# Story of Colorado Education

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**Capstone 2**

# Contents

# 1   INTRODUCTION

According to the American Psychological Association, "Inadequate education and increased dropout rates affect children's academic achievement, perpetuating the low-[socioeconomic status] status of the community."Therefore, it is critical that polciy makers, schools, activist groups, and parents understand clearly how our schools are performing and develop ideas of how to improve them .The purpose of our project is to accomplish that by providing a highly visual report of performance of its schools and identify some data-supported ways of providing better education to Colorado's most vulnerable students.

## 1.1   GOALS AND OBJECTIVES

- Make recommendations to improve data quality

- Offer a thorough and highly visual analysis of the performance in Colorado schools

- Determine how performance is changing over time

- Make recommendations to improve education quality for vulnerable students

## 1.2   PROJECT OUTLINE

In order to accomplish our goals and objectives we have created an outline to

1. Examine how poverty is changing over time, how we are addressing it, and whether or not our efforts are improving performance

2. Determine if schools' diversity is representative and how we are meeting the needs of different communities

3. Analyze spending, determine if schools are spending fairly, and what effect it has on performance

4. Determine how overall performance is changing over time.

# 2   DATA

We have compiled data data from several sources: performance and socioeconomic data for Colorado schools offered by the non-profit organization, Colorado School Grades, census SAIPE data regarding the number of children in poverty in school districts, and district expenditures

from the state of Colorado. Our analysis will be limited to the 2010-2012 school years of non-BOCES schools because that is all we have been provided from Colorado School Grades; despite this limitation, we have attempted to make our analysis scalable should more data become available in the future. Sadly, the process of cleaning and joining data into a tall format took about 90% of the total time devoted to the project.

## 2.1   CLEANING DATA

The data used for this project was incredibly messy. In particular, the data from Colorado school grades was often inconsistent and redundant, the expenditures data was provided in a report style format that required heavy manipulation to become usable, and the three different data sources were difficult though not impossible to join.

### 2.1.1   EXPENDITURES FORMAT

In the Appendix Figure 7.5, we see data for the expenditures that is in a report style format. In other words, information for each schools total spending and the spneding per pupil is given in a way that is separated by blank lines in a presentable way. While this data is easy to look at, it is completely unusable for analysis. Furthermore, the tables were given in an outdated .xls format, and some of the spending numbers provided had commas and parentheses in them that had to be removed. For our analysis, we kept the total spending for each district and the spending per pupil. We converted the data into a tall format as shown in the Appendix Table 7.2. This process took an exorbitant amount of time to accomplish correctly.

### 2.1.2   COLORADO SCHOOL GRADES INCONSISTENCY

Colorado School Grades data had even more problems. The most concerning of which was that for every school year and every dataset, different number of schools information were recorded. For example, in the 2010-2011 school year, the dataset that detailed the change and improvement of schools reported 2082 schools while the data that specified the percentage of students receiving free and reduced lunches was 1753.

In addition, performance indicators were sometimes different for each year. The college readiness indicator, for instance, was specified as 0 and 1 for some years and 1 and 2 for others. Each were mapped to 0 and 1 for False and True respectively. Rank was also determined differently for each school year. In one school year, rank for middle and elementary schools was combined and for another separate. Furthermore, some datasets contained information for state and district results while others did not. This information was removed.

### 2.1.3 COLORADO SCHOOL GRADES REDUNDANCY

## 2.2 JOINING DATA

# 3 ANALYSIS

## 3.1 POVERTY

### 3.1.1 INCREASING POVERTY OVER TIME

Appendix Figure 7.6 p-values 0.030

### 3.1.2 FREE AND REDUCED LUNCH FOR CHILDREN IN POVERTY



**FIGURE 3.1:** The percentage of free and reduced lunches provided to students increases at a higher rate than the percentage of children in poverty. There could be weak clusters at each end suggesting some schools are more willing to provide free and reduced lunches than others.

### 3.1.3 POVERTY AND PERFORMANCE

## 3.2 DIVERSITY

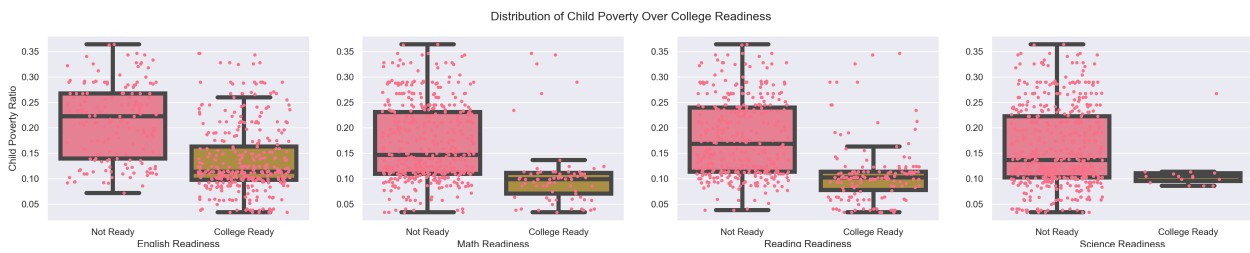### 3.2.1 LACK OF REPRESENTATIVE SCHOOLS

**FIGURE 3.2:** In every category we observe that increased poverty is linked with less college readiness.
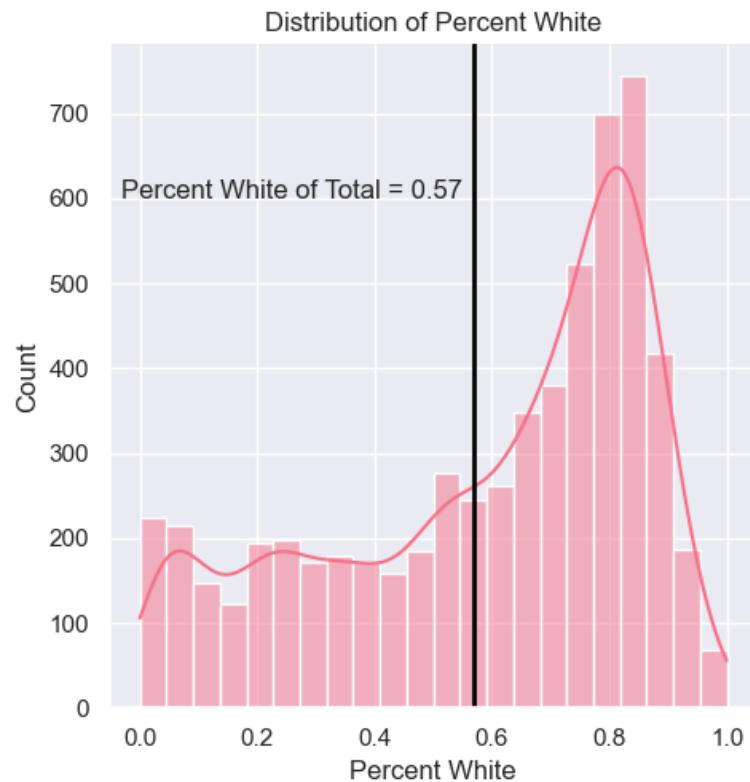


**FIGURE 3.3:** After determining the percentage of white students in Colorado Schools by multiply percentages by total students in school, it seems that our schools are not diverse.

### 3.2.2  FAILURE TO MEET NEEDS OF HISPANIC COMMUNITIES

## 3.3  SPENDING

### 3.3.1  UNFAIR SPENDING

7.11

### 3.3.2  SPENDING IMPROVES COLLEGE READINESS

7.12

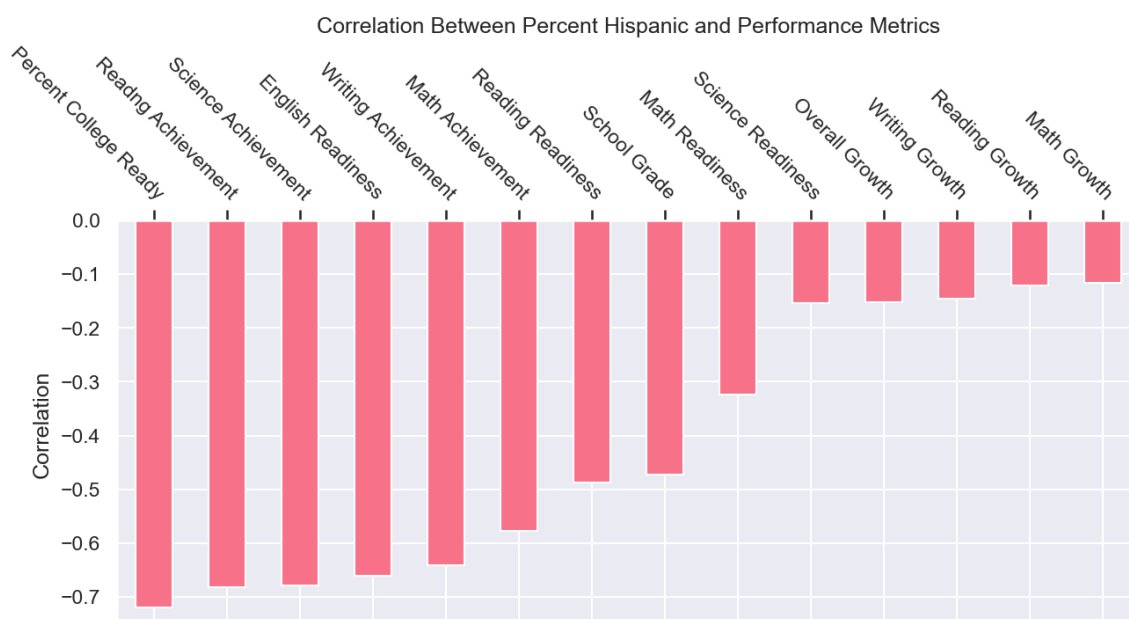**FIGURE 3.4:** Across every performance metric, schools with a higher percentage of Hispanic student are negatively correlated with their performance metrics.

## 3.4 PERFORMANCE OVER TIME

7.13

# 4 RESULTS

## 4.1 RECOMMENDATIONS

### 4.1.1 IMPROVE DATA QUALITY

### 4.1.2 PERFORMANCE OVER TIME

### 4.1.3 IMPROVE EDUCATION FOR VULNERABLE STUDENTS

# 5 CONCLUSION

## 5.1 FUTURE WORK

# 6 BIBLIOGRAPHY

# 7 APPENDIX

| Quantile | Total Spending Per Pupil |
|----------|--------------------------|
| 0.0%     | $6090.00                 |
| 2.5%     | $8346.90                 |
| 25.0%    | $10116.25                |
| 50.0%    | $12401.50                |
| 75.0%    | $15827.00                |
| 97.5%    | $36131.82                |
| 100.0%   | $108789.00               |

**TABLE 3.1:** Quantiles for spending per pupil show a heavily skewed dataset. Between the max and the 97.5% there is an order of magnitude difference

## 7.1 TABLES

|   | district_name | county | instruction_total | support_total | ... | community_per_pupil | other_per_pupil | sum_per_pupil | year |
|---|---------------|--------|-------------------|---------------|-----|---------------------|-----------------|---------------|------|
| 0 | MAPLETON 1 | ADAMS | 39962942 | 23760636 | ... | 33 | 761 | 9653 | 2010 |
| 1 | ADAMS 12 FIVE STAR | ADAMS | 220263102 | 130356958 | ... | 23 | 2087 | 10837 | 2010 |
| 2 | ADAMS COUNTY 14 | ADAMS | 34792431 | 34598159 | ... | 100 | 1120 | 11104 | 2010 |
| 3 | BRIGHTON 27J | ADAMS | 62557927 | 50921503 | ... | 15 | 1296 | 9287 | 2010 |
| 4 | BENNETT 29J | ADAMS | 4853879 | 3540284 | ... | 0 | 939 | 8784 | 2010 |

**TABLE 7.2:** Expenditures data after being manipulated into a tall data format.

| Quantile | Total Spending Per Pupil |
|----------|--------------------------|
| 0.0%     | $6090.00                 |
| 2.5%     | $8346.90                 |
| 25.0%    | $10116.25                |
| 50.0%    | $12401.50                |
| 75.0%    | $15827.00                |
| 97.5%    | $36131.82                |
| 100.0%   | $108789.00               |

**TABLE 7.3:** Quantiles for spending per pupil show a heavily skewed dataset. Between the max and the 97.5% there is an order of magnitude difference

## 7.2 FIGURES

TABLE IVC                    COMPARISON OF ALL PROGRAM EXPENDITURES                    2012-2013

| | DISTRICT/ | | Total | | | |
|---|---|---|---|---|---|---|
| | | Instruction | Support | Community | Other | Total |
| COUNTY | BOCES | Services | Services | Services | Expenditures | Expenditures |
| | | | | | | |
| ADAMS | MAPLETON 1 | | | | | |
| $ Amount | | 38,592,373 | 25,709,054 | 779,878 | 4,153,285 | 69,234,590 |
| $ Per Pupil | | 5,081 | 3,385 | 103 | 547 | 9,115 |
| % All Funds | | 55.7 | 37.1 | 1.1 | 6.0 | 100.0 |
| | | | | | | |
| ADAMS | ADAMS 12 FIVE STAR | | | | | |
| $ Amount | | 221,051,769 | 120,585,070 | 1,335,918 | 51,372,445 | 394,345,203 |
| $ Per Pupil | | 5,347 | 2,917 | 32 | 1,243 | 9,538 |
| % All Funds | | 56.1 | 30.6 | 0.3 | 13.0 | 100.0 |
| | | | | | | |
| ADAMS | ADAMS COUNTY 14 | | | | | |
| $ Amount | | 38,196,626 | 36,456,267 | 413,091 | 77,970,868 | 153,036,852 |
| $ Per Pupil | | 5,516 | 5,265 | 60 | 11,260 | 22,100 |
| % All Funds | | 25.0 | 23.8 | 0.3 | 50.9 | 100.0 |
| | | | | | | |
| ADAMS | BRIGHTON 27J | | | | | |
| $ Amount | | 67,423,272 | 52,627,926 | 247,509 | 24,647,115 | 144,945,822 |
| $ Per Pupil | | 4,392 | 3,428 | 16 | 1,605 | 9,441 |
| % All Funds | | 46.5 | 36.3 | 0.2 | 17.0 | 100.0 |
| | | | | | | |
| ADAMS | BENNETT 29J | | | | | |
| $ Amount | | 4,894,710 | 3,252,791 | 0 | 988,729 | 9,136,230 |
| $ Per Pupil | | 4,766 | 3,167 | 0 | 963 | 8,895 |
| % All Funds | | 53.6 | 35.6 | 0.0 | 10.8 | 100.0 |

**FIGURE 7.5:** Expenditures data was initially given in a report style format.
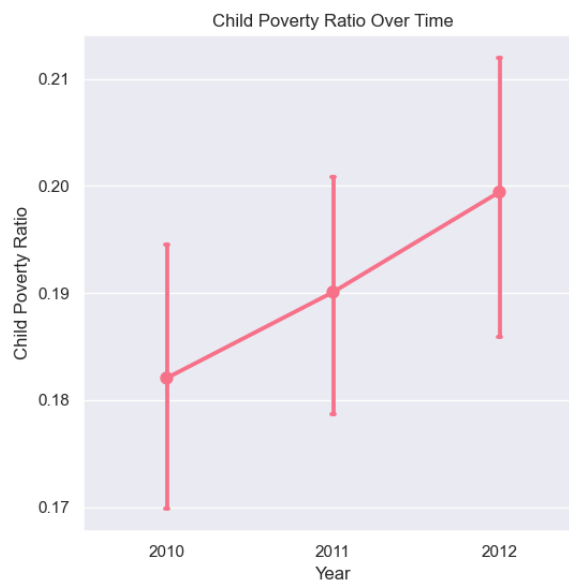


**FIGURE 7.6:** Poverty is increasing at a rate that is visually noticeable even within the three year time frame. A t-test to determine if poverty in 2012 was indeed greater than 2010 yielded a p-value of 0.030 making us reasonably confident in our hypothesis.

**FIGURE 7.7:** The percentage of free and reduced lunches provided to students increases at a higher rate than the percentage of children in poverty.
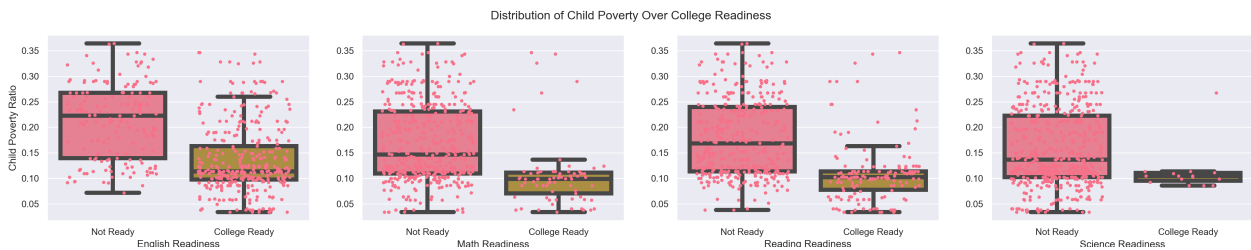


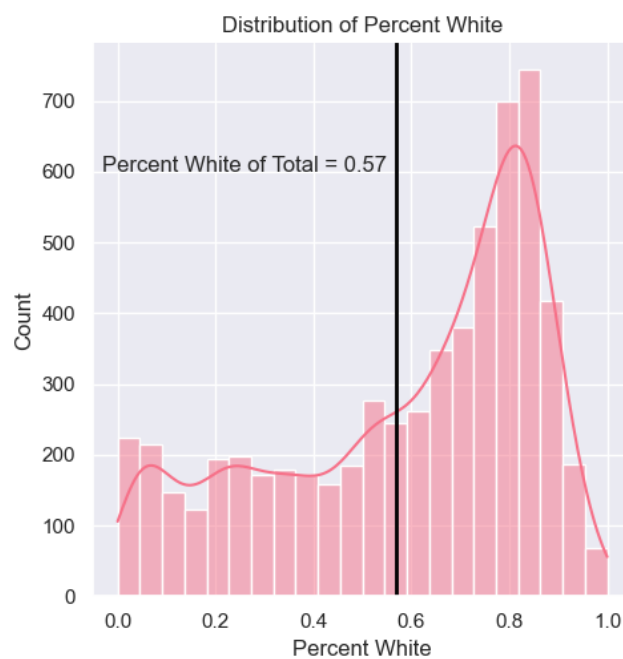**FIGURE 7.8:** In every category we observe that increased poverty is linked with less college readiness.



**FIGURE 7.9:** After determining the percentage of white students in Colorado Schools by multiply percentages by total students in school, it seems that our schools are not diverse.
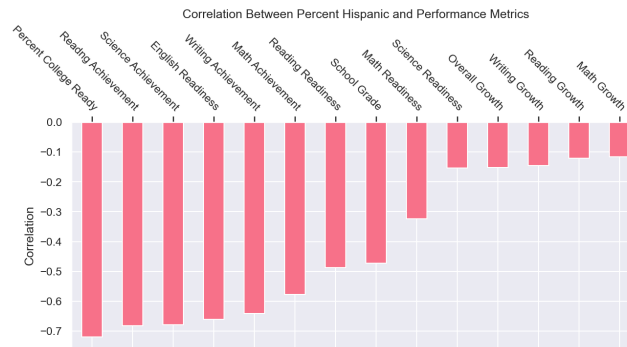
**FIGURE 7.10:** Across every performance metric, schools with a higher percentage of Hispanic student are negatively correlated with their performance metrics.
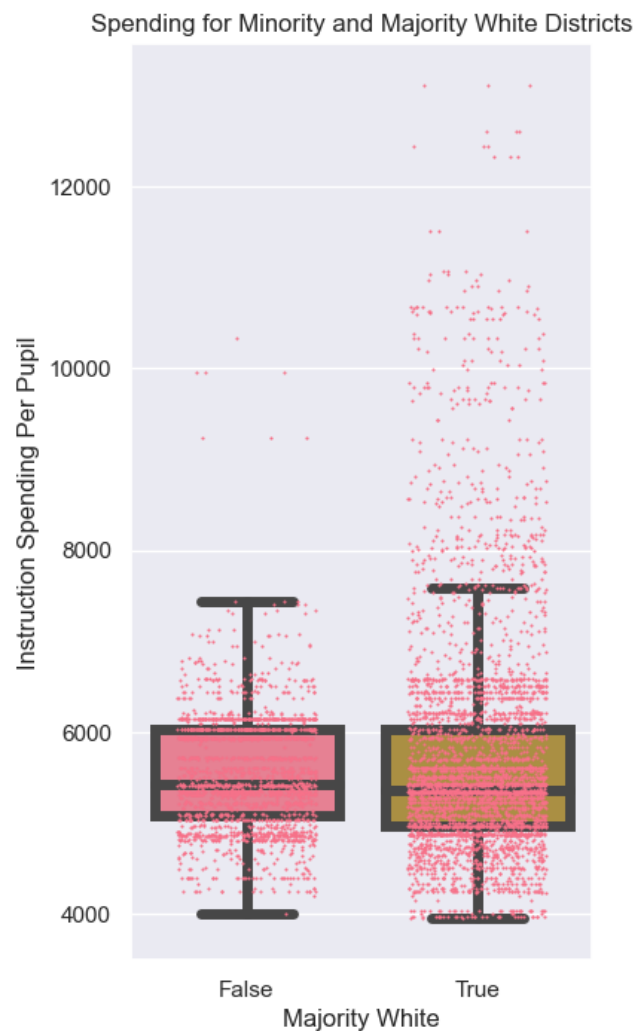


**FIGURE 7.11:** We observe that the vast majority of outliers for spending are in the majority white schools. A t-test to determine if majority white schools receive more funds per pupil than minority white districts yielded a p-value 2.08e-9.
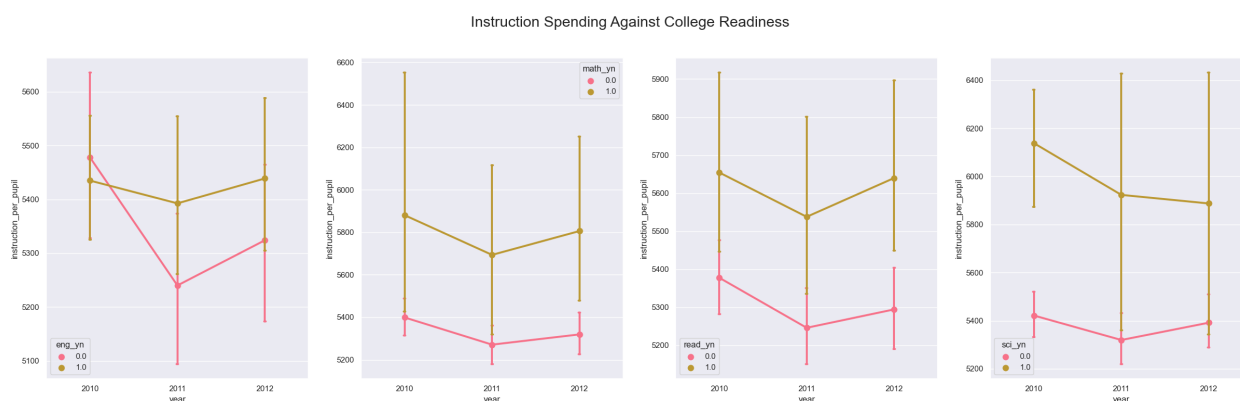
**FIGURE 7.12:** In every category we observe that increased spending is linked with more college readiness in every category and nearly every year. Mann-Whitney U rank testing yields p-values of 0.141 for english readiness, 0.00021 for math readiness, 2.91e-5 for reading readiness, 6.07e-5 for science readiness.
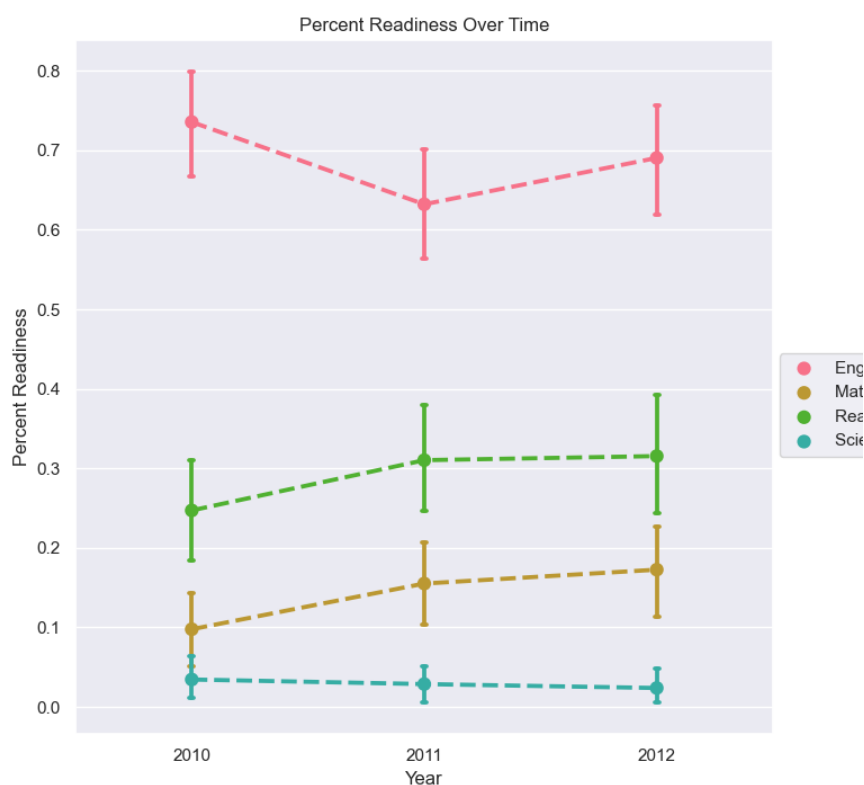


**FIGURE 7.13:** We can see that mean college readiness is not changing meaningfully over time. Furthermore, the percentage of students receiving high engligh ACT scores is drastically higher than any other category particularly science.