Keeping the Learner Interested in Class: Engaging Students with Clickers

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Introduction

In these current times, students are becoming more technology-dependent, which can cause students to have their attention divided among several things at the same time. As instructors, this presents a challenge since losing focus can often be demotivating for a student. As their attention drops and gaps in knowledge occur, trying to connect the information heard at the start and end of a lecture can cause students distress and decrease motivation.

Our hypothesis is that incorporating technology into the class through the use of a handheld classroom response system (often referred to as "clickers") will help students stay active in class which in turn will help maintain their attention during the lecture and will reduce the knowledge gap.

We performed two studies to test this hypothesis: the first is an observational study and the second is an experiment. We analysed the feedback and findings from a questionnaire-based survey of students' experience and perceptions of the use of clickers across two introductory Statistics and Probability courses at the University of Waterloo. In our second study we compared the final exam grades of students in an introductory Probability course across different years to study the effect of clickers on their performance.

Study 1

In our first study, we analyse the feedback and findings from a recent questionnaire based survey of students' experience and perceptions of the use of clickers. The main objective of this analysis is to better understand how students find the use of clickers in class. This study is aimed at providing recommendations to help overcome some of the drawbacks, while amplifying the benefits of clickers, improving student engagement, increasing their enjoyment of the course material and to help improve overall course performance.

Methods

A three item survey was formerly carried out among 5 sections of STAT 230 and 2 sections of STAT 202 students at the end of the 2016/2017 academic year. STAT 230 had 826 students and STAT 202 had 502 students. Participation in the survey was voluntary and done through the University of Waterloo Student Portal, Learn. In total, we had an acceptably good response rate of 57%.

Results

The first result demonstrates that a large majority of students in both STAT 230 and 202 found clickers helpful and/or beneficial in some way.
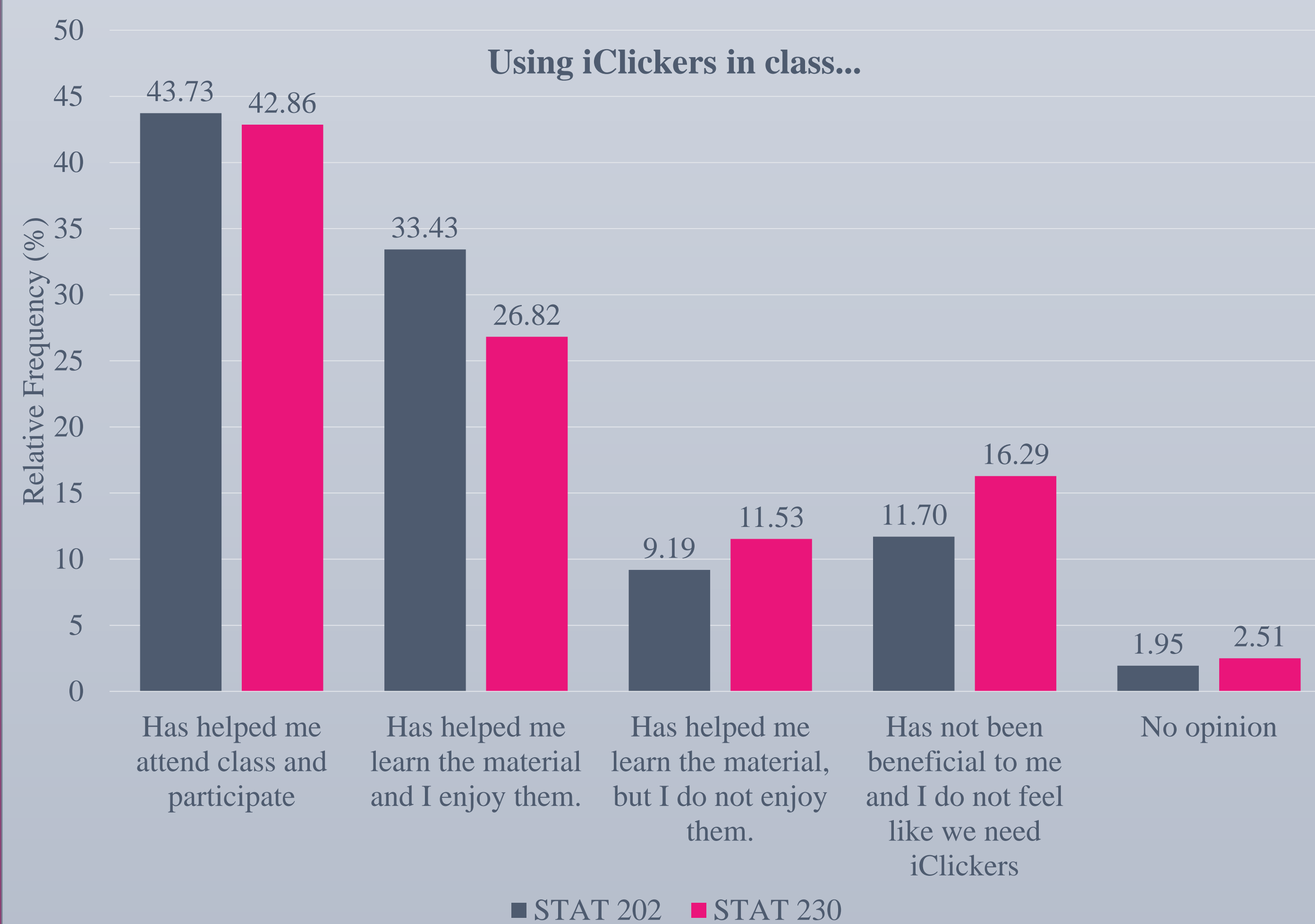

Figure 1: Display of Question 1 results

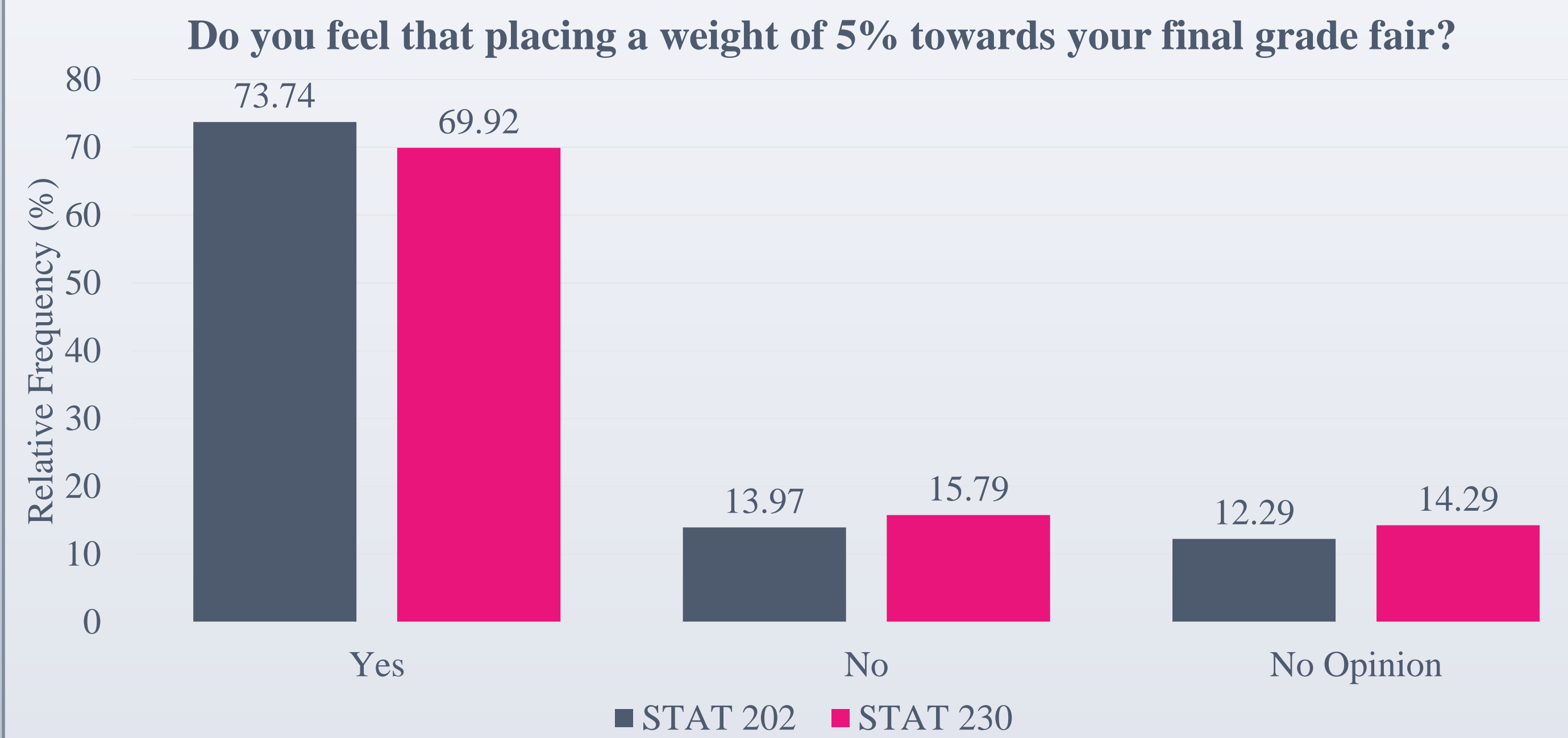Our second result is that students felt a 5% weight for the clicker questions was fair.

Figure 2: Display of Question 2 results

Students were also asked to comment on what they feel are the biggest drawbacks of clickers. Some drawbacks include forcing student participation; lack of consistency in the number and frequency of clicker questions asked by instructors across the multiple sections; and not enough time given to answer the questions.

Study 2

For our second study, we wondered if we could quantify the effect of clickers on student performance in a course. The three authors, Dina, Nagham, and Diana have taught at least one section of STAT 230 almost every term for the last 4 years, so we focused specifically on STAT 230 only. The period studied includes several terms both with and without clickers.

Methods

The response variable chosen was not the final grade in the course, since the clickers themselves formed a part of this grade and using it would be disingenuous. Instead, the grade on the final exam paper itself was used, which does not have any direct dependence on the use or absence of clickers.

Explanatory variables for the main study included whether clickers were used or not, and the instructor of the section. Only sections taught by Dina, Nagham, and Diana were included in the data.

Additionally, for the terms in which clickers were used, the relationship between the grade on the clicker component of the course and the grade on the final exam was investigated.

Results

The first result is that, irrespective of the instructor of the section, terms in which clickers were used had students achieve an average of 2.57 points higher on their final exam. This result is highly statistically significant (p-value 0.00001, 95% confidence interval (1.43, 3.71)), and model assumptions were satisfied.

Figure 3: Exam Performance based on Clicker Usage

Secondly, we observed a positive correlation of 0.343 (95% confidence interval (0.305, 0.380)) between students' grades on the clicker component of the course, if they were used, and their performance on the final exam. Furthermore, each additional point earned on the clicker grade was associated with an increase of 4.45 points on the final exam (p-value 0, 95% confidence interval (3.93, 4.96)).
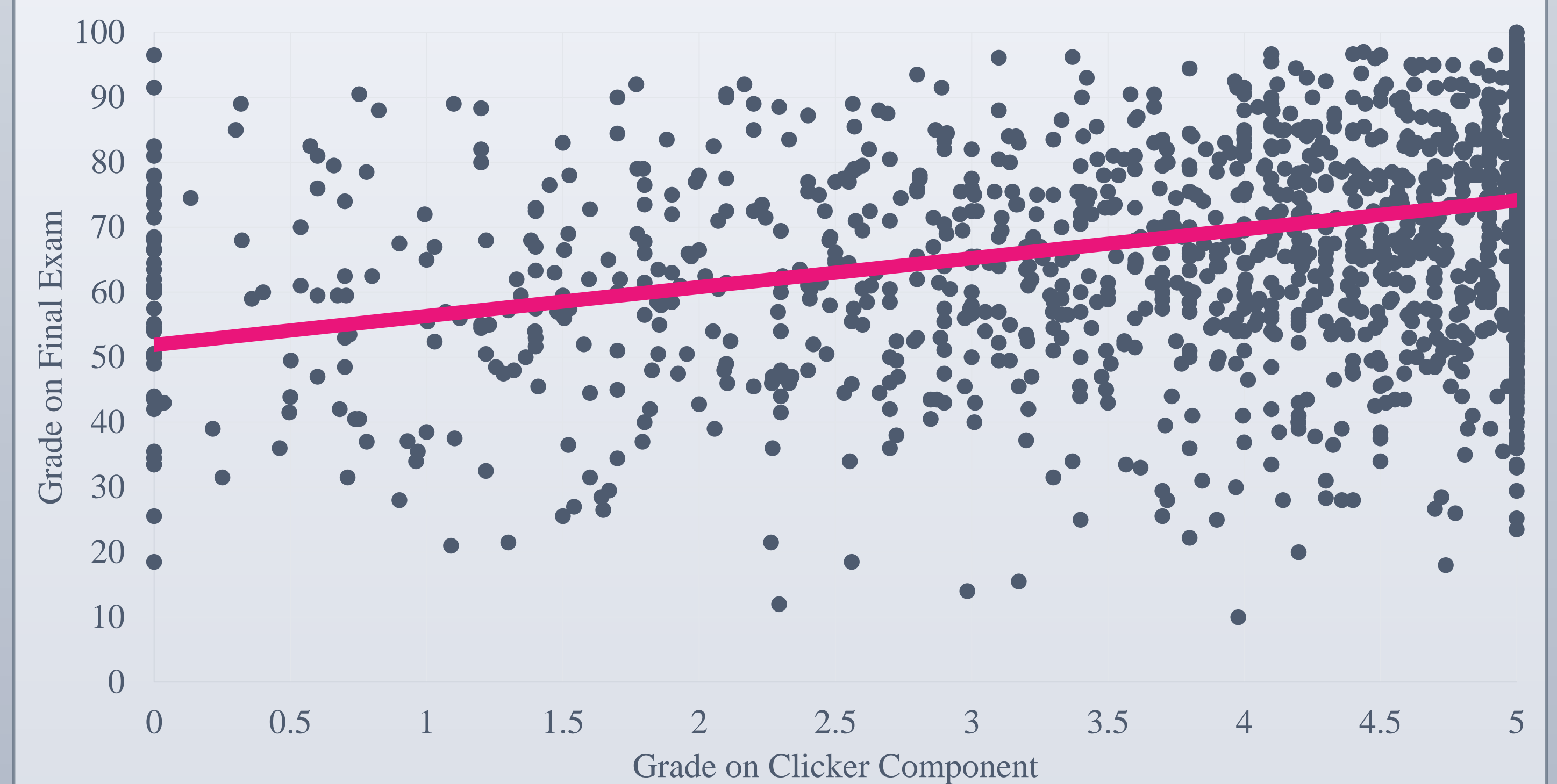

Figure 4: Grade on Final Exam vs Clicker Grade

It should be noted that the predictive power of both results is not very strong, with R^2 values of less than 10%, so clearly there are many other factors that affect students' performance on final exams. However, there appears to be a positive association between the use of clickers (and how well students do on the clicker questions) and higher performance on the exam.

Conclusions and Recommendations

Our two studies show that:

- Most students appreciate the role that clickers play in learning the course material
- Clickers are associated with a 2.57% increase in performance on the final exam
- Performance on the clicker questions is positively correlated with final exam grades

Through our use of clickers, we recommend the following best practices:

- With multiple sections, the instructors should agree on the minimum number of questions that they use during each lecture.
- Award a small percentage of the final course grade to clicker responses, around 5% being a suggestion.
- Use questions that probe understanding of concepts. Target concepts that are well-known to be difficult for students.
- Encourage students to try and answer the question again when more than 30% have answered incorrectly. Try to explain the problems with their wrong answers and where possible be armed with examples to dispel these misconceptions.

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