improve where I have fallen behind. (Agree/ Disagree)	129	23
I believe that I will have a better GPA were a continuous GPA system used rather than a discrete one. (Agree/Disagree)	129	23

Most survey respondents believed (59.9%) the current plus/minus GPA system is an inadequate tool for determining students' academic competency with 73.0% expressing that the inability to cross to a higher-grade boundary towards the end of the semester actually undermines their motivation to study for finals and complete assignments. However, respondents felt less convinced that their GPA meaningfully affected their interest, passion and motivation towards their studies. Instead, 54.6% of respondents reported that their motivation for pursuing engineering increased when they saw/experienced engineering applications in a work environment (co-op assignment) or in an engineering-related extra-curricular activity. Some respondents felt too overwhelmed with academic time commitments (projects, homework,

exams) to see the joys of engineering they once thought they had. But in reference to GPA, some have abandoned the hope of improving their GPA, mentioning that they do not have an affinity towards a course and thus their grades suffer no matter how hard they study; some students completed the work mainly because of deadlines. Others mentioned that due to the competitive environment in their academic program, their GPA (rather than conceptual knowledge or understanding) has been at the forefront of their minds.

On the other hand, the continuous grading scheme (as compared to the straight or plus/minus approaches) was viewed more positively. Although such a scheme is not yet in place, 84.9% of student's surveyed believe that its implementation could have a positive impact on not only their grades, but their overall interest and motivation towards their studies. Most respondents believed their GPA would be higher under a continuous scheme. Furthermore, a majority of students (84.9%) across academic years and regardless of their current GPA believed that a continuous scheme would allow them greater opportunities for (GPA) improvement when they have fallen behind in a course. Our research using gradebook data showed that GPA increases are possible, but not guaranteed, under a continuous calculation scheme. However, this evidence suggests a continuous scheme *could* increase interest and motivation towards the pursuit of their academics because of the potential for improved GPA outcomes.

Summary and Future Study

This research explores a continuous GPA calculation system whose outcomes *could* depart significantly from current practices, and whose implementation *could* affect student attitudes and behaviors toward their studies. Survey respondents indicated their belief that straight and plus/minus GPA scales are not adequate methods of differentiating students' academic competencies, and that a continuous GPA system may improve clarity of differentiation among students. The survey data also suggest that a continuous system could encourage students to maintain their interest in engineering coursework throughout the entire semester, because there is always an opportunity to improve their GPA. Our simulation studies suggest that a continuous system may also help address concerns about grade inflation.

However, more in-depth research about all the implications of a continuous grading scheme should be conducted. Future work could include an actual implementation such as the experiment by Mcclure [10] allowing student to choose their preference of grading system and observing their attitudes. Although the benefits are clearly supported from this initial study, there is also evidence to suggest complications may arise as students may actually work harder, produce better overall grades and increasing overall course GPA (which may be perceived as grade inflation). In addition to further understanding student attitudes and behaviors in response to a continuous GPA system, we will need to carefully consider policy and implementation issues, especially implications for transcripting and communicating to potential employers or graduate schools how the GPA is calculated. However, with these observed positive relationships between GPA and motivation in engineering students, the possible implementation of a continuous scheme—although complicated--should not be discounted.

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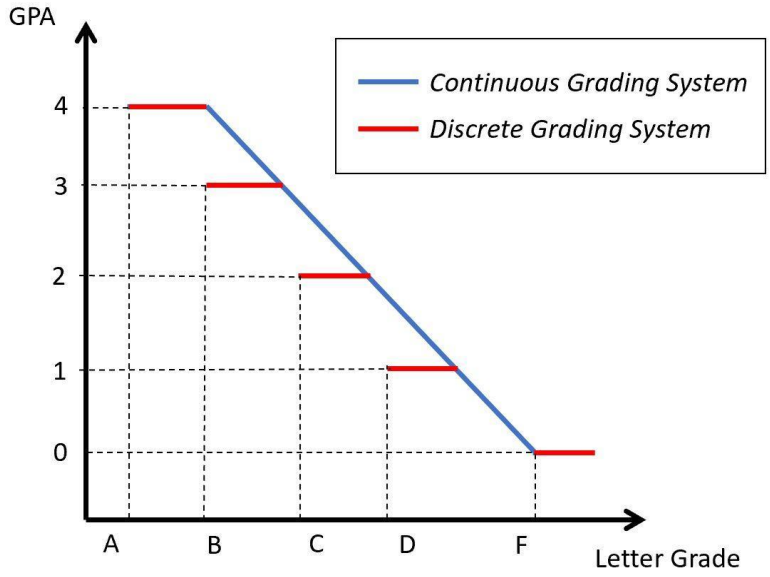
Appendix I: Survey Questions

GPA Sensitivity and Motivation

1. What is your academic standing (Choose one: Freshman, Sophomore, Junior, Senior)?
2. What is your major? (Write in major)
3. What is your current cumulative GPA? (Write in GPA)
4. GPA is an adequate way of determining students' knowledge of a course and overall competency from university. (Yes/No)
5. Do you believe that grades (e.g. projects. lab work, homework and numerical grades from examinations) and interest, passion and motivation are intrinsically related? (Yes/No)
6. What affects your motivation to pursue Engineering? (Rating, 1 – highest motivation, 7 – lowest motivation)
    a. Grades (Letter Grades on Transcript)
    b. Overall/Semester GPA
    c. Passion for Engineering
    d. Need to finish the homework and projects
    e. Fear of Failure
    f. Enjoying non-engineering related activities after finishing engineering coursework
    g. The goal of simply finishing the course
7. Has your motivation for studying your course work increased or decreased over the past few semesters? (Increased/Decreased)
8. How do you know if your interests in engineering has increased or decreased? Give a concise example. (Short-response question)
9. Do the grades of interim homework, projects, labs, exams, etc. affect your interest towards a particular course that you initially had interest in? (e.g. low homework scores discourage/encourage you to work harder)? Give a concise example. (Short-response question)
10. Does knowing that you will not be able to cross into a higher grade boundary undermine your motivation to study for your finals or complete any related coursework given (e.g you are unable to get an A, and will not drop below a B, therefore you put in the minimum effort to review for exams or complete homework)? (Yes/No)

Do you agree or disagree with the following statements regarding the concept of a "Continuous" versus "Discrete" grading system based on the figure below. If a continuous system were to be implemented, your course GPA (over a 4.00) will be more sensitive to your final numerical grade (percentage scaling). For instance, if you missed an A (i.e. 4.00/4.00), you will be awarded 3.98/4.00 instead of a 3 (B) or 3.7 (A-).



11. A continuous GPA system with a greater differentiation between grade boundaries will give more motivation to study harder and I will have more opportunities to improve where I have fallen behind. (Agree/ Disagree)
12. I believe that I will have a better GPA were a continuous GPA system used rather than a discrete one. (Agree/Disagree)

For the following questions, keep in mind your current feelings about engineering and the courses that you are currently enrolled in or have been enrolled in for your current academic standing (Strongly Agree/Agree/Somewhat Agree/Neither Agree nor Disagree/Somewhat Disagree/Disagree/Strongly Disagree)

a) While in my engineering courses, I thought about how much I enjoyed the those that I were enrolled in.
b) Engineering courses are fun to do.
c) I enjoy engineering courses very much.
d) I felt like I was enjoying all the courses I was enrolled in.
e) I thought the courses were rather boring and dull, not at all what I was expecting.
f) I thought engineering is an interesting activity.
g) I would describe my courses as very enjoyable.
h) Engineering is fun.