# Analysis of Student Perception in Thermodynamics

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## Abstract

Thermodynamics I is the first thermal/fluids course students take in the Mechanical and Aerospace Department at North Carolina State University. As observed in questionnaires that students complete on the first day of class, most students have heard that the course is difficult before taking the course themselves. This study seeks to understand student perception of the course by measuring each student's perception of her or his performance on tests during the semester. The student's perceived grade on the test after taking it is compared to the student's actual grade to determine how many students accurately predicted the grade they earned. Being able to predict a grade after completing the test would indicate that the student has an understanding for the material, even if she or he does not get every problem correct. For the first test, about half of the students in the study were accurate in their predictions but this number dropped for subsequent tests. This analysis includes comparing their perceived grades to the students' cumulative GPA.

## Keywords

Thermodynamics, undergraduate education, perception

## Introduction

Thermodynamics I has a reputation for being a challenging course for undergraduate students. It is taught in the Mechanical and Aerospace Engineering (MAE) department at North Carolina State University for sophomore MAE students. About half of the enrolled students come from other engineering disciplines, and these students are typically juniors and seniors.

The current study analyzes student perception of their own test performance throughout the semester. Perception can be indicative of the attitude a student has for a course[1,2] but also a gauge of a student's knowledge and understanding. Also included in this study is the amount of time spent studying as self-reported by the students[3]. These self-reported perceptions are compared to test grades and grade point averages.

## Current Study

The students in one section of Thermodynamics I were provided an opportunity in class to report on the grade they thought they had earned on the previous test and an estimate of how many hours they had studied for said test. These questions were asked in class using Top Hat after the students had taken the test and before the graded tests were returned. The questions were as follows:

What grade do you think you earned on the test?

a) A
b) B
c) C
d) D
e) F

How many hours (approximately) did you spend studying for the test?

a) 0-2
b) 2-4
c) 4-6
d) 6-8
e) 8+

Students were not required to participate in the study. Forty students answered these questions for all three tests of the semester and therefore are included in this study. The test averages for these forty students and their average GPA (grade point average) are shown in Table 1. The GPA is cumulative for each student and was provided by the university for this study. It is typical for this course that the Test 1 average is the highest.

*Table 1. Averages for 40 Students in Study.*

| | Test 1 | Test 2 | Test 3 | GPA |
|---|---|---|---|---|
| Class Average | 82% | 65% | 75% | 3.326 |

## Analysis

An important part of a student's education is how they perceive their own knowledge. It is necessary for students not only to correctly solve problems but also identify when they have made a mistake based on their knowledge of the concept. After taking each test, students were asked to predict their grade before seeing the solutions of the test. Figure 1 shows the results for the first test based on the letter grade that each student predicted. For instance, 5 students accurately predicted that they earned a C on Test 1. Three students predicted a C grade but actually earned a D or F. Four students predicted a C grade but actually earned an A or B.

Of the 40 students, 19 accurately predicted their test grade, 6 over-predicted, and 15 under-predicted. The high number of students who under-predicted their grade for Test 1 may be due to the reputation of the course. Twenty students predicted that they earned a B which was by far the most popular choice, with ten of these students actually earning an A.

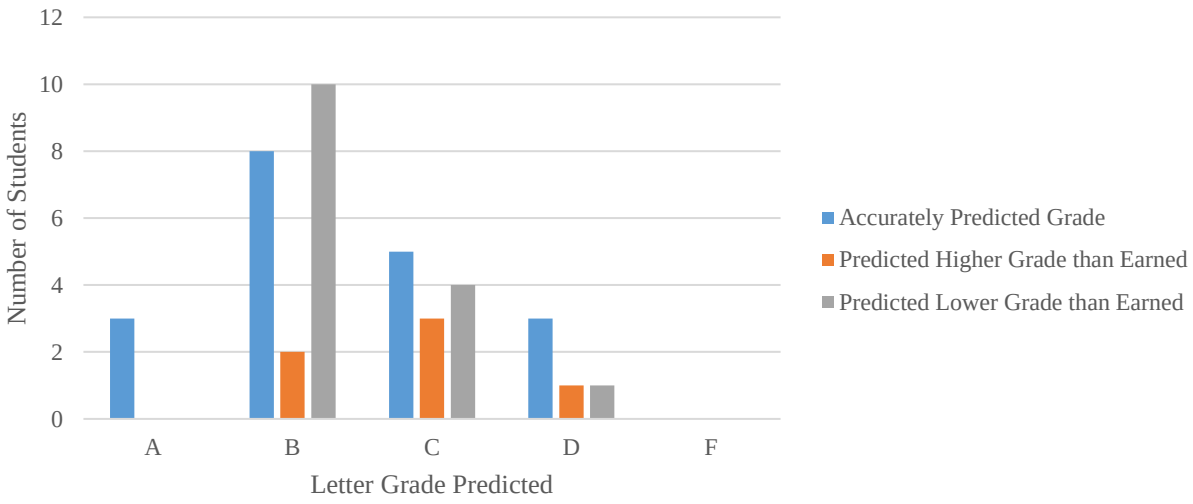


*Figure 1. Number of Students for Each Prediction for Test 1.*

The results for Test 2 are shown in Figure 2. The most popular prediction was a grade of C. 62% of those that predicted a C over-predicted their grade and actually earned a lower grade. Since the class average for Test 1 was 82% (as shown in Table 1), students may have felt more confident for Test 2 which would account for 24 students over-predicting their grades. Seven students accurately predicted their grade and 9 students under-predicted.

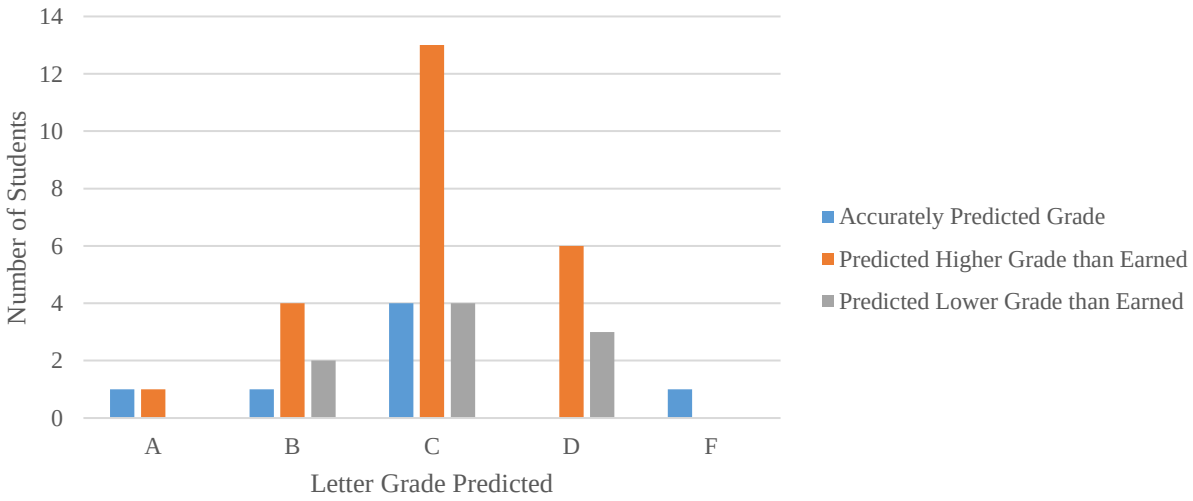


*Figure 2. Number of Students for Each Prediction for Test 2.*

Despite Test 2 having the lowest average of the three tests, the predictions for Test 3 show that 21 students predicted a higher grade than they earned. The results for Test 3 are shown in Figure 3. An equal number of students predicted B as predicted C and over-predicted their test grade.

Eleven students accurately predicted their grade on Test 3, 21 over-predicted, and 8 under-predicted.

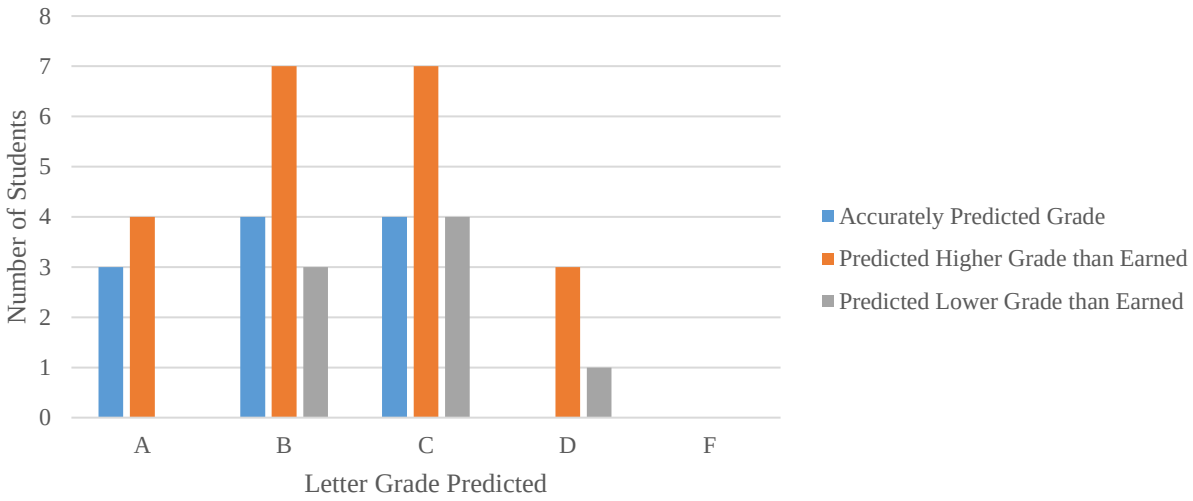


*Figure 3. Number of Students for Each Prediction for Test 3.*

The cumulative GPA for each student at the end of the semester was used to determine the average GPA per test prediction. As Figure 4 shows, the average GPA for the students who accurately predicted their grade for each test is within one-tenth of the average for students who under-predicted their grade. For each test, the students who over-predicted their test grade had a lower GPA average.

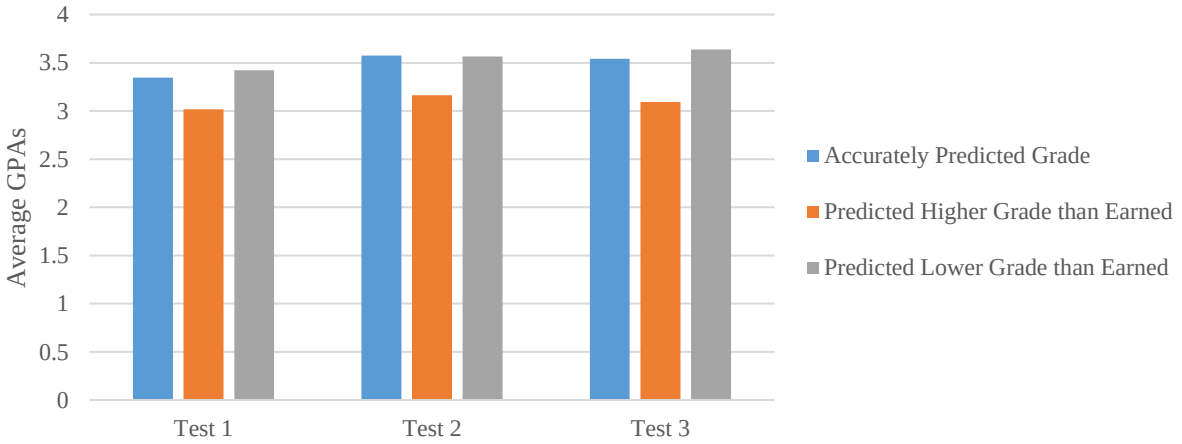


*Figure 4. Average GPA of Students for Each Prediction.*

For this study, students were also asked to self-report approximately how many hours they studied for each test. Table 2 summarizes the responses. The average GPA for the students that made each selection is also shown. Most students responded with "2-4" hours for Test 1. For Tests 2 and 3, most said 4-6 hours but the trend during the semester is an increase in the number of hours, which is expected given the cumulative material in the course. The least number of hours spent studying was self-reported by the students with the lowest average GPAs, and the most hours was reported by students with the highest average GPAs (with the exception of Test 2 where it was 0.04 lower than the highest average).

*Table 2. Self-Reported Studying Time for Each Test and the Average GPA.*

| | **Test 1** | | **Test 2** | | **Test 3** | |
|---|---|---|---|---|---|---|
| **Hours Studying** | Number of Students | Average GPA | Number of Students | Average GPA | Number of Students | Average GPA |
| **0-2** | 2 | 3.18 | 1 | 2.63 | 0 | N/A |
| **2-4** | 17 | 3.16 | 11 | 3.05 | 7 | 3.31 |
| **4-6** | 9 | 3.43 | 14 | 3.48 | 16 | 3.23 |
| **6-8** | 8 | 3.46 | 8 | 3.43 | 12 | 3.32 |
| **8+** | 4 | 3.57 | 6 | 3.44 | 5 | 3.68 |

## Conclusions

Given the reputation of Thermodynamics I as being a challenging course, it is not surprising that more students under-predicted their grade on Test 1 than on the other tests. The high average for Test 1 may have caused students to feel over-confident and so the majority of students over-predicted grades for Test 2. However, the majority also over-predicted grades for Test 3 despite a low average for Test 2. Regardless of the test, a student's perception seems correlated to that student's cumulative GPA.

Further study is needed to understand how student perceptions are formed and how a student's perception changes as they progress through the course. Future work will collect data on student perception prior to taking the test to better gauge how students measure their knowledge of the material and survey students to analyze how perceptions of the course prior to taking it affect students' work. Also, student perception will be analyzed based on the level of the student (sophomore, junior, or senior), the major, and the gender.

## References

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3 Adams, Jeffrey B., “What makes the grade? Faculty and student perceptions,” Teaching of Psychology, 2005, 32(1), 21-24.

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The author is a Teaching Assistant Professor at North Carolina State University in the Mechanical and Aerospace Engineering Department. She teaches undergraduate courses in the thermal-fluid sciences. She is the course coordinator for Thermodynamics I and has taught the course in the traditional lecture and flipped formats.