

# Examining the Unexamined Education: Reviving Philosophy in Secondary Schools

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*Problem-solving and critical thinking skills are at a premium providing students with these skills the American educational system must reincorporate philosophy within secondary schools. This research study sought to discover what effect does the engagement with and study of formalized logic have on large urban school district students' ability to answer questions more rationally. The hypothesis was that when participating in a philosophy-infused class, the LUSD students' critical thinking skills would improve on logical reasoning examinations measuring problem-solving. The results of the study revealed that students enrolled in an introduction to philosophy course outperformed their unenrolled classmates on both the verbal and numerical reasoning assessments. The experimental curriculum produced a moderate positive effect on the numerical reasoning test scores of the experimental group when compared to the control group. Additionally, the same results were seen when measuring the pre-test and post-test scores of the experimental group.*

## INTRODUCTION

One of the world's greatest philosophers, Socrates, was charged with impiety and corrupting the youth of Athens in Plato's *Apology*. Upon reading, one has to stop and ask what depraved wickedness was the founder of modern western philosophy engaged. Socrates was not involved in the misappropriation of funds from the Athens public school system, nor was he indicted for fraudulently manipulating the standardized test scores of Greece. Plato tells his readers that Socrates was imploring all the people of Athens that the unexamined life was not worth living. He merely wanted all citizens of Athens to question their beliefs, to better understand themselves, and to be more conscientious citizens of Athens.

This faith in self-reflection is espoused as one of the bedrocks of the American educational system. In fact, former President Obama had urged a national campaign to promote problem-solving, critical thinking, and creativity in American schools. Across the political spectrum, educational policy makers have made improving schools and focusing on problem-solving a part of their formal platforms. Why then has there been an attack upon the very courses that form the foundation of critical thinking and problem-solving? Teachers of philosophy are no longer sentenced to death through poisoning but are forced to accept the other option that Socrates refused: exile. The push to move American schools into the twenty-first century has led to the turning away from basic lessons of self-reflection learned more than twenty-four hundred years ago across the Atlantic Ocean.

### ***Presentation of the Problem***

The dwindling influence of philosophy in the educational curriculum is a common problem happening across the world, the United States of America, and in the Large Urban School District (LUSD). Within schools, educational leaders are vehemently detailing their aspirations for promoting critical thinking and problem-solving while simultaneously restricting such growth by pulling funding from subjects considered otiose in the twentieth-century. Science, technology, engineering, and mathematics (STEM) educational programs are important educational concentrations in the post-modern world but are promoted at the expense of philosophical study.

Various states and in particular LUSD are in the process of implementing STEM projects in order to prepare students for the information age. The unintended consequence of this adaptation is the reliance upon standardized testing which is best utilized when measuring students' accumulation of facts and formulas presented in math and science courses. Even in courses that could be called the humanities, such as English Language Arts and American government, are tested in ways that fail to measure critical thinking skills and individual interpretation. Therefore, if the critical thinking and problem-solving skills are part of the primary focus in our schools we need to bring the basic skills required for such higher level thinking back into the classroom.

The researcher chose the underutilization of philosophy within high schools to be pursued specifically after having worked within the LUSD for numerous years. Students within this district are primarily educated to score well on the Missouri Assessment Program (MAP) examinations. It needs to be noted that this is not an accusation against the LUSD administration but rather the ongoing consequences of the No Child Left Behind (NCLB) policy of the Bush administration and an increased focus on STEM curriculum. Our educational institutions are driven by fear and funding to promote practical skills that will purportedly translate into jobs in an ever more globalized world economy while neglecting the skills that will make those same students responsible world citizens.

### ***History of the Problem***

Today's educational world is highly departmentalized, and cross-curriculum activities are lauded due to their rarity. However, this was not always the case when it came to the accumulation of knowledge. In the ancient world, philosophy was considered anything that attempted to explain the world through non-mystical means. Thus, philosophy was not always viewed as an inaccessible field of study isolated from the workings of the real world. Therefore, all of the different areas that compose STEM programs were once a part of the philosophical universe.

As the ancient world gave way to the medieval, modern, and post-modern world, the compartmentalization and sophistication of fields of knowledge became much more defined and pronounced. Departmentalization was a naturally occurring adaptation to the increase in human knowledge and understanding. Experiments about the nature of how the world works are no longer relegated to thought experiments but to actual scientific investigations. As our knowledge of the world evolves and becomes more complex and detailed the separation between forms of knowledge and understanding has become wider.

### ***Current Status of the Problem***

The walls between specific domains of instruction today are more distinct and stringent than ever before. Economic instability in a globalized world and school accountability efforts are the primary catalysts for the current impetus on removing philosophical studies from LUSD high schools and throughout the United States. National and state departments of education focus their regulatory gaze upon a district's career readiness data. These accrediting agencies and organizations want to see how

students are performing in English, science, and mathematics. These are the skills prophesied as being most valuable to employers of today and the future and will thus provide economic stimulants for the national gross domestic product. However, philosophical approaches to globalization would allow students to rationalize that different nations are no more natural than state borders within one's own country.

The school accountability movement has also led to the current decrease in the prominence of philosophy in high schools. Standardization approaches, such as Common Core, were created to promote critical thinking and problem-solving within existing curricula. Although the standards present ways of measuring such skills within diverse fields of study the actual measurements used to show student learning neglect assessments that would provide such information. Since school funding is now tied to achievement on such standardized tests, districts and schools are now forced to focus on rote memorization and test-taking skills instead of improving critical thinking.

The problem lies with the fact that job-related skills alone will not help produce more productive members of society. Algebra will not tell you who to vote for, and chemistry will not explain how to view a problem from someone else's perspective, but philosophy and critical thinking can guide you to those answers. Currently, the status of all schooling is under attack throughout LUSD and America in general. Areas of education ranging from art, music, philosophy and social studies are being deemed unnecessary in an era of budget tightening. We have to ask ourselves whether we want our children to be individualistic freethinkers or automaton cogs in an advanced assembly line.

### ***Research Question***

There is one central research question that will be addressed, tested, and analyzed over the course of this study. The question deals with philosophical concepts taught in an introduction to philosophy course at The Academy within the LUSD. To gain a more holistic assessment of student learning from the course, the question was measured quantifiably through student performance on logic assessments and formulating logical interpretations.

◆ Question: What effect does the engagement with and study of formalized logic have on LUSD students' ability to answer questions more rationally?

### ***Definitions***

The research question has several terms that require a more nuanced definition. The term "effect" in the question will be measured quarterly using quantitative data gathered from formalized student assessments dealing with formal logic. "Engagement" will be defined as students reading, writing, discussing, and contemplating philosophical texts from Plato, Aristotle, Descartes, Kant, and Nietzsche. "Formalized logic" refers to the study of rational and fruitful arguments, whether that is through deductive or inductive reasoning. "LUSD students" will be referring to the group of juniors and seniors participating in the introduction to philosophy course at The Academy during the 2016-2017 and 2017-2018 school years.

### ***Hypothesis***

When participating in a philosophy-infused class, the LUSD students' critical thinking skills will improve on logical reasoning examinations measuring problem solving.

## DESIGN OF THE RESEARCH

Data from the current research study was analyzed utilizing a quasi-experimental quantitative methodology. The information gathered throughout the study determined whether the hypothesis which stated that participation in a philosophy-infused class, improves the critical thinking skills of LUSD students on logical reasoning, ability examinations measuring problem-solving was valid or not.

To create a more formalized and standardized method of assessment, the research study was comprised of a pre-test-post-test non-equivalent group design. Therefore, the students were engaged with a pre-test at the beginning of the school term for 2016-2017 and 2017-2018. The post-test portion of the study transpired during May 2017 and May 2018. Both the pre-tests and post-tests were made up of two reasoning tests.

A key facet of the study was the inclusion of the control group, which was actively enrolled in a corresponding social studies seminar course working without a structured program dedicated to problem-solving and critical thinking. Data accumulated at the end of the terms was thus not only reviewed for changes within individual subjects over the course of the class but also between the two differing seminar courses. Whereas the social studies seminar class infused with philosophical topics and reasoning and logic curriculum primarily promoted critical thinking, the other seminar classes only included problem-solving as a side-effect of its typical curriculum. The study showed the significance and benefits of a structured course promoting the essential skills needed for critical thinking.

It must be made clear that one of the limitations of the study was the fact that the control group was taught by a different teacher than the experimental group. However, an effort was made to provide both groups with educators of relatively similar qualifications and backgrounds to negate the differences as much as possible. The instructors of the control group and experimental group were of the same gender and race, they were both highly qualified social studies teachers with content related master's degrees, and both had received dual credit certification through a local university. The main difference between the educators was that the control group teacher had more years of experience in the classroom.

All of the data collected came from the pre-tests and post-tests given to both the experimental and control groups. The independent variable in this quasi-experimental study was the philosophy and logic curriculum taught to the experimental group. Enhancing the critical thinking skills and problem-solving abilities in students allowed them to become more prepared for the workplace of the future and more empathetic to differing viewpoints.

### *Demographics*

The demographics of the student sample are best understood through the lens of the entire district and school at large. Figure 1 presents the racial demographics within the LUSD. The LUSD is predominantly an African-American district with a small Caucasian minority and even smaller populations of Hispanics, Indians, and Asians.

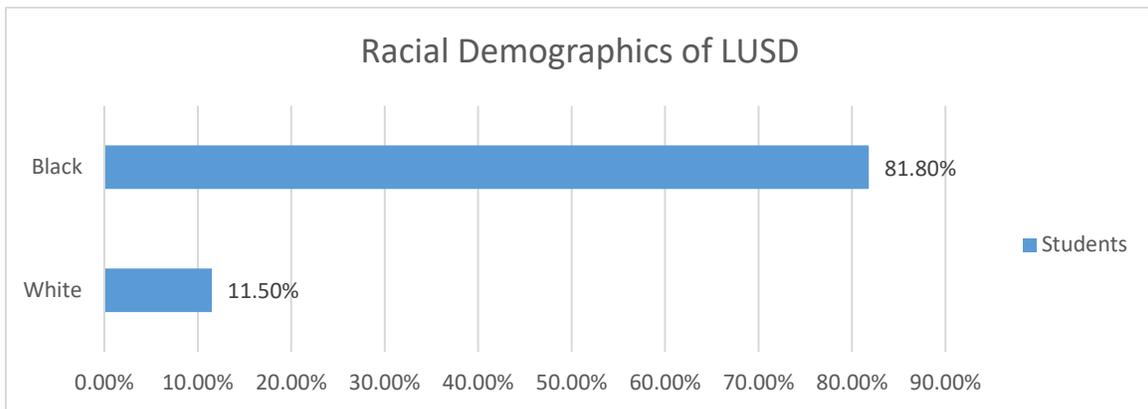


Figure 1: Racial demographics of the large, urban school district.

Figure 2 shows the racial demographics of both The Academy and the particular social studies seminar course being studied in detail. There is a slight decrease in African-American enrollment at The Academy (71%) when compared to LUSD (81.8%) and a further decrease when looking at the student sample in this study (59%). Figure 3 presents the gender ratio in LUSD, The Academy, and the study’s student sample.

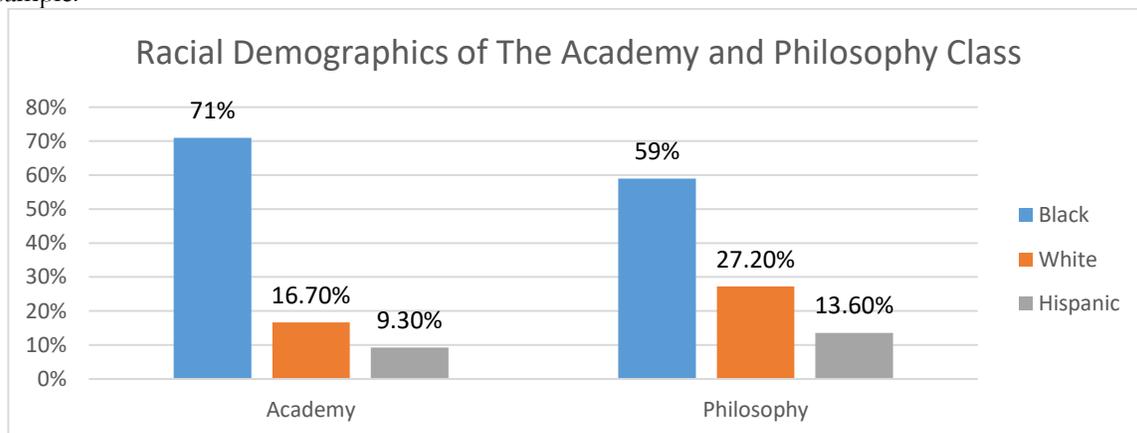


Figure 2: Comparative racial demographics of The Academy and the experimental philosophy class.

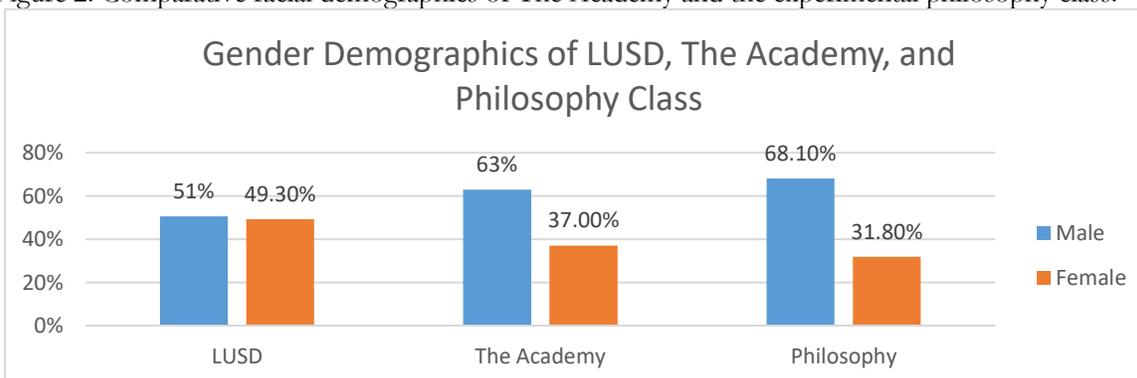


Figure 3: Comparative gender demographics of the LUSD, The Academy, and experimental philosophy class.

The targeted student sample, which was under the microscope throughout the research study, was populated by more males on average than a typical classroom in LUSD and The Academy. Additionally,

there was more Hispanic students in the study than are traditionally represented within LUSD and The Academy.

### ***Target Sample Selection***

The individual students selected to make up the target sample were seniors at The Academy. These forty students were enrolled in the introduction to philosophy through popular culture social studies seminar. The sample students had spent three years in social studies, English, science, and mathematics courses at the secondary level. The point of waiting until the subjects are in their senior year was to give them the maximum amount of time learning critical thinking skills in a typical educational curriculum. Therefore, the difference between the control group and experimental group was limited leading into enrollment in the philosophy course.

The designated forty students that populated the sample were selected at random from the senior class. Freshmen, sophomores, and juniors had not completed enough traditional curriculum and were additionally limited on their choices of electives. Twelfth-grade students had completed most of their required courses and were available for random assignment into elective courses. The only excluding criteria for seniors was their corresponding enrollment in Advanced Placement English literature. Due to scheduling conflicts, students participating in the AP course were not be able to be randomly assigned to either the philosophy class or a different social studies seminar course, which additionally served as the control group.

Comparing the experimental group with the control group provided clarification of the benefits or detriments of adding a philosophical course to the secondary curriculum. Therefore, the target sample group was contrasted with an equally randomized control group. The differentiation between the experimental and control groups at the end of the course shed light on the consequences of neglecting the fundamental of problem-solving and critical thinking - philosophy. The target sample group had a more advanced understanding of how to logically attack difficult and complex questions and situations.

### ***Description of the Program***

The international educational community continues to be referenced as a Goliath facing American students and educators. Not a week goes by without hearing a political pundit arguing the shortcomings of public education in the United States and how we are falling behind in STEM preparations. The philosophical curriculum implemented within the social studies seminar at The Academy rationalized that what is missing in our schools is an understanding of how to answer complex questions within all disciplines and not a lack of preparation in four distinct fields.

Within the LUSD STEM programs are being prioritized as the key to successfully preparing students for the twenty-first century. Four years of math and science courses are now required for graduation while social studies and the humanities are pushed further into the background. The Academy has implemented a philosophical course for seniors to teach them the basics of problem-solving and rational, logical, and critical thinking. The program is designed to offer students trouble-shooting skills for real-world issues faced throughout life. STEM programs tend to focus solely on skills that are to be mastered but are only applicable in specific situations. The philosophy program complemented our students' STEM preparations while broadening its applicability.

The current program was taught by a teacher with a background in philosophy and popular culture. The combination of philosophy and pop culture was specifically chosen in order to introduce students with no or limited philosophical background to structured critical thinking and logic. The introduction of complex ideas and reasoning is more adequately implemented for secondary students through topics they are already familiar with. The target sample group read fiction and nonfiction texts while also viewing television shows and feature length films with philosophical implications. Rather than merely watching

or reading material for entertainment purposes, the experimental group examined philosophical ideas and logical reasoning skills before the start of a unit. After finishing a text or video, the students were debriefed and assessed on writing assignments aligned to the philosophical topic at hand.

### ***Definitions***

“Pre-test-post-test non-equivalent group design” refers to the set-up of the quasi-experimental method utilized for the study (Figure 4). The control groups were treated in the usual manner as the general population, while the experimental group was given an independent variable throughout the course of the study.

Experimental	O <sub>1</sub>	X	O <sub>2</sub>
.....			
Control	O <sub>3</sub>		O <sub>4</sub>

Table 1: Pre-test-Post-Test Non-equivalent Group Design

“Social studies seminars” denoted the elective social studies courses that were available to seniors at The Academy. The social studies classes open to twelfth-grade students were coding, The Academy history, and introduction to philosophy through popular culture. “Reasoning tests” referred to the “ability tests designed to measure a student’s ability to think, reason and solve problems...and the level of complexity they can comfortably deal with.” Lastly, “popular culture” was defined as texts and videos that correspond with the tastes of mass society rather than a distinct niche.

### ***Time Line***

The quasi-experiment took place across the 2016 – 2017 school year and the 2017 – 2018 school year created and approved by the LUSD. The pre-test portion of the study transpired in August 2016 and August of 2017. At the end of each school year, the post-test was facilitated in May 2017 and May 2018. Once all the data had been collected from the control and experimental groups from both school years, data analysis occurred during the months of June, July, and August of 2018.

## **COLLECTION OF THE DATA**

To collect the relevant data from the target sample a letter of consent was constructed and shared with students and their guardians. The average age of the target sample was 17.5 years. Therefore, a significant portion of the sample was of minority status. However, there was also a substantial share of the group that was over eighteen at the time of the course and was protected by the Family Educational Rights and Privacy Act. Thus, parental consent was not required and was, in fact, illegal for those students over the age of eighteen.

The purpose of the letter of consent was to reassure the sample target that their academic data would remain confidential. The students were not engaged in activities that were outside the normal purview of a social studies seminar when participating in the study. Student data was collected using the identical methods and assessments that were required of all students enrolled in the course whether or not they volunteered their scores for analysis within the project. The letter also made clear that only their data would be used for comprehensive analysis and not specific examples of their individual work.

Due to the utilization of an existing course with a predetermined curriculum and framework, participants willing to volunteer their data allowed for a continual study of advancing understanding. The informed consent and assent forms were sent to possible participants on May 1, 2017, before any data collection and archival gathering. This method was selected to negate most pitfalls in data gathering and analysis from participants who change their minds over the course of the school year.

### ***Description of Assessment Tool***

The goal of this study was to measure the improvement of students' reasoning and logic skills after exposure to a rudimentary philosophy class teaching formalized logic. The data collected for this project was compiled through student test scores on a numerical reasoning pre-test and post-test. Additionally, students were simultaneously assessed on a verbal reasoning pre-test and post-test. The state of Victoria Department of Education and Training in the country of Australia described the verbal reasoning test as "a multiple-choice test that measures the ability to think and reason using words and language. Items in the test tap into vocabulary, word relationships, classification and deduction."<sup>1</sup> Likewise, the department defined the numerical reasoning test as follows: "a multiple-choice test that measures the ability to think and reason using numbers. Items in the test tap into series, matrices, arithmetical reasoning and deduction."<sup>2</sup>

Moreover, the assessments selected to measure the increase in students' cognitive abilities was a commercially produced test that had been rigorously piloted and tested by the education department in the state Victoria in Australia. The assessment was implemented as a non-parametric test since the structure of the overall study is action research. There were no assumptions made about the parameters or distributions for the larger population of twelfth-grade students within The Academy, LUSD, or United States of America. The sample target was too limited to render a standard bell curve scientifically accurate. Lastly, the assessment was also a criterion-referenced test. The data collected from the students was originally disaggregated and then combined to look at individual increases as well as group achievement.

Verbal and numerical reasoning ability tests were selected for the assessments due to their correlation to a plethora of problem-solving and critical thinking skills. The Academy and LUSD recognize four core areas of academics for secondary schools: social studies, English, science, and math. The skills needed to be successful in the four main areas are all at play in the verbal and numerical reasoning test. Furthermore, the philosophical avenues that lead to increased logical and rational thinking also improve a student's ability to perceive issues from many different vantage points and increase empathy.

The target sample was composed of two separate groups of twelfth-grade students at The Academy. The primary focus of the study was the experimental group receiving the philosophical instruction, but there was a secondary control group participating in a non-philosophically enhanced social studies seminar. Therefore, the full population of the study ended up being eighty students with the forty experimental group students analyzed for improvement after the incorporation of the independent variable.

### ***Plan for Analyzing the Data***

The quantitative data analysis portion of the study measured the variance between the experimental and control groups. The goal of the inquiry centered around the effective nature of the independent variable: students engaging with a philosophical curriculum. Pre-test and post-test scores from the reasoning ability assessments were accumulated from the target sample over the course of the 2016-2017 and 2017-2018 school years. Analyzing the data answered the question of whether philosophical study enhances a student's ability to think critically and problem-solve.

The analysis portion of the study also included both nominal and ordinal data. The disaggregation of the data took place within limited categories, such as male and female. Ordinal data was also

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<sup>1</sup>State of Victoria Department of Education and Training. (2016)

<sup>2</sup> Ibid.

exploited during the study to gauge the growth of individual students apart from the whole. However, as with ordinal data, the rankings were not corresponding to overall ability to reason or problem solve.

Additionally, data was also interpreted as being both descriptive and inferential. The descriptive and inferential statistics were analyzed to determine rather the directional hypothesis was valid. These statistics coincide well with the non-parametric methodology used during the assessment process. Microsoft Excel performed the statistical processing for finding the mean, median, and standard distribution. It should be noted that the nominal and ordinal data and descriptive and inferential statistics were used to describe the experimental and control groups and their assessment results. Inferential statistics were also applied to the results, but due to such a minor sample size, the inferences made from the data are restricted.

## RESULTS OF DATA COLLECTION

As previously mentioned, student data were collected over the course of the 2016–2017 and 2017–2018 academic school years. The research focused on four cohort groups: two of the groups were involved in the experimental philosophy course, one in 2016–2017 and the other in 2017–2018; while the other two cohorts consisted of the control groups enrolled in a typical grade level elective in 2016–2017 and 2017–2018.

Throughout the two-year collection process, there were several students who were enrolled in the experimental group or control group and later dropped from the course because of institutional scheduling changes. Only students that were able to complete an entire year in the experimental or control groups had their data recorded for data analysis. Furthermore, students that were enrolled in any of the four cohorts after the semesters had begun were allowed to partake in the standardized tests for their sense of growth and as part of the course requirements, but their data were also excluded from the data analysis in the current research.

Combining the four cohorts into two distinct aggregated groups consisting of one experimental group and one control group allowed data analysis of a larger sample size. Additionally, utilizing cohorts from different years created data from a broader spectrum of students and not just a snapshot of one classroom from one specific year. A second accommodation to the study came from within the demographics of the students engaged in the experimental group. Hispanic and Asian student populations within the experimental group were too small to quantify reliable results, and thus their data were only analyzed as part of the larger experimental group instead of through additional racial disaggregation. Therefore, most of the data analysis focused on the score differences between the two significant cohorts, experimental and control, with limited digressions into more specific demographic categories, such as race or gender. Lastly, the data were simultaneously collected from two different commercially produced and piloted standardized tests: one measured numerical reasoning while the other assessed verbal reasoning.

### *Data*

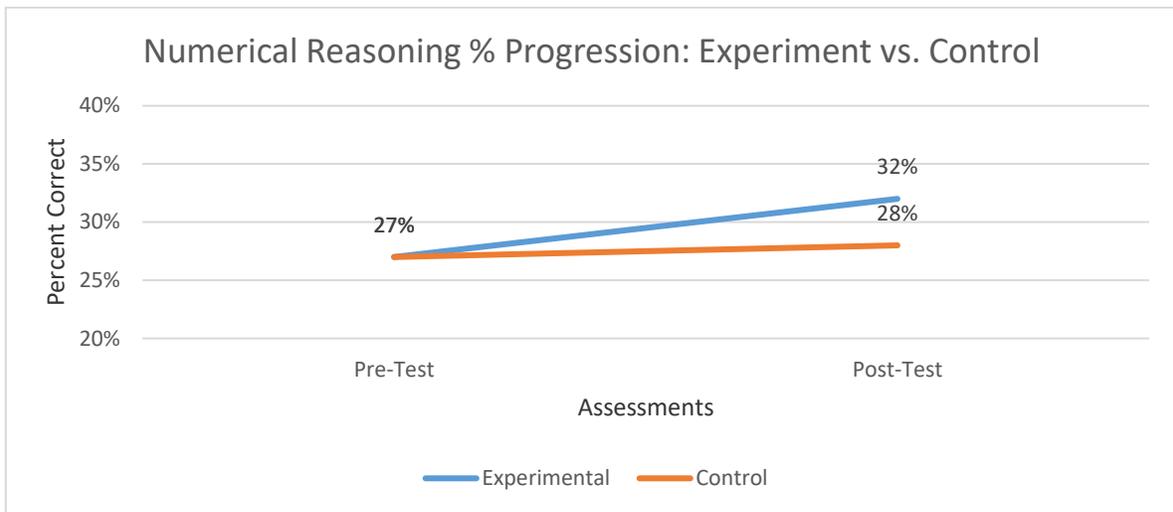


Figure 5: Comparison of numerical reasoning progression.

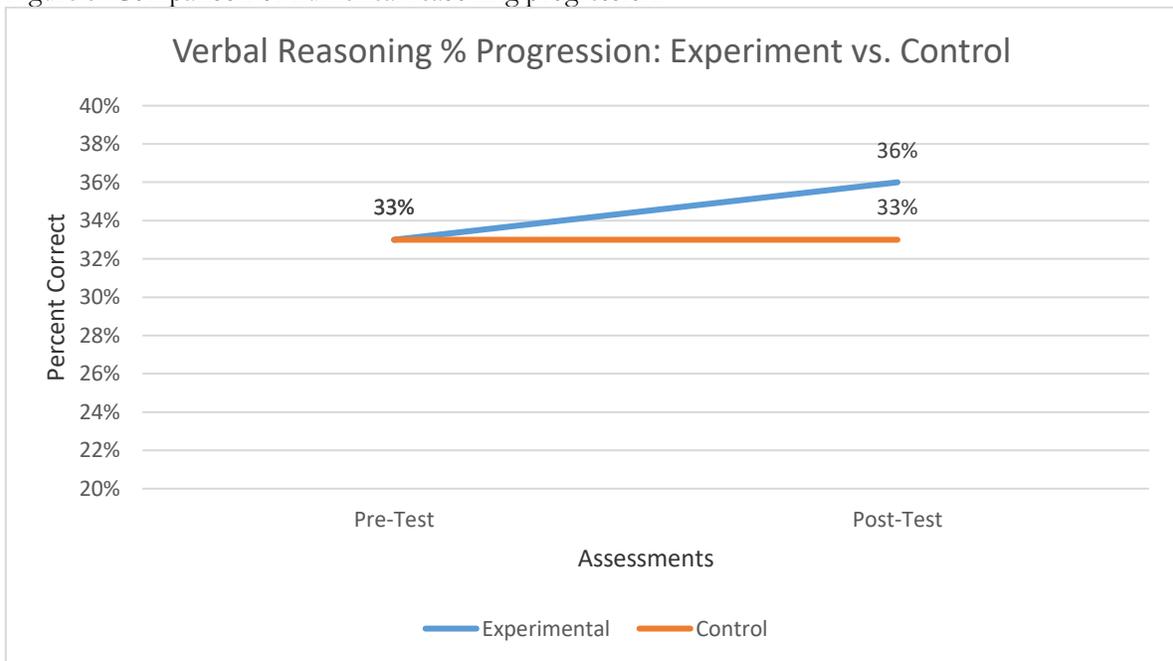


Figure 6: Comparison of verbal reasoning progression.

The two preceding line charts illustrate the divergences between the aggregated experimental group, which was enrolled in the introduction to philosophy through pop culture course, and the aggregated control group, which was enrolled in traditional social studies elective courses, on both the numerical and verbal reasoning assessments. Over the course of an academic year, the randomly assigned students in the experimental cohort outperformed their control group classmates by 3% to 4% according to the cohorts' mean.

Figures 5 and 6 provide the most rudimentary measure and analysis of the research question: What effect does the engagement with and study of formalized logic have on LUSD students' ability to answer questions more rationally? There was an increase in the students' ability to logically answer reasoning questions, but further analysis provides insights that are more detailed.

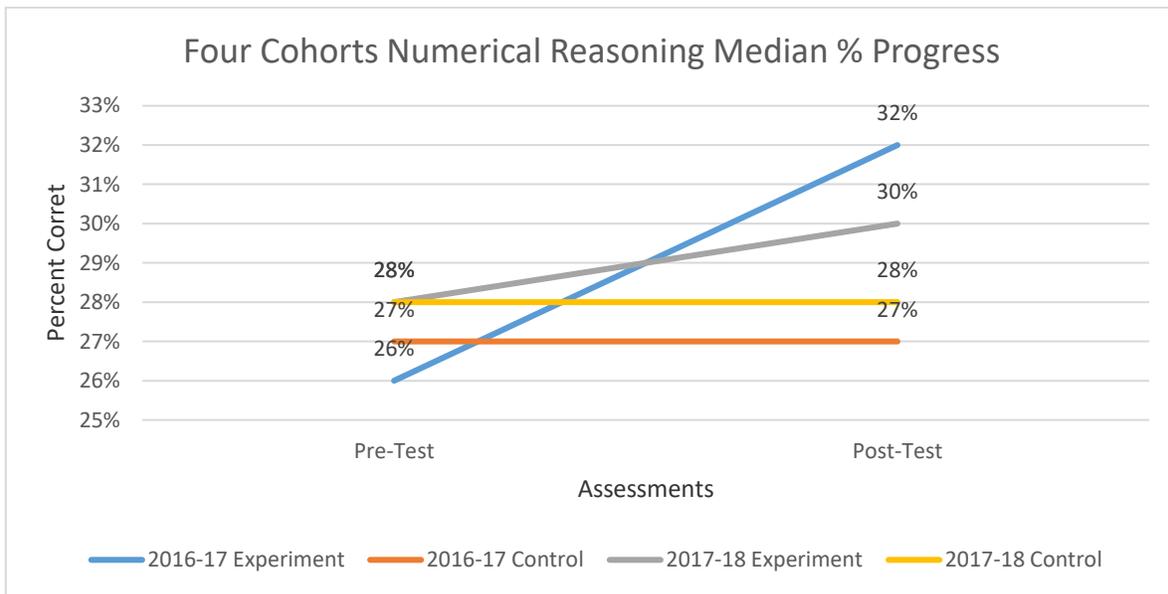


Figure 7: Disaggregated numerical reasoning comparison.

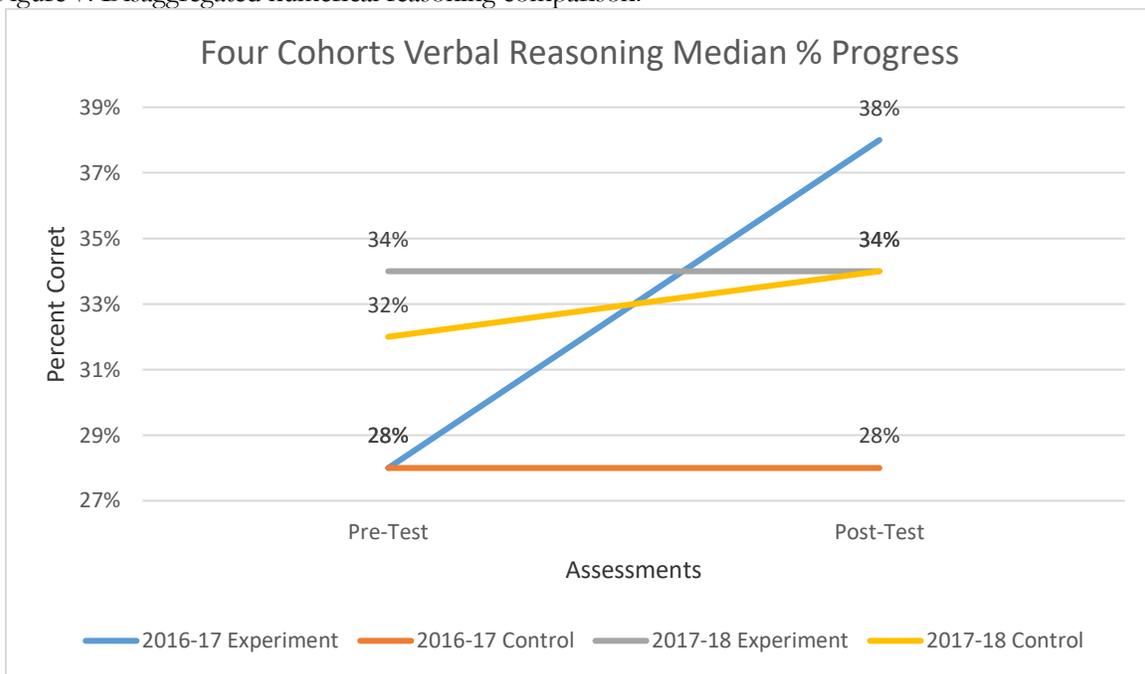


Figure 8: Disaggregated verbal reasoning comparison.

Figures 7 and 8 utilized the pre-test and post-test median rather than the mean and in combination with disaggregation of the data into the four separate cohorts, two experimental and two control, painted a dramatically different picture of the data sets. Whereas figures 5 and 6 illustrated a mild sloping overall improvement for the aggregated experimental group, the next two tables produced a much more chaotic and complex picture of the learning. The latter tables depicted an enhanced portrait of overall and individualized learning at a larger scale without blurring into an artless average. In fact, during the 2017-2018 academic year, the control group outperformed the experimental group in verbal reasoning, and thus created another narrative than merely suggesting that the experimental groups always outperformed the control groups.

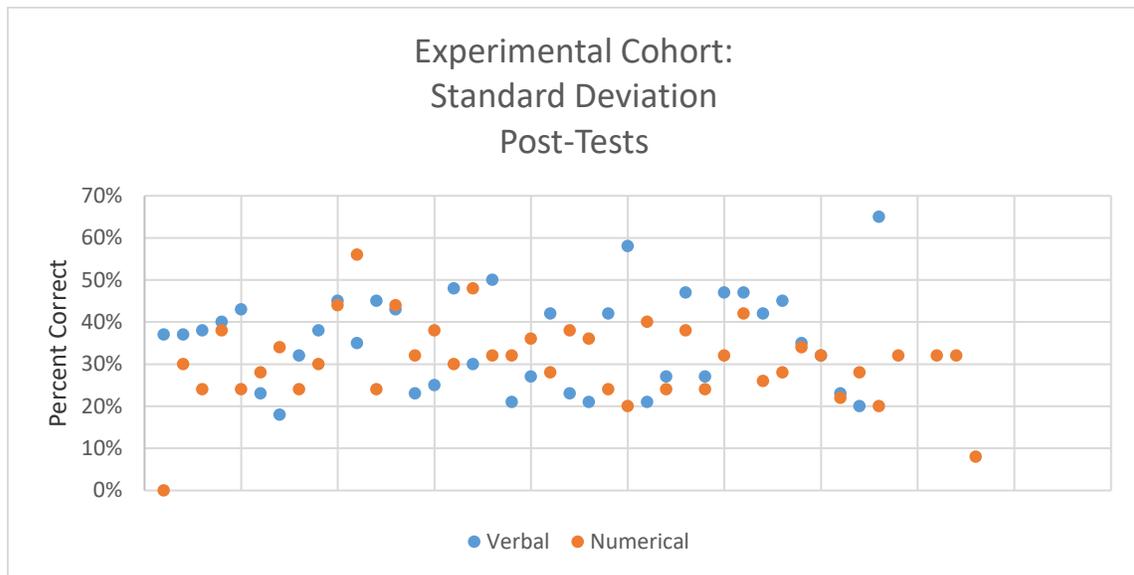


Figure 9: Experimental cohort's standard deviation for post-tests.

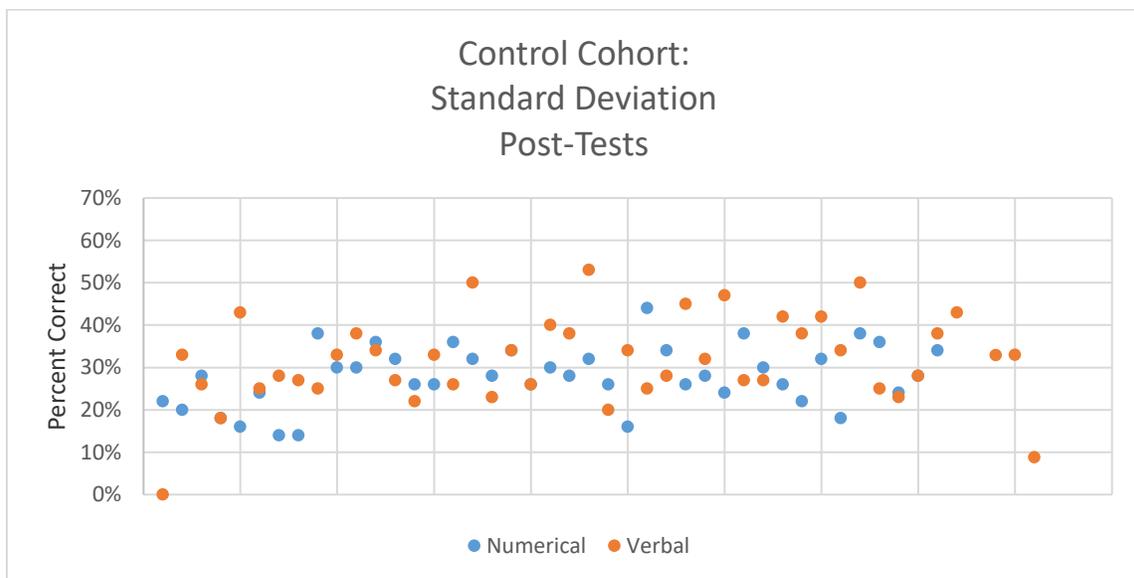


Figure 10: Control cohort's standard deviation for post-tests.

Further analysis of the data sets reveals that students from the experimental cohort had a higher standard deviation (11.32) than those in the control group (8.79) on the verbal reasoning assessment. Figures 9 and 10 reveal this difference through the usage of scatter charts. The acquisition of basic logic and reasoning skills from the experimental philosophy curriculum led to a varied accumulation and utilization of knowledge. Likewise, the control group (7.03) also had a lower standard deviation than the experimental group (7.97) on the numerical assessment. However, when looking at figures 7 through 10, it should be noted that both aggregated cohorts had similar numbers of outliers at both the higher and lower portions of the spectrum. Additionally, test scores for the control group remained relatively stagnant on both the pre-test and post-test, whereas the experimental group significantly increased their scores and thus increased their deviations amongst themselves. The utilization of standard deviation, however, becomes even more beneficial when we look at effect size.

Utilization of a pre-test-post-test non-equivalent group designed quasi-experimental method enabled the researcher to compare the aggregated experimental cohort with the aggregated control group. This combination of methodologies created the effect sizes based on Cohen’s *d*:

Type of Logic	Effect Size	Strength
Verbal	0.30	Modest Effect
Numerical	0.53	Moderate Effect

Table 2: Experimental vs. Control Design

Type of Logic	Effect Size	Strength
Verbal	0.22	Modest Effect
Numerical	0.70	Moderate Effect

Table 3: Pre-Test vs. Post-Test Design

Figures 11 and 12 depict the effect sizes, which allowed for a quantifiable measurement of the effectiveness of the course curriculum. Figure 11 compared the control group that lacked the formal logical class work to the experimental group, while 12 illustrated the difference between the experimental’s pre-test and post-test scores. Both the verbal and numerical portions of the post-tests shed light on the effectiveness of the experimental curriculum. The effect size was more substantial following the numerical reasoning final assessment and registered a moderate effect. The numerical reasoning test is closely aligned with mathematical principles, which is the standard-bearer for logical reasoning; therefore, the curriculum effect being more pronounced on that assessment is not a revelation. Likewise, the verbal assessment showed a modest effect for students who partook in the experimental class.

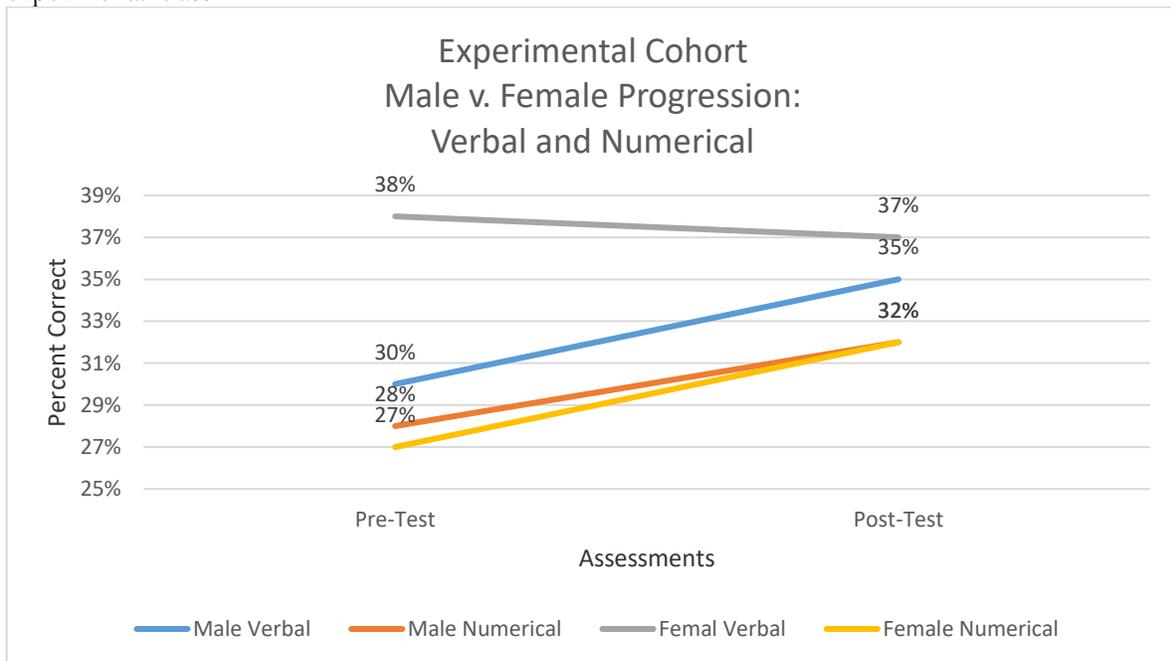


Figure 13: Female and male progression for verbal and numerical.

Figure 13 is a line chart that displays the experimental group’s growth at the conclusion of the course while comparing female students to male students. The growth rates between males and females were very similar on the numerical reasoning test after engaging with the curriculum as the males increased overall by 4% and the average females score improved by 5%. The verbal scores were more diverse as the males improved by 5%, while the females decreased by 1%, yet still outscored their male counterparts. The female verbal score averages on the pre-test and post-test highlight one of the

difficulties of relying solely on standardized tests. Did the females' understanding of logical reasoning decrease over the semester or did the pre-test lend itself to being overly vulnerable to guessing?

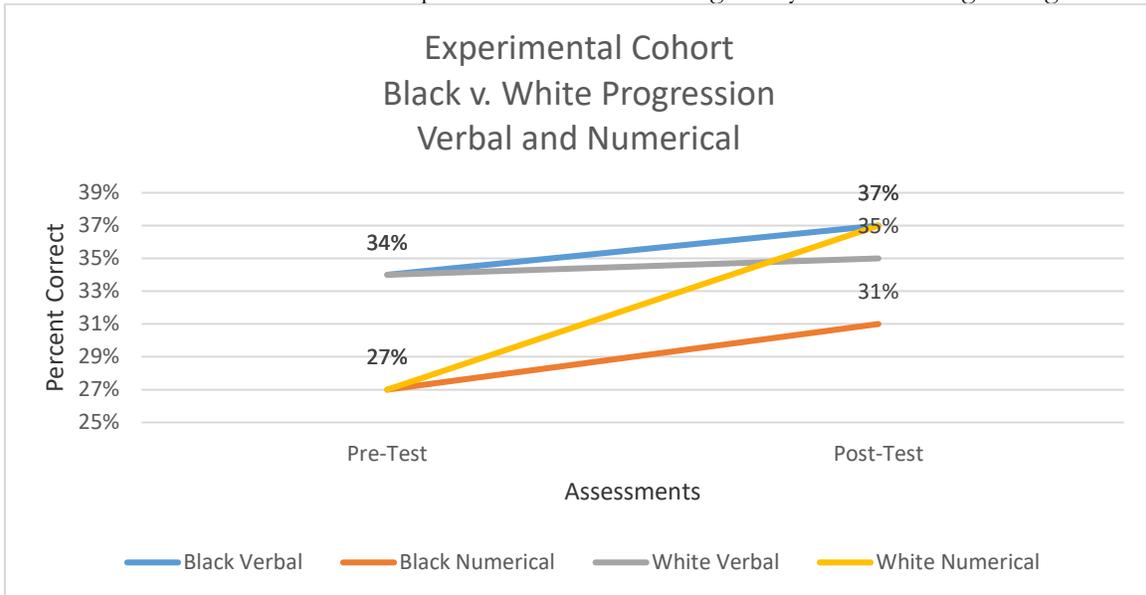


Figure 14: Black and white progression for verbal and numerical.

A second demographic disaggregation is portrayed in figure 14, which looked at the differences that occurred between black students and white students in the experimental cohort. Black students outperformed their white classmates on the verbal assessment by scoring an average of 37% on the post-test while the average white student scored 2% lower. However, on the numerical reasoning test, white students improved by 10% while black students increased their performance by 4%.

Processing the data sets through the lenses of mean, median, standard deviation, and effect size allowed for a detailed investigation into the research question and the hypothesis. The original hypothesis stated when participating in a philosophy-infused class, the LUSD students' critical thinking skills will improve on logical reasoning examinations measuring problem solving. On average, the experimental cohort began with a score of 27% on the verbal reasoning assessment and by the end of the course scored a 32%. Furthermore, the experimental group had earlier scored a 33% on the numerical pre-test and finished the year with an average score of 36%. Therefore, the hypothesis was found to be correct.

Further investigation into the data revealed an answer to the critical research question on what effect does the engagement with and study of formalized logic have on LUSD students' ability to answer questions more rationally. The data from the students in the experimental cohort illustrated that the philosophy curriculum was moderately effective in regard to numerical reasoning and modestly effective for verbal reasoning.

## STUDY ANALYSIS

The current study was designed to measure whether the re-introduction of a formal logic curriculum would increase the analytical problem-solving skills of students at The Academy within the LUSD. In fact, the hypotheses specifically stated that LUSD students' critical thinking skills would improve on logical reasoning examinations measuring problem solving. To accomplish this goal, the action research project began with a simple question: What effect does the engagement with and study of formalized logic have on LUSD students' ability to answer questions more rationally.

There were numerous primary sources dealing with previous research studies done on the beneficial effects of studying logic in the classroom. However, the current research is the first to be done in a LUSD within the United States of America. Analysis of the data demonstrated a modest to moderate benefit to students who participated in the introduction to philosophy course when compared to those not enrolled. Over the course an academic year, students in the experimental group grew by 5% from 27% to 32% on their standardized numerical reasoning test while those in the control group increased by a single percent. Additionally, the experimental group also outperformed the control group on the verbal reasoning assessment by improving by 3% from 33% to 36% while the control group remained stagnant at 33%.

At the most primitive and macroscopic level, the data has thus verified the studies hypothesis. Students were able to improve their logical problem-solving skills by formally participating in a philosophy course. However, as always is the case with statistics, the story of acquiring rational and logical decision-making capabilities is more complicated and centers on the unique individuals.

Further analysis of the data sets revealed further differentiation between the experimental groups and control groups. For instance, the 2016-17 experimental group improved their verbal reasoning scores by 10%, while the same year's control group remained immobile at 28%. A 10% divergence in student performance fully illustrated the benefits that came from a formal critical thinking curriculum.

One of the more fascinating results from the study was the comparison of the standard deviations between the control cohort and the experimental cohort. In both cases, the control group had a lower standard deviation than the experimental group. These smaller numbers, 8.79 on the verbal and 7.03 on the numerical compared with 11.32 and 7.97, demonstrated the influence that the curriculum had on student learning. Students from the control group remained at a basic level of understanding of logical and rational problem-solving, while those engaged in the class were able to extend their learning and advance at their levels of capability while dispersing further away from the mean and each other.

The last significant statistical measurement was the effect size. The effect size was the key to answering the initial research question dealing with the effects of a formalized logic curriculum. The data solved this question by demonstrating a 0.53 and 0.30 effect size (Figure 11) for those enrolled in the introduction to philosophy course as opposed to the control group and a 0.22 and 0.7 effect size (Figure 12) for those students solely enrolled in the introduction to philosophy course. This secondary measure helped to minimize the role of differences in student intelligence within the small sample size and differences in teaching abilities within the experimental and control classrooms. Therefore, overall, students in the philosophy class demonstrated that the curriculum had a modest to moderate effect on their ability to logically and rationally problem-solve.

### ***Limitations***

The study did suffer from several limitations, but none of these were overly debilitating to the research and its conclusions. As mentioned briefly in the previous section, there was a lack of a standardized curriculum for the introduction to philosophy through popular culture course. Additionally, students had not experienced any formalized reasoning or logic training before their twelfth-grade year. Lastly, the sample students were taken from only The Academy, and not from elsewhere within the LUSD.

The course curriculum was a combination of several textbooks, primary and secondary sources, and popular culture artifacts. There was no scope and sequence created at the district or state level, and the instructor made all curriculum decisions. Although the study of logic and rational thinking can be easily reproduced, it would be rare to find a similar course taught in the same manner and using the same materials as those used in the 2016-2017 and 2017-2018 courses at The Academy.

The second limitation of the study deals with the issue of introducing a brand-new topic of learning to students who have never dealt with any prior knowledge of the subject. Although this fact has turned out to be a hindrance to the speed and efficiency of the courses, it was also a shining example of how well students can do acquiring an entirely new template of knowledge without any previous training or experience.

The final limitation deals with the sample size and its captive audience. The number of participants was large enough with eighty out of a possible three hundred and five students to be beneficial for the specific school but would not hold as reliable to the universal secondary school community. To gain further understanding of the role of philosophical study in the education of students, future studies will need to incorporate a more significant number of participants from a more diverse population.

## Recommendations

Once the research question had been answered and was able to explain the effect of formalized logic and reasoning training, there was substantial proof in concluding that the hypothesis was correct. Students engaged in the study of philosophy at The Academy were able to improve their logical reasoning skills as measured through examinations assessing problem solving. The modest and moderate effect sizes were evidence of the class' success, but that was only the first step in re-introducing the study of philosophy into secondary schools.

The ability to reason and solve problems from various vantage points will only be enhanced by providing the necessary skills earlier in a student's academic career. The formalized study of logic may necessitate waiting until secondary schooling due to its complicated and somewhat unnatural style of thinking. However, if the basic principles of logic can be brought forth slowly throughout elementary and middle school, then a student's ability to comprehend the new philosophical arguments will be significantly enhanced.

As with all educational topics, the curriculum for introducing students to philosophy and the rational decision-making process needs to become more standardized and universal. There is no accountability for teaching such a course at the secondary level, especially when the said course is an elective. To gain the full benefits of increasing student performance in problem solving, educators will need design courses and pedagogical strategies to enhance the skills of the teacher and facilitator.

Most of the research that dealt with the study of philosophy within schools came from countries outside of North America. There is no better mixture of students and learning styles than inside the United States of America. The U.S. needs to begin implementing problem-solving techniques throughout the nation in many diverse settings with various demographics. Additionally, this universal implementation will create an entire generation of students that will be prepared for the more complex and ever-changing world economy.

Lastly, to adequately measure the impact of the formalized study of logical reasoning requires a longitudinal study. The more thorough analysis of changes within an individual over the course of their academic career, when compared with students not partaking in a philosophy course, will provide essential data and evidence in support of re-introducing philosophy in secondary schools.

## References

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