# Marijuana Tax Policy and Education

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**Independent Study**

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## Introduction

Marijuana is becoming more and more legalized in the United States. With its legalization, there is growing legislation for states to gain tax revenue from this popular recreational drug. As taxation produces more funds, there are a growing ideas or theories about how the money should be allocated and spent. Education is a possible recipient for funds. This topic hits home as students that receive benefits from various tax revenues that enable us to receive an education. However, the focus of our study was on a program from the Colorado Department of Education (CDE) that seeks to build better schools for public schools in Colorado. Marijuana taxation is relevant to this topic because the Building Excellent Schools Today Program (BEST) receives tax revenues from the excise tax on marijuana and grants it to schools in order to help with capital construction costs. Existing literature has sought to make a correlation with student attitudes about their learning environment and performance, but all previous work has been inconclusive. Though our study is on the same track, we look to contribute by analyzing the funding of the improvements and their impact on student performance through panel comparisons of before and after funding is received.

Our hypothesis is that once a school receives grant money from the BEST program that the school's standardized test scores will improve because the learning environment of the students has been upgraded. To be clear, the tax money from marijuana sales helps fund the BEST program and then the BEST program allocates the money in order to improve the physical building of the school, which in turn enriches a student's learning experience and should result in better school performance. Though largely inconclusive, or uncorrelated, our findings helped better understand and possibly provide information about how the taxation of a recreational drug

like marijuana impacts the education system of a state. The following data analysis through statistical modeling will hopefully flesh out some of the details that underlie this relationship.

**Literature Review**

As mentioned earlier, the research on the specific thesis statement we propose is limited. However, there exists a small amount of literature focused on specific aspects of school life in various countries. In his dissertation, Mutlaq M. Al-Enezi found a relationship between school building conditions and achievement of twelfth graders in Kuwait (Al-Enezi, 2002). This research was applicable to our study because it served as a guide in generating our thesis because it showed that correlation, not the causality, was possible. In her study of building condition and student achievement and behavior, Carol Cash found that student test scores were higher in buildings that received higher quality ratings by a review board in rural Virginia (Cash, 1993). Her work had similar findings to the work of Al-Enezi as well in terms of the correlation between the conditions and achievement, also. However, Cash's work served as a guide to our main variable of interest. As we looked at rank, her use of scale motivated us to use that as a standard for comparison. Both of these papers provided useful helping points as we began our research, but their applicability to our specific focus was of concern. Also, the time period of these papers is not as close to our period of study as we hoped. We ran into some road blocks due to lack of data availability, but that will be discussed later. Other research showed similar results.

Due to this lack of previous work on our topic, we used other resources available. We reached out to education professionals at our high schools and professors at Centre College in Danville, Kentucky to gain a further understanding of the perceived correlation between building condition

and student achievement. Teacher Craig Widener of Bowling Green High School in Bowling Green, Kentucky believed that the improvement of the school would make students more comfortable and thus more engaged in the learning experience (Widener, 2018). Another education professional, Dr. Donna Plummer of Centre College, reiterated Mr. Widener's stance. Although this is not concrete research, we believe that the opinions of these people who deal with children and young adults daily provided sufficient evidence and knowledge to be viewed as validation for our hypothesis. Our paper hopes to add to this field of research by exploring the funding behind school improvements and if this allocation structure is the proper way to help improve schools and therefore improve student performance. Further, we hope to add support to the previous literature already conducted by having this study be successful in the support of the prior theses presented.

**Best Program and Economic Theory:**

The BEST program, beginning in 2008, seeks to build better schools for public school students by providing funding for capital construction needs and school renovations. Every year a group of schools are selected to receive BEST program funding. Our study assumes that schools are selected for BEST program funding based upon capital construction needs alone; excluding any demographic or geographic variables. We made this assumption because of the opaque description of the BEST program application process on the Colorado Department of Education's website. Another key assumption we made was that standardized test math score performance could serve as an accurate proxy for aggregate test score performance for all public school students. This assumption was made because of the lack of consistency in the Colorado Department of Education's standardized test score record keeping and time limitations. Based upon our literature review and contact with education professionals we hypothesized an enriched

physical setting should improve student performance. Therefore, if a school receives BEST program funding the school should see an increased in its students standardized math test scores.

**Data:**

Our data was found on the Colorado Department of Education's (CDE) website. It came in the form of excel spreadsheets that were imported into STATA data sets creating one panel STATA data set. Our data consists of standardized math standardized test scores, demographic variables, and a *satisfy* variable between the years 2010 and 2017. We could only use standardized math test scores due to time limitations. Colorado went through two standardized test score transitionary periods between 2010 and 2017. During 2010 and 2011 the CSAP test was used, from 2012 to 2013 the TCAP test was used, and from 2014 until present the CMAS test has been used. Fortunately, the *satisfy* variable is present in all the test score data sets. The *satisfy* variable measures the proportion of students in every school for each school year that achieves a 'satisfactory' score according to the Colorado Department of Education's requirements. From the *satisfy* variable we created our independent variable *rank*. The *rank* variable is dependent on the *satisfy* variable and the *year* variable. Every school was a given a *satisfy* value for every year their school had available test scores.

There are seven number 1 ranks, one for each year between 2010 and 2017. Denison Elementary School had a *rank* value of 1 for the year 2010. This indicates that Denison Elementary School had the highest number of students score satisfactory, thus Denison Elementary School had the highest value for *satisfy* in 2010. Denison Elementary School's rank varies from 1 in 2010, to 4 in 2014 and 8 in 2017. The *rank* variable does this for all schools present in the data set. We made the *rank* variable because the *satisfy* variable did not easily allow us to see the variation in standardized test scores for a school between years and in comparison to other schools. We

wanted a more precise way to check a schools progress, or lack thereof, in test score performance. If we only used the *satisfy* variable for Denison Elementary School we would be comparing the following eight raw *satisfy* scores: 97.4, 97.5, 87.7, 81.7, 98.3, 97.5, 85.8, and 99.5. We could not tell how many schools scored better or worse in each year. The *rank* variable allows us to see how many schools scored better and worse than Denison Elementary in every year. In Table 1 below there is a list and explanation of all variables used in our regression aside the from eight year control variables

Table 1: Variable Explanation

| Variable Name | Variable Type | Dependent or Independent | Explanation |
|---|---|---|---|
| *rank* | See above | Dependent | See above |
| *best_yes* | Dummy | Independent | Turned on if a school received BEST program funding |
| *percent_other* | Demographic | Independent | Percentage of student body in a given year that is not white, black or hispanic |
| *percent_white* | Demographic | Independent | Percentage of student body in a given year that is white |
| *percent_black* | Demographic | Independent | Percentage of student body in a given year that is black |
| *percent_hispanic* | Demographic | Independent | Percentage of student body in a given year this is hispanic |
| *percent_gifted* | Demographic | Independent | Percentage of student body in a given year that qualifies for the 'gifted student' program |
| *percent_lunchpro* | Demographic | Independent | Percentage of students in a given year who qualify for the subsidized student lunch program |
| *percent_mig_im* | Demographic | Independent | Percentage of students in a given year who are migrants or immigrants |

Our race variables, *percent_other, percent_white, percent_black* and *percent_hispanic* are not dummy variables because we have the actual percentage of students in each school for every year that identify in one of the four categories. The *percent_gifted* variable is comprised of the percentage of students who are considered 'gifted' in a given school year. The requirements for 'gifted' status were ambiguous on the CDE website, however it is probably safe to assume these students perform better in school than those who are not considered gifted. Students who qualify for subsidized lunch program--captured in the *percent_lunchpro* variable--come from low socio-economic backgrounds. The exact requirements to qualify for the subsidized lunch program were not given on the CDE website. The CDE did not provide clear requirements for why a student could be considered a migrant. Thus, we interpreted the variable to mean the percentage of students who enrolled at the school in a given year from a different geographical area, state or country. That is why we named our variable *percent_mi_im;* to encompass those from different geographical area or states (migrants) and those from different countries (immigrants). Typically, migrants and immigrants will move to a new location to find work. Therefore, it can be determined that these students are probably the children of individuals relocating for work. Located below in Table 2 are the descriptive statistics of our data (excluding *SchoolName* and *id* because they are categorical variables). The observations (total) column contains the overall number of observations not accounting for panel data--the same school being present over multiple years. The observations (panel) column accounts for the number of observations that are seen in multiple years. Essentially, it is the number of schools present in the data set.

| Table 2: Descriptive Statistics | | | | | | |
|---|---|---|---|---|---|---|
| Variable Name | Observations (Total) | Mean | Observations (Panel) | Std. Dev (Overall) | Min | Max |
| *best_yes* | 10127 | .0218228 | 1594 | .146112 | 0 | 1 |
| *percent_other* | 10127 | .0197231 | 1594 | .0404642 | 0 | 1 |
| *percent_white* | 10127 | .6177424 | 1594 | .3372589 | 0 | 1 |
| *percent_black* | 10127 | .0348054 | 1594 | .0858228 | 0 | 1 |
| *percent_hispanic* | 10127 | .3315381 | 1594 | .31964 | 0 | 1 |
| *percent_gifted* | 10127 | .0534659 | 1594 | .0908141 | 0 | 1 |
| *percent_lunchpro* | 10127 | .4261537 | 1594 | .3308669 | 0 | 1 |
| *percent_mig_im* | 10127 | .0067876 | 1594 | .0184941 | 0 | .2576923 |
| *Year* | 10127 | 2013.307 | 1594 | 2.248481 | 2010 | 2017 |
| *satisfy* | 10127 | 50.77688 | 1594 | 22.64376 | 0 | 100 |
| *rank* | 10127 | 656.9655 | 1594 | 389.5538 | 1 | 1466 |

The aggregate race breakdown of our schools from greatest to least is white with approximately approximately 61.8%, hispanic with 33.2%, black with 3.5% and other with 2.0%. This means that for the 1594 schools in our data set on average 61.8% of the students are white, 33.2% are hispanic, 3.5% are black and 2.0% are other. On average the percentage of students who are gifted is 5.4% for each school. The percentage of students who qualify for subsidized lunch on average for each school is 42.6%. The percentage of students considered to be migrants or immigrants on average for each school is 0.7%. Lastly, on average on 2.2% of 1594 school in our data set receive the best program funding at any point in time.

**Empirical Models:**

To understand the how the BEST program funding may or may not have an affect on student standardized test performance we chose the following three models. For each model we used the fixed effects (FE) estimator method. We chose the fixed effects method over the ordinary least squares (OLS) estimator method because the fixed effects method accounts for observed and unobserved attributes of the schools that are constant over time where the OLS method does not. Rather, the OLS method treats each school's observations between the years as if they are from different schools entirely.

Model 1: Fixed Effects

$$rank_{it} = \beta_0 + \beta_1 best\_yes_{it} + u_{it}$$

Model 2: Fixed Effects

$$rank_{it} = \beta_0 + \beta_1 best\_yes_{it} + \beta_2 y2011_{it} + \beta_3 y2012_{it} + \beta_4 y2013_{it} + \beta_5 y2014_{it} + \beta_6 y2015_{it} + \beta_7 2016_{it} + \beta_9 2017_{it} + u_{it}$$

**y2010 omitted*

Model 3: Fixed Effects

$$rank_{it} = \beta_0 + \beta_1 best\_yes_{it} + \beta_2 y2011_{it} + \beta_3 y2012_{it} + \beta_4 y2013_{it} + \beta_5 y2014_{it} + \beta_6 y2015_{it} + \beta_7 2016_{it} + \beta_9 2017_{it} + \beta_8 percent\_other_{it} + \beta_9 percent\_white_{it} + \beta_{10} percent\_black_{it} + \beta_{11} percent\_hispanic_{it} + \beta_{12} percent\_gifted_{it} + \beta_{13} percent\_lunchpro_{it} + \beta_{14} percent\_mig\_im_{it} + u_{it}$$

**y2010 omitted*

Table 3 below contains the expected signs for each of our independent variables.

Table 3: Expected Signs of Variables of Interest

Key: Positive (+), Negative (-), Ambiguous (~)

| Variable | Expected Sign of β (+, - , ~) of Each Variable |
|---|---|
| *best_yes* | - |
| *y2011* | ~ |
| *y2012* | ~ |
| *y2013* | ~ |
| *y2014* | ~ |
| *y2015* | ~ |
| *y2016* | ~ |
| *y2017* | ~ |
| *percent_other* | ~ |
| *percent_white* | - |
| *percent_black* | + |
| *percent_hispanic* | + |
| *percent_gifted* | - |
| *percent_lunchpro* | + |
| *percent_mig_im* | + |

We expected to see a negative coefficient from the *best_yes*, *percent_white,* and *percent_gifted* variables. A important detail to remember is that a lower rank indicates a school is performing better. Recall, the highest possible rank is 1. Therefore, a negative coefficient would indicate a

better rank. We expected the *best_yes* variable to have a positive coefficient because of our previous research that, on average all else equal, an improved school setting should result in better performing students thus resulting in a better rank. We expected *percent_white* to have a positive coefficient because economic theory suggests on average white students from higher socioeconomic backgrounds than other races. This increased socioeconomic status usually results in better school performance and subsequently higher standardized test scores. Therefore, on average all else equal, we expect a school with more white students to have a better rank. We also expected *percent_gifted* to have a negative coefficient because a student who is considered 'gifted' should perform better in school than non-gifted students. Therefore, on average all else equal, if a school has more gifted students their rank should improve.

We expected the signs of *percent_black, percent_hispanic, percent_lunchpro* and *percent_mig_im* to be negative due to the lower socioeconomic status usually associated with group. Economic theory suggests students who come from lower socioeconomic statuses perform worse in school. Individuals from black, hispanic, and migrant or immigrant communities typically come from lower socioeconomic backgrounds. Therefore, on average all else equal, schools with greater proportions of black, hispanic and or migrant/immigrant students will probably have a worse rank. To qualify for the subsidized lunch program a student must come from some threshold of lower socioeconomic status. Therefore, if a school has a greater number of students who qualify for subsidized lunch, on average all else equal, the school's rank would get worse.

**Results:**

In Table 4 are our regression results from the models outlined in the previous section along with various t-tests in the appendix that were used to help further explain our results.

*Significance levels: 0.01*** 0.05** 0.1**

| Table 4: Regression Results | | | |
|---|---|---|---|
| Variable | Model 1 | Model 2 | Model 3 |
| *best_yes* | -29.35137<br>( 29.0979) | 47.83315<br>(30.1253) | 52.89162<br>(40.79584) |
| *constant* | 657.6061<br>(.6349992) | 652.7987<br>(4.046828) | 492.5661<br>(225.3137) |
| *y2011* | | 3.442103<br>(3.293235) | 11.38586**<br>(5.166604) |
| *y2012* | | 12.63751***<br>(4.025901) | -4.420244<br>(10.89815) |
| *y2013* | | 58.14545***<br>(5.10263) | 45.13425***<br>(11.96884) |
| *y2014* | | 65.33129***<br>(5.32793) | 46.00427***<br>(11.72075) |
| *y2015* | | -54.20794***<br>(8.657288) | -89.92053***<br>(13.15738) |
| *y2016* | | -54.51248***<br>(9.396105) | -110.3591***<br>(18.12522) |
| *y2017* | | -37.04919***<br>(9.512634) | -108.9583***<br>(19.24114) |
| *percent_other* | | | 87.05686<br>(205.6443) |
| *percent_white* | | | 119.2165<br>(228.1793) |
| *percent_black* | | | 257.2973<br>(244.3013) |

| | | | |
|---|---|---|---|
| *percent_hispanic* | | | 229.0948<br>(234.0431) |
| *percent_gifted* | | | -485.6583***<br>(93.43479) |
| *percent_lunchpro* | | | 209.0556***<br>(47.46492) |
| *percent_mig_im* | | | 603.768**<br>(257.8398) |

We used Models 1 and 2 as comparisons to help peel back the relationship between rank and the independent variable regarding whether or not a school received the BEST funding and then added in year variables to explain the time effects that could occur within the model. However, the results that are relevant to our research question come from Model 3 of the fixed effects panel model. First, we see that the *best_yes* variable was insignificant and positive. This goes against what theory would suggest because it indicates that if a school received the BEST funding, then on average all else equal, their ranking became worse since the best ranking to have is 1. Our non-regression methods also support the result of a positive coefficient for the *best_yes* variable in Model 3. Figure 1 in our appendix indicates schools that receive BEST funding, on average all else equal, have a higher--worse--rank than those who do not receive BEST funding. Although we thought the racial demographics would have an impact on the ranking, our data suggests that they play a minor, if any, role in the ranking of the school in the standardized test score comparison. Our non-regression methods also support this result. Figure 2 in the appendix displays how the proportion of students for each race is fairly similar, on average all else equal, for schools that do and do not receive BEST funding.

Next, we move to the classifications of students based on academic ability, socio-economic status and migrant status. For the *percent_gifted* variable, we see that the point

estimate in the regression is negative and significant at all relevant levels. This indicates that the ranking of a school is negatively correlated with the percentage of students that are identified as gifted academically. For our predictions, this is helpful because it held true to theory and supports the idea that if a school has more gifted students then they are more likely to be ranked higher than those schools that have less. Migrant status and free and reduced lunch program status also held true to theory. For the *percent_migrant* variable, we predicted that if a school had more migrants then it would be ranked lower than schools with less due to children having to adjust to outside circumstances. The regression results indicate that, on average all else equal, when the percentage of migrants at a given school increases, the ranking of the school worsens. The same logic follows for the *percent_lunchpro* variable. However, the difference between migrant and reduced lunch children is that the free and reduced lunch students are categorized by the socio-economic status of their family. Regardless, their impact on ranking followed theory in that it was a positive estimate which means the school's ranking would worsen if there were more children on free and reduced lunch, on average all else equal.

The implications of our results indicate and confirm a few theoretical findings that are applicable to the real world. First, our results show that children from minority and lower socio-economic backgrounds often perform worse on standardized tests than their counterparts of the same age. Also, children identified as gifted academically can improve the ranking of the school, even if marginally. Theory would suggest this to be true due to the idea that gifted children perform better in school and help the learning environment of children around them through peer led learning or setting an example.

## Conclusion

Although our main research question was left in the inconclusive category, we still managed to salvage some findings that can help drive and explain future research on this topic. Hopefully, the effects of the BEST funding become more evident in the years to come so that the process can be refined and furthered in a manner that increases the educational experience of students. Further, the use of the marijuana excise tax revenue could be useful for funding better schools for students in Colorado, but due to our inconclusive results it could also be allocated in a more conducive and effective fashion to help the state. One point that we would like to make about our study is that the main piece of information needed to help improve our model is the criteria used to select which schools receive the BEST funding. However, the data and process outline were unavailable, but we believe this information could have greatly helped our research question reach an answer. For future researchers, one possible route that this study may help on is the continued tracking of the BEST program and its funding to see how it unfolds when given the proper amount of time for its initiatives to take hold.

Works Cited

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Widener, Craig. Personal Interview. March 2018.

# Appendix

Figure 1

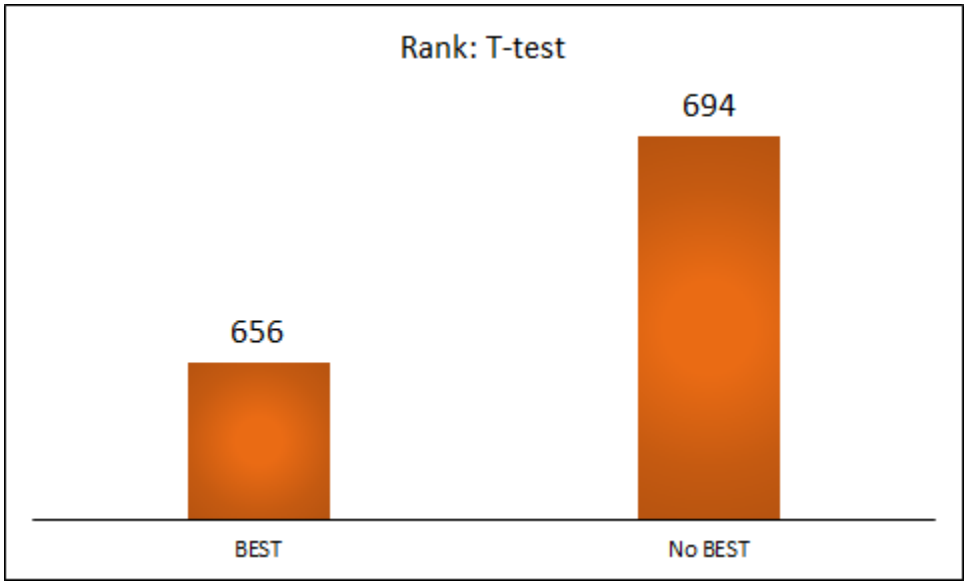



Figure 2

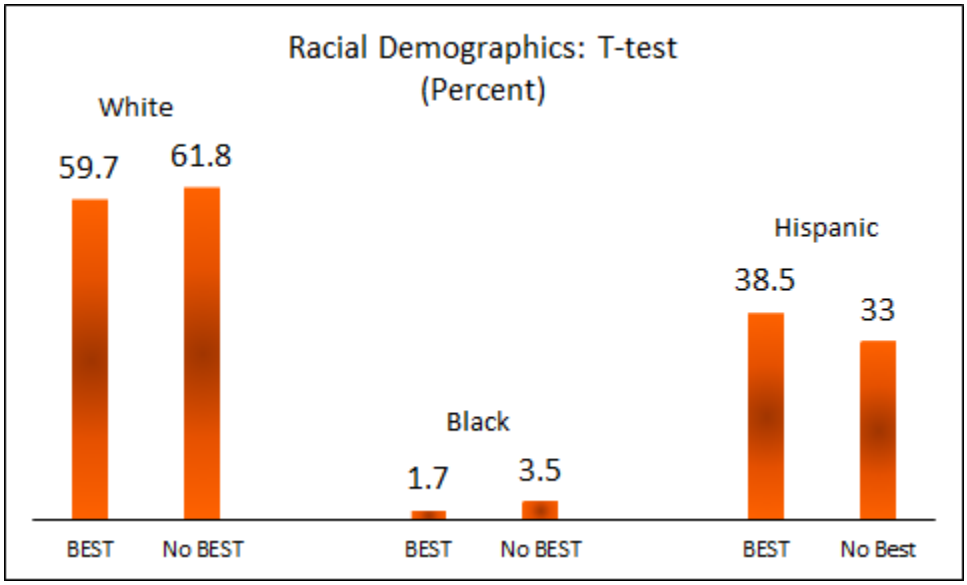
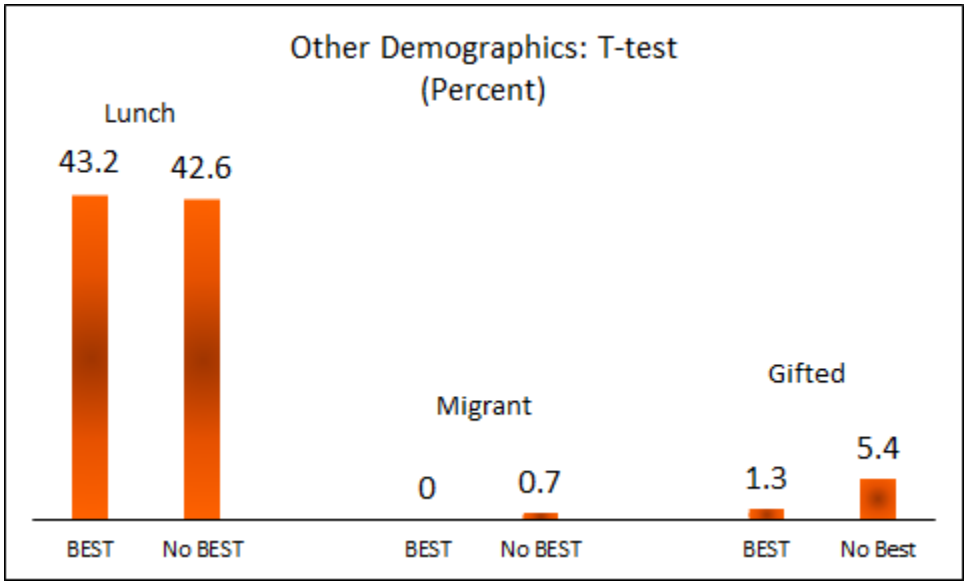


Figure 3


Other Demographics: T-test
(Percent)
Lunch
43.2
42.6
Migrant
0
0.7
Gifted
1.3
5.4
BEST
No BEST
BEST
No BEST
BEST
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