Effectiveness of the Socratic Method: A Comparative Analysis of the Historical and Modern Invocations of an Educational Method

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EFFECTIVENESS OF THE SOCRATIC METHOD: A COMPARATIVE ANALYSIS OF THE HISTORICAL AND MODERN INVOCATIONS OF AN EDUCATIONAL METHOD

By

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of the Requirements for
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Thesis Summary
The inception of this thesis hinged on a moment of curiosity. Since I plan on attending law school following graduation, I wanted to know whether the Socratic method – the educational method predominantly used in law school classrooms across the United States – is effective or merely used as a matter of tradition. This is the question examined within the thesis submission you are about to read.

The thesis summarizes current schools of thought in regards to the Socratic method, posits my own definition of the method, compares historical and modern uses of the Socratic method, looks for differentiating themes among both students and teachers then and now, and provides preliminary data on the effectiveness of the Socratic method via a pilot study.

By the end of this thesis, you should have an understanding of exactly what the Socratic method is, how it is employed, and the best student-teacher fit for use of the method. Additionally, the tentative conclusion you should draw from the data analysis of the included pilot study is that Socratic instruction is positively correlated with performance on a syllogistic (logic) reasoning task. Generally stated, the take away is that the Socratic method has a significant effect on a student’s ability to think logically; however, this is only a correlation and future study needs to be done before we can claim anything conclusively.

The final segment of this thesis ties together the historical verses modern discussion in the initial chapters with the findings of the pilot study. The Socratic method is – based
solely on the found correlation – effective at teaching logicality, but the method may not be the most efficient method of doing so. The discussion section of this thesis presents alternative methods or implementation ideas for the Socratic method. For example, research exists showing that students who are exposed to Socratic questioning and instruction in elementary or middle school typically benefit more from the method overall.
Abstract

This baccalaureate thesis analyzes an infamous instructional method. In the United States, the Socratic method has traditionally been found in the classrooms of law schools; however, as the method is modified, its use is being tested in primary and secondary schools. This thesis compares the traditional Socratic method that is enshrined in Socrates’ dialogues with his students to modern invocations of the method and its byproducts (i.e., Socratic circle, Maieutic method, Socratic questioning, self-directed learning). Equally as important to the discussion of the Socratic method is the metamorphosis of both students and instructors since 470 B.C., the time in which Socrates’ was alive. There is a difference in student demographics, their motivation, and how they relate to their teachers or professors.

Enmeshed within the analysis of the Socratic method is a pilot study run by myself and overseen by Dr. Melanie Palomares. The pilot study addressed the effectiveness of the Socratic method using a digital survey and a twenty-item logic assessment. Participants were asked about their educational history with particular focus on the amount of exposure they had to the method. Their correct responses on the syllogistic reasoning task were analyzed by total number correct and, secondarily, by proportion correct (for responses that were nearly complete, but not entirely). Results indicated a significant, positive correlation between the number of Socratic-styled courses a student had experienced and the number of correct responses they gave on the syllogistic reasoning task, \( r = 0.457, n = 34, p > 0.01 \). This significant correlation was true when responses were tested with proportion correct instead of number correct.
Chapter I: Introduction

As a country founded on and governed through laws and adjudication, education of future legal scholars, justices, judges, and attorneys runs parallel with the interests of our nation. One of the most infamous methods for teaching law students is the Socratic method (Hlinak, 2014; Szypszak, 2015). Steeped in prestigious tradition, the Socrates’ unintended torture tool strikes fear into the hearts of law students across the United States. Unpredictable “cold calls” and the subsequent humiliation remain at the forefront of a “one L’s” mind (Turrow, 1998; Boghossian, 2012). Horror stories pass from student to student; recounts of gross embarrassment at the hands of the most traditionalist Socratic instructors bridge the generational divide. Ironically, the very method so far described has also been hailed as a truth-finder, a molder of young minds, and as an epistemological tool for perfecting a student’s ability to “think like a lawyer” (Gregory, 2014; Hlinak, 2014; Szypszak, 2015; Reich, 1998).

These variations in opinion over the Socratic method, predictably, stem from differing definitions and invocations of the instructional method. Originalists currently debate whether Socrates intended to seek a higher truth or educate pupils in his philosophies, as well as whether he was truly an unknowing teacher looking to collaborate on equal ground with his students or an expert looking to subtly stultify his students (Candiotto, 2015; Davies & Sinclair, 2012; Delić & Bećirović, 2016; Mintz, 2006; Reich, 1998; Tubbs, 2006). In juxtaposition, modernists are less concerned with
following Socrates’ exact method. Instead, these educators and philosophers advocate teaching in the spirit of Socrates (Fullam, 2015; Mintz, 2006). This being true, I must first explain what the Socratic method is before moving on to an analysis of the method in its traditional form as compared to the modified versions seen in law classrooms today.

A prospective lawyer’s ability to effectively reason is paramount to his/her trade. Additionally, a law student’s ability to formulate logically sound, justifiable arguments is crucial to their performance in law school and in their ability to pass the bar examination that licenses them to practice law. Thus, it is the job of a legal education to instill the ability to reason within its students. The main method of doing so has, traditionally, been Langdell’s case study method, an offshoot of the Socratic method (Friedland, 1996). This modern invocation of Socrates’ method has come under fire in recent years, calling its effectiveness into question (Fullum, 2015).

**What Exactly is the Socratic Method?**

Regardless of the perspective an expert takes on the intent behind the Socratic method, there is concurrence about fundamental components of a Socratic dialogue (Boghossian, 2012; Candiotto, 2015; Gregory, 2014; Lam, 2011; Leigh, 2008). First, an instructor poses an open-ended question or has the student ask a question of him/her. Alternatively, the student or teacher can put forth a claim or argument as the topic to be examined. The purpose of this step is two-fold: (1) to provide a central topic into which one can inquire and (2) to produce a sense of wonder in the student. When asked broad, open-ended questions about virtues such as justice, good, evil, and truth, people have the
tendency to try to answer for themselves and their own knowledge. (Delić & Bečirović, 2016; Gregory, 2014; Moore & Rudd, 2002)

Second, the student is asked to generate a hypothesis in response to the question. During this phase students are allowed to – perhaps even encouraged to – makes mistakes or have flaws in their reasoning (Goldin, 2011). In Plato’s written accounts of Socrates’ lessons, Socrates does not castigate students for their subpar responses. Instead, he seems to see it as an opportunity to guide their thinking into a more accurate line of cognitive processing (Plato, Ferrari, G.R.F., & Griffith, 2000; Szypszak, 2015). If you look at current critiques surrounding the Socratic method in its contemporary use – namely that of the egotistical, condescending professor berating the anxious, ashamed student – it appears that professors have lost sight of Socrates’ patience for inadequate answers.

Third, the professor engages the students a series of questioning called *elenchus*. *Elenchus* is a cyclical process of cross-examination, counterexample, and refutation (Boghossian, 2012; Burns, 2016; Davies & Sinclair, 2012). This is the heart of the Socratic method and remains intact throughout the methods many modifications (Candiotto, 2015; Friedland, 1996; Hlinak, 2014; Mintz, 2006; Reich, 1998). Its conception occurred when Socrates realized that, when pressed, his interlocutors would often contradict themselves (Mintz, 2006; Tubbs, 2006). By pointing out circumstances under which the student’s hypothesis “could be false,” the professor is essentially forcing his/her pupil to discover the reasoning error they have made (Goldin, 2011). Each counterexample provided by the experienced tutor allows the student to revise his/her hypothesis in order to prevent the weakness spotted by the professor. In order to effectively adjust the hypothesis, the student must figure out what the professor has
already. The difference, however, between the Socratic method and corrective lectures or assignments is that it is incumbent upon the student to teach themselves (Leigh, 2008). By discovering the logical fallacies they have fallen prey to, the student gains mastery of the subject. They gain confidence in their own ability to reason and in the assertion of their own ideas into discussions (Lam, 2011; Szypszak, 2015).

This is the ideal outcome of the law student in law school. Students should build a conceptual understanding of the law that they can apply to litigation or improvisation in the courtroom setting (Goldin, 2017). Additionally, law students exposed to the Socratic method are intended to internalize the questioning paradigm represented by Socrates’ seeming prodding of his interlocutors (Kerr, 1999). The critical thinking skills trained by Socratic dialogue encourage students to rail against the human, unwitting tendency towards confirmation bias (Delić & Bečirović, 2016; Goldin, 2011). In the place of confirmation bias, students are lead to actively seek out circumstances under which their own belief or claim could be or is false. Active learning as a study habit is both a requirement and an outcome of a Socratic education (Leigh, 2008).

Beyond persuading a student to “give birth” to opinion, the *elenchus* functions as an equalizer. As the primary mechanism of Socratic instruction, the *elenchus* undergirds and ensures the effectiveness of the method due to the mental state provoked in the student through negative dialectical questioning: *aporia* (Boghossian, 2012; Reich, 1998; Mintz, 2006). *Aporia*, otherwise termed “Socratic perplexity” breaks down the barriers of bias, belief, and smug superiority (Boghossian, 2012). This state of perplexity arouses a students’ curiosity, leading them to ask questions and inquire into a subject about which the previously believed they were knowledgeable. The elenchus, thus, labors to
illuminate one’s own ignorance on a matter (Fullam, 2015). In Socrates’ dialogues with various students, the cross-examination period is geared towards “clearing away the cobwebs” of prior beliefs and prejudices (Tubbs, 2006). When dogmatism yields to enlightened doubt, curiosity abounds. Students such as Meno and Gorgias were eager to learn and so, once informed of their uninformed position, sought, with renewed earnestness, to reconstruct an improved model or belief or body of knowledge. Thus, the purpose of the *elenchus* is not to embarrass or demean students. Once awakened, aporic curiosity drives the Socratic dialogue to denouement. In this pursuit, Socrates’ both joined and guided them.

Beyond the *elenchus* there are one to two further steps. The forth component of the Socratic method, in any invocation, is the student’s acceptance or rejection of their original hypothesis (Delić & Bećirović, 2016). Should the student still accept the proposed answer, they must actively reject the teacher’s counterexample by providing counterarguments in refutation of the example. The goal of these rebuttal-geared arguments is to point out fallacies or weaknesses in the counterexample itself. For example, if a student’s initial claim is that women are capable of performing jobs historically reserved for men and the teacher’s counterpoint is that men have been scientifically proven physically stronger and faster, the student can point out the incorrect conflation of physical strength as a requirement for all male-dominated jobs. The student’s counterpoint could then be that different jobs require different abilities that may be better accomplished by a female. The student would then give a specific example of such a job and a female characteristic that predisposes a woman to successful performance for that job. Key to continued acceptance of an initial stance is the notion
that a student must provide evidence for their position. This develops a student’s ability to reason through and justify their own thoughts (Jensen, 2015). Constructing an argument during a Socratic dialogue requires one to undertake a metacognitive analysis. Essentially, they must become aware of how they think, why they think it, and what fallacies exist within their line of thinking (Fullam, 2015; Burns, 2016).

In juxtaposition to acceptance of the original hypothesis, a student can reject their previous position. Should rejection be the outcome, the student is free to revise their position, triggering the beginning of another ʻelenchusʼ (Delić & Bećirović, 2016). In this way, Socratic dialogues are cyclical. Steps three and four persist until a final truth or irrefutable answer – one agreed upon by all parties involved in the dialogue – is reached.

A fifth step exists in Socrates’ rendition of the Socratic method. Though the fifth component in application within legal education generally belongs among obsolete idealism, philosophical or political debates, by nature of the issues they seek to solve, align nicely with the goal. In a word, the final step to Socrates’ method is action. If Socratic inquiry produces truth, then we, as citizens and intelligent beings, are induced to adjust our lives to the new principles and/or virtues brought to fruition through our questioning dialogue (Reich, 1998; Gregory, 2015). This final step is more controversial when looking at modern invocations (Fullam, 2015; Rancière, 1991).

**Why We Should Question It**

There is a general assumption that the educational pedagogy used in legal classrooms is effective, so much so that scrutiny is rare (Friedland, 1996). Ever since the Socratic method was first brought into law schools as a defining institution by Professor
Christopher Columbus Langdell in 1870, its use has been prolific and, generally, unquestioned on the basis of its merit (Friedland, 1996; Fullum, 2015).

In first year law classes, approximately 97 percent of professors use the Socratic method. Of those 97 percent, 30 percent use the method “most of the time,” 41 percent use it “often”, and 21 percent use it “sometimes.” Only 5 percent of professors teaching first year classes say they use the Socratic method “rarely.” When surveyed, there is a pervasive belief among law professors that the Socratic method is the most effective instructional method for teaching the law. This belief is so pervasive that 90 percent stated this justification for why they use the Socratic method as opposed to alternative methods proven to be just as effective. While the claim of efficaciousness may, in fact, turn out to be true, there is an interesting corollary between tradition and use of the Socratic method. Of the professors who believe the Socratic method is the most effective instructional method, approximately 50 percent stated they figured this to be true because their instructors in law school used the Socratic method. (Friedland, 1996)

Interestingly, and seemingly in contradiction to, the beliefs of the aforementioned professors, a study by Yudcovitch in 2014 provided evidence that third year graduate students (such as law or medical students) actually perform much better on examinations than first years after receiving Socratic instruction (Yudcovitch & Hayes, 2014). Therefore, perhaps we simply have the sequential ordering of the method incorrect. Instead of using the Socratic method primarily in first year law classes to teach students how to “think like lawyers,” perhaps we should give them a substantive base of specific and local knowledge first. A 2017 study by Goldin supported Yudcovitch’s finding, implying that the students who profit the most from Socratic instruction are those who
already have a procedural background through which they can incorporate new ideas into their mental schemata (Goldin, Pedroncini, & Sigman, 2017).

An important consideration of why professors may insist on using the Socratic method is in the prestige of legal institutions. This prestige is based on academic rigor and, as stated before, tradition. Removing the Socratic method from a law schools repertoire could negatively impact the quality of its students’ education, the academic standards of the school, and, as an unintended consequence, the funding of the school (Boghossian, 2012; Hartwell & Hartwell, 1990; Lewis, 2012). Currently, law school tuition is astronomically high, in part because a legal education is seen as a respectable investment. Changing the rigor of legal curricula may reduce this view in the general population.

Regardless of the effectiveness of the Socratic method specifically, educators should always be concerned with the efficacy of their chosen teaching method(s). Recent studies have highlighted the fact that students learn differently and the success of any one educational method varies from student to student (Anderson, 1984; Birch & Bloom, 2004; Furlan, Agnoli, & Reyna, 2013; Macpherson & Stanovich, 2007). Therefore, the Socratic method may not work effectively for all students. Two studies actually resulted in the effectiveness of the Socratic method only working for about one-third to one-half of students (Goldin, Pezzatti, Battro, & Sigman, 2011; Goldin, Pedroncini, & Sigman, 2017). If a significant portion of learners cannot adequately learn from the Socratic method, then we should consider employing alternate techniques.

Furthermore, students should be concerned as to the effectiveness of the Socratic method in their legal education. If effective, the method is inarguably beneficial in
educating lawyers. Learning the entirety of the Black Letter law is impossible; however, should a law student learn how to logically reason through the law as presented to them, they can then discern for themselves how the law applies to a given case.

In the following chapters, I will lay out an argument for the Socratic method if implemented differently. Additionally, alternatives to the traditional method will be suggested in order to meet the educational needs of all students, not just the lucky few. In chapter II, I will analyze the Socratic method as it was originally intended. This analysis covers Socrates’ beliefs and intentions for the method. Additionally, Plato’s slightly modified methodology will be included as they occurred so close in time and they are nearly identical in their mechanisms. In chapter III, the thesis will turn to the matter that sparked the idea behind this thesis: the Socratic method as it exists today. This historical trajectory may be useful in determining what, if any, improvements we can make to the Socratic method. Chapter IV defines how the Socratic method should be understood for the purposes of the pilot study included in chapter VI. Chapter V briefly illuminates the differences in students in Socrates’ time versus today’s students. The drawing together of all of these different pieces occurs in chapter VII.
Chapter II: Socrates’ Method

A slave boy discusses geometry with a respected educator in Athens, Greece, around 470 B.C. That educator, named Socrates, explains the concept of the “diagonal argument” to a relatively uneducated, but eager to learn, student (Meno) through a series of fifty questions. The slave is asked to find exactly double the area of a square. First, Meno provides a hypothesis for how to do so: add the length of two sides of the original square to determine the length of a side of the new square. He explains to a patiently waiting Socrates that he could then draw four sides of that doubled length. Socrates points out the fallacy in this argument and, at some point in the dialogue, points Meno to the diagonal of the square with his finger. This prompted his student to consider the use of the diagonal as a tool for solving basic geometric problems. Through a series of hypotheses, counterexamples, and justifications, Meno eventually learns that the diagonal of the original square is the length of one side of a doubled square. (Plato & Bluck, 1961)

The described scene, recorded by Plato, was one of the first instances of Socratic inquiry in history (Tubbs, 2006). Socrates’ educational method was initially just a form of philosophy. He believed all answers existed within humans; we just need to bring out the truth through thoughtful inquiry (Tubbs, 2006; Davies & Sinclair, 2012). Furthermore, Socrates’ was most concerned with the soul and he espoused the belief the “learning is always incomplete” and “the unexamined life is not worth living (Tubbs, 2006; Delić & Bečirović, 2016). To Socrates, careful deliberation and reasoning, carried out through reflective dialogue, would illuminate the truth of a matter. Essentially,
Socrates’ thought one intelligence enhances another and that, together, two people can discover an irrefutable truth. Learning these truths and self-correcting his behavior, tailoring his life, to these uncovered virtues and principles was one of the foremost reason for thoughtful inquiry (Tubbs, 2006).

While these beliefs are noble goals, they are mostly controverted by the nature of the Socratic method. Even in Socrates’ time, the *elenchus* was a more genuinely curious form of cross-examination. Such a process does not truly test for truth, but for logical consistency (Hartwell & Hartwell, 1990; Rancière, 1991). Watered down, the outcome Socrates’ championed as truth was merely just a point of consensus between student and teacher. As Rob Reich stated, “the Socratic method tells a person that he is wrong, but not why” (Reich, 1998). Taken in the current context, this means that the final outcome of a Socratic dialogue is not correct because it is grounded in some universal truth; it is true because there are no further inconsistencies to be pointed out by student or master. Furthermore, if Socrates’ method produced truth, then Socrates himself would be a “confident purveyor of truth,” able to know the truth. However, time and time again Socrates claims to have no knowledge. This paradox is known as *docta ignorantia* (Fullum, 2015; Reich, 1998). The debate over the ignorance of one of the greatest educators in history is one shrouded in cynicism and idealism. Educational philosophers such as Rancière and Reich believe Socrates to be feigning ignorance as a way to either stultify as student’s intelligence, or to force students to formulate their own answers. Others claim that his ignorance is sincere since he is always allowing for revisions to claims and hypotheses (Lam, 2011; Mashburn, 2007; Szypazak, 2015). In this idealistic view, Socrates is genuinely collaborating *with* his student to discover an answer together.
Beyond searching for truth claims, Socrates also utilized deliberate inquiry for the purpose of education. For the duration of his time on earth, Socrates devoted his life to shaping young minds, making masters from students, and encouraging people to actively educate themselves as a matter of principle (Candiotto, 2015; Friedland, 1996; Lam, 2011). In short, he taught his students how to teach. This claim has recently been corroborated through fNIRS studies recording prefrontal activities in both students and teachers during a Socratic dialogue (Holper, Goldin, Shalóm, Battro, Wolf, Sigman, 2013). What has been found is that students who truly conceptualize information during the dialogue (were able to transfer the knowledge learned to problems with similar principles), had slower prefrontal activity than students who did not; however, students who learned how to apply the conceptual knowledge gained in the dialogue had the same level of prefrontal activity as teachers. Stated in simple terms, students who internalized the Socratic dialogue and later used that process to apply conceptual knowledge think “like a teacher” (Holper, 2013). He used the *elenchus* to create an awareness of a knowledge gap in his students (Reich, 1998). Once the students became aware of their own ignorance on a matter, they were then intellectually liberated. His use of cross-examination to create perplexity and subsequent curiosity was a destructive process (Szypazak, 2015; Delić, H., & Bećirović, 2016). In Socrates’ mind, a student’s preconceptions, prejudices, and assumptions had to first be torn down before they could engage in a genuine search for truth together. A fitting description of the *elenchus*, then, is an equalizer.

In quick summary, the original form of the Socratic method included all of the elements discussed in the introduction. In addition to these components, Socrates imbued
his version of the method with moral aims and aspirations of achieving the morally
“Good life.” In this form of the method, instructors claim no knowledge of basic
principles in order to have students answer questions that address specific points. The
purpose of this founding form, in Socrates’ eyes, is self-improvement and become aware
of one’s own ignorance/gaps in knowledge. Basically, Socrates employed this method
because he believed that in order to truly learn, one must become aware of what one does
not know. One drawback to this invocation of the method, however, was that an overall
answer was not always reached. Sometimes a consensus could not be found on a matter.
As an educator, Socrates’ taught “procedural knowledge or a method of inquiry…a
certain way of thinking and organizing reasons, of evaluating arguments” (Lewis, 2012).

The first, but closely related, modification of Socrates’ method actually came
from one of his students: Plato (Leigh, 2008). In Plato’s earlier works chronicling
Socrates’ lesson, a clear pattern of methodology was established. This methodology was
the elenctic method as detailed above. However, Plato’s later works – particularly The
Sophist – showed a departure from this verbal, two-sided dialogue (Rosen, 1983).
Through the written work of The Sophist, Plato introduces us to his own educational
pedagogy, the maieutic method. One of Plato’s students would be expected to carry out a
detailed analysis of the character, Stranger’s, arguments. In order to understand these
arguments as a coherent whole, the student would have to follow the written dialogue
within The Sophist and formulate questions to reconcile small inconsistencies in reason.
Similarly to Socrates, Plato believed that dialogue produces natural questions in students;
however, Plato believed this effect could stem from written dialogue instead of restricting
a student’s education to spoken dialogue with another person (Leigh, 2008)
Plato’s maieutic method follows all of the components of Socrates’ method except for the fact that the dialogue teaching the students how to reason logically is between the student and themselves after prompting from a text (Leigh, 2008). This dialogue is generated through internal reflection. Internal reflection, in Plato’s eyes, causes students to inquire as to the validity of the espoused claims in a dialogue. The “teachers” role in the maieutic method is to simply clarify portions of the dialogue or novel concepts, and to ensure the student considers certain key points. The essential ingredient in this methodology is active learning, a process by which students are directly involved in acquiring knowledge (Conrad & Dunek, 2012). Parallel to the idea of active learning, and following in the spirit of the Socratic method, is the idea of active open-mindedness (Conrad, 2012; Lam, 2011). Within the pedagogy of the maieutic method a student must actively seek conditions under which their personal belief or argument may be false. In short, the maieutic method gives a student all the tools they need to solve a problem, but places the burden of connecting the dots upon the student.

The reason that the maieutic method has been included in this section detailing Socrates’ method is because it is a direct derivative of his methodology. The only difference is the internalization verses externalization of the dialogue process, but the results are the same and the basic components of each are identical. We can, essentially, consider the maieutic method a Socratic method for reading students.
Chapter III: Modern Invocations

Following Socrates’ model of teaching students how to think and Plato’s incredibly minor adaptation to the Socratic method, the next major step forward in the method’s history came in 1870 when Professor Christopher Columbus Langdell submitted a series of cases regarding contract law to Harvard Law School for the purpose of studying broad legal concepts and legal reasoning. The method became known as the Case Method or the Langdell Method. (Pulliam, 1968)

Thought of as sensational during its beginnings, the Case Method has gained notoriety through infamy. Depictions of harsh, condescending professors, flustered and humiliated students burst in every law student’s mind when they hear the words “Socratic method” (Turow, 1998). When asked, past and present law students have deemed the Socratic method a “survival ritual,” demeaning “guess what I’m thinking game,” and way for professors to show how much smarter they are than their student (Kerr, 1993; Silver, Rocconi, Haeger, Watkins, 2012). Students trade horror stories with anyone who will listen and dread the unpredictable “cold call.” In general, people now imagine scenes of Professor Kingsfield in The Paperchase, Ell’s first day of law school in Legally Blonde, or rapid-fire exchanges in the hit-show How to Get Away with Murder when someone talks about Socrates’ method. This is because the case method, as the predominant pedagogical device in an American legal education, has been conflated with the Socratic method to the point that most people no longer use the terms interchangeably.
Langdell’s invocation of the Socratic method, like Socrates’, places the *elenchus* at the heart of the process (Mintz, 2006). He believed the *elenchus* was a model in “how to think like a lawyer” in that it mirrored cross-examination and litigation (Pulliam, 1968; Reich, 1998). Additionally, “thinking like a lawyer,” to some, means developing a logically sound, reflective manner of reasoning through a problem, case, or argument (Leigh, 2008; Lam, 2011). This skill remains necessary for the actual generation of arguments as well. The main difference between Langdell’s modern version of the Socratic method and Socrates’ method lies primarily in intent. Socrates’ methodology was to uncover truth, learn for the sake of learning, achieve a moral life, and make students aware of their own ignorance (Tubbs, 2006). In comparison, Langdell’s Socratic method is aimed specifically at teaching prospective lawyers how to think, how to argue, and how to analyze. There is no moral or spiritual component to Langdell’s method, which could explain why high levels of depression in law students have been linked to a loss of intrinsic values and principles law students experience as their intellectual conceptions of the world around them changes (Larcombe, Malkin, & Nicholson, 2012).

According to William Perry, this shift in intellectual development occurs upon a spectrum of positions beginning with absolutist, dualistic views and ending in complete relativism (Perry, 1999). Based on the usage of Langdell’s Socratic method in today’s law classes, having students shift to at least position five (the first point in which a person believes in the relativity of knowledge) is likely an intended outcome of the case study invocation of the Socratic method. In order for an attorney to generate an argument from any side he or she may be hired to represent, he or she cannot believe in absolutism. If an attorney believes there *is* a right answer instead of a multitude of valid answers, the
representation they can provide for their clients will be subpar, especially if they are forced to defend a view they do not personally think is the “right” answer.

Around the 1960’s and 1970’s unrest within the student body at Harvard Law School reached its boiling point (Kerr, 1999). Students refused to put up with a pedagogy that shamed, humiliated, and frustrated them more than it taught. In a survey run by Friedland in 1996, Harvard Law professor who had been teaching during the 1960’s and 1970’s described the contained uprising as a demonization of professors. In response, many professors softened the edges on Langdell’s version of the Socratic method. Students were allowed to pass if they could not answer a question, discussions included panels of students instead of just one, and some professors even questioned a multitude of students one-on-one rather than honing in on a single student for the class-period. This isn’t to say that every Harvard tenured professor changed their teaching styles. Some stayed true to the case study method; however, the straight-laced, Langdellian-era Socratic method as the eminent fixture in legal education came to an end. In its place, Socratic teaching emerged (Mintz, 2006). With it came a host of alternative teaching methods that maintained key pieces of the Socrates’ method.

Avi Mintz, an influential voice in educational pedagogy development, described modern invocations of the Socratic method as having two branches. First, the Socratic method as implemented by Professor Langdell. In terms of use, this method is mostly restricted to law schools. The second branch is titled Socratic teaching and it has found uses in primary, middle, and secondary schooling. Alternative educational tools that fall within this larger umbrella include Socratic seminars/circles, Socratic questioning, and

Socratic seminars are probably the most commonly used of the Socratic teaching techniques, and, thus far, studies on the efficacy of Socratic circles has been favorable (Mintz, 2006). In a Socratic circle, a certain amount of footwork is required of the student before he or she even sets foot in the classroom. Students are assigned a text to prepare for class. They are then split into two groups in which they will review the text again in a group format. After this initial review period ends, each group is assigned to a role: inner circle or outer circle. Students assigned to the inner circle – titled as such due to the concentric, circular formation of desks/students – will ask questions and discuss the text with one another. One student will ask a question, others will answer, and someone may counter a stated argument. (Mintz, 2006; Friedland, 1996) This exercise is intended to be student-directed. The teacher plays a minimally guiding role to ensure certain lesson objectives are covered. Additionally, having the students be in groups, like teams, foster discussion over debate. Intellectual, curious discussion should be the outcome of a Socratic circle. Once the inner circle has finished discussing the assigned text, the outer circle is then prompted to speak for the first time since the exercise started. The outer circle functions to give feedback about the discussion, points raised during the discussion, and considerations that students in the inner circle may have overlooked. Assignments to outer or inner circle should alternate. (Mintz, 2006)

Though Socratic circles have been shown to produce gains in critical thinking skills similar to the Socratic method, I am not convinced that this method should or even could replace the Socratic method. While self-directed learning allows students the
autonomy to drive their own education, there is a risk of their inquiry devolving into tangents. In order for this kind of method to work, students would have to be actively engaged, willing to participate, and disciplined enough to actually thoroughly examine assigned texts before class. Additionally, since Socratic teaching is used at lower educational levels, when students are developmentally less mature, I question the ability of the students to maintain an environment of mutual discussion. If William Perry’s positions of intellectual development are accurate, then these younger students would still be stuck in dualistic positions. When Perry’s positions have been applied to law students, researchers that even most first year students are in a dualistic position (Wangerin, 1988). They still believe there is a right answer and that the world exists in black and white (Perry, 1999). That being said, there is some evidence to support the view that Socratic inquiry causes students to move through Perry’s positions towards relativism (Wangerin, 1998). However, the efficaciousness of the Socratic method when studied only applies to a fraction of students (Goldin, 2017).

When looked at through the historical lens of the Socratic method, it appears that Socratic seminars are a blend Plato’s maieutic method and Socrates’ method. It is incumbent upon students in Socratic circles to have read a text and reflected on it ahead of time. In law schools, assigned text would likely be case law, which is a form of judicial dialogue. Furthermore, those students are expected to generate questions and insights about the text to bring forth during the circle exercise. Prior to discussion of the text with other students – a group, student-directed inquiry – students have fostered knowledge solely through an internal dialogue with themselves (Leigh, 2008). To avoid disappointment or embarrassment in class, students have to ask themselves questions
about the work, try to answer those questions, formulate their own opinions on the matter, and then provide support for those opinions. Once the students move into the circle exercise, Socrates’ style of external dialogue becomes clearer.

Socratic questioning, a second offshoot of the Socratic method, is more basic. This method did not develop in any particular place or time, it was a result of the progressively soften uses of the Socratic method in law schools (Moore, 2002). Over time, as critical thinking became a focus of State school curriculums, Socratic inquiry was looked to as a tool and a model for improving students’ performance on thinking tasks (Pulliam, 1968). For elementary-aged children, a true *elenchus* is shirked. Short, simple, open-ended questions are suggested (Moore, 2002). Additionally, silence should be allowed as a byproduct of young students’ first exposures to the Socratic method (McLachlan, Eastwood, & Friedberg, 2016). They may need time to arrive at an answer.

As students reach middle and high school, Socratic questioning should morph into a closer rendition of the *elenchus*. At this educational level, Socratic questioning encourages instructors to inquire into the source of a students’ belief, what the student thinks the implications of their argument may be, why their answer may be valid, and what other people may think of their claim (Moore, 2002). These questions sound similar to the *elenchus*, but it is important to note that Socratic questioning simply triggers a student’s internal dialogue. Like the maieutic method, knowledge acquisition occurs internally; however, the internal dialogue is guided by open-ended prompting by a teacher. The teacher does not argue a student’s point as he or she would in Socrates’ or Langdell’s methods (McLaughlan, 2016; Moore, 2002). Instead, the teacher serves to
structure a student’s learning. This benefit cannot be over-stated when Socratic inquiry is used by younger populations.

Self-directed learning and independent study – both goals promoted by Socrates’ methodology – are a learned skill that requires frequent training (Jensen, 2015; Conrad & Dunek, 2012). Initially, we should not expect students to efficiently or entirely effectively carry out self-study. This is a skill gained over time. One of the current issues that can be seen through an extensive literature review on the subject is a question of what comes first. Does Socratic instruction create independent-learning habits in students as suggested by scholars such as Adler, Leigh, Reich, Furlan, and Burns? Or do students who are already self-directed better suited for Socratic instruction, as purported by Goldin? In Goldin’s 2017 study, an experiment comparing a group with Socratic instruction to one who did not receive Socratic instruction, results indicated that only a fraction of students – one-half of adolescents and one-third of adults – had truly learned conceptual knowledge from the Socratic dialogue.

The final modern invocation of the Socratic method I want to quickly discuss involves dyads, or groups, of students who undergo the Socratic method collectively. This form of the Socratic method is becoming increasingly common in legal education with 49 percent of law professors using group methods in skills-based courses, 17 percent in first-year courses, and 62 percent in upper-level seminars (Friedland, 1996). Group-based Socratic instruction has been purported as a remedy to the inordinate amounts of stress and isolation experienced by students during their first year in law school (Jolly-Ryan, 2009; Larcombe, 2012; Pritchard & McIntosh, 2003; Rhode, 2001; Sheehy & Horan, 2004; Rundle, 2014). Legal professionals and have touted group methods as
teaching other important lawyering skills, particularly when it comes to collaboration and communicative clarity (Rundle, 2014).
Chapter IV: Today’s vs. Yesterday’s Students

Contemporary student populations differ markedly from those during Socrates’ time (Pulliam, 1968; Ingham & Boyle, 2006). In 470 B.C., students were educated by choice. Pupils who went to instructors such as Socrates’ wanted to learn, and so performed their own research outside of lessons and school. Education was not yet a public endeavor, and it certainly was not considered a right. Socrates’ did, however, teach those individuals who wanted to learn regardless of their social statues. The prime example of this is enshrined in Socrates’ lessons with the slave boy, Meno (Plato & Bluck, 1961).

Moving forward in time, education continued to be a localized, private endeavor among aristocratic families and the southern “planting class”. These families arranged for private tutors for their children and even sent children to England for a proper education. This occurred alongside the development of the public school system in the 1600s. In terms of a legal education, those most serious about practicing law went to schools in England, such as the Middle Temple of the Inns of Court. (Pulliam, 1968)

In the United States during the 17th century, the first public school was opened in Dorchester, Massachusetts, in 1635 (Pulliam, 1968). This was the first offering of “free” education to members of society, and a “proper” education was made compulsory seven years later in the Massachusetts Bay Colony. During the 18th century, “common schools” were established in the United States (Pulliam, 1968). These were locally funded, but still sent parents tuition bills. Larger towns – most of them located in the New England
colonies – opened “grammar schools” that later went on to become the modern day high school (Pulliam, 1968). The demographics of these early schools were male and white for the most part. Due to education being changed from elective to required, not all students being schooled were interested or motivated to learn. Homework, while expected to be done outside of the class, was likely a secondary thought to some students.

Today’s students are no longer necessarily aristocratic. Student populations now include a wide diversity of ages, races, and socioeconomic status (Ingham, 2006). Additionally, both males and females are educated in an equal manner. The common complaints in news headlines about today’s students are that they are lazy, unmotivated, and unwilling to critically analyze incoming information. If we relate this to Perry’s positions of intellectual development, the conclusion to be drawn is that more and more students remain locked in dualistic/absolutist positions. They do not experience the same rate of intellectual development as their historical counterparts may have. In fact, students tend to retain a dualistic worldview even into their first year of law school which is subsequent to a collegiate education in undergraduate school (Wangerin, 1988).

Some have accused the presence of amotivation in modern students as a result of stultification in early educational experiences (Rancière, 1991). It is believed that children have a natural inclination towards philosophy and wonderment (McLachlan, 2016). As children, students ask a myriad of questions. They are curious about the world around them. As students are increasingly pushed to achieve high marks, pass standardized exams, and be able to recall specific facts for tests, this sense of wonderment in education slowly ebbs (Rancière, 1991). By the time a student reaches
high school, they are more interested in learning the exact facts and formulas they need to pass the test rather than learning a concept for the sake of later application.

Essentially, the difference between yesterday’s students and today’s students is a loss of curiosity that, in turn, results in a loss of motivation to learn. One goal of Socrates’ method through the use of the *elenchus* was to produce *aporia* in a student (Boghossian, 2012). *Aporia* – or Socratic perplexity – supposedly aroused curiosity in Socrates’ students. If this is true of the Socratic method, perhaps it can be used to address the effects of stultification in lower levels of education. If applied sooner, students may retain that sense of wonder that drives them to research and inquire into subjects that grab hold of their attention.
Chapter V: Definition for Thesis

When beginning this thesis, I wanted to know whether the legal education I am poised to receive will actually teach me the law in an effective manner. This is primarily why I am evaluating the case study version of the Socratic method, as opposed to Socrates’ use of it. That being said, the original Socratic method, if we returned to it in law schools, could actually be more effective.

For the purposes of this thesis and the pilot study contained within it, the Socratic method is understood as a process based in principles of formal logic. The pilot study makes the assumption that the Socratic method teaches logicality in its students. This is supported by studies showing net increases in a student’s ability to think critically and transfer conceptual knowledge focused on in the lesson. The exact “steps” to the process, as understood today and for this thesis follow closely with Socrates’ method.

Students are asked to provide a hypothesis or answer to some general question or broad principle. Upon receiving the student’s response, the teacher leads the student through a reasoning process intended to point out flaws or considerations the student should take into account. The student is then given a chance to revise his/her initial answer and the cross-examination period begins again. The middle portion of the method involving cross-examination and refutation will, understandably, take up the largest portion of the process and can repeat, cyclically, a number of times. By the end of the process, the student and teacher should have arrived at some answer or argument that is logically valid. That is, a claim to which there are no more logical objections.
The methodology I have just described tracks the original components of the Socratic method, but the intention behind using it is more aligned with Langdell’s version of the method. The *elenchus* is the valued component in this form of education, and I must, in order to test my general expectation that the Socratic method is effective at teaching students logical thinking, assume that the method does produce logicality in its pupils. Thus, the outcome of the Socratic method, as defined for the purposes of this thesis, is learned logicality.

A Socratic student should, by the end of a Socratic lesson, have learned conceptual knowledge they can later apply to different, yet similar, situations that rely upon the same principles and formal rules of logic. This conceptual knowledge includes the procedural knowledge of how to question, cross-examine, and support/refute a given position. Being lead through a Socratic dialogue should imprint a discerning pattern of reasoning in the mind of a Socratic student. They should, in time, be able to reason through arguments they encounter in the future with the same rigor and attention to detail as was required of them by the instructor during the dialogue.

With the briefest possible summary, the pilot study is testing the effectiveness of Langdell’s modern invocation of the Socratic method.
Chapter VI: Pilot Study

Assessing the Socratic Method’s Ability to Produce Logicality in its Pupils

A Pilot Study

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Assessing the Socratic Method’s Ability to Produce Logicality in its Pupils

The Socratic method, hailed as the crux of legal education in the United States, has come under fire in recent years (Boghossian, 2012; Fullam, 2015; Rancière, 1991; Kerr, 1999; Rhode, 2001). Past students, now turned attorneys, pass down stories of trial and tribulation starring the primary educational method that strikes fear into law students’ hearts. Current students lament the harsh competitiveness, stark pressures, and anxiety that the Socratic method produces (Silver, 2012). Prospective students hear these horror stories and imagine a prestigious environment in which they will be torn to pieces by omniscient law professors (Turrow, 1998).

Such stories are not only anecdotal. Empirical evidence supporting claims of harm to students’ well-being has surfaced in the United States, as well as in foreign nations with established legal institutions such as Canada, Australia, and the United Kingdom. Concurrence exists among researchers across oceans and continents regarding how a legal education results in higher rates of depression in law students than the general population (Dresser, 2005; Jolly-Ryan, 2009; Larcombe, 2012; Pritchard, 2003; Rhode, 2001; Rundle, 2014; Sheldon & Krieger, 2007). Of college-aged individuals, approximately 10-20 percent experience depression (Larcombe, 2012). This percentage increases to 30-40 percent during a law student’s first year (Larcombe, 2012; Sheldon, 2007). Even more concerning is the continued rise of rates of depression in law students as they progress through their second and third academic years. Rates of depression in “two and three L’s” reaches, on average, around 40-50 percent (Larcombe, 2012). Such a drastic increase has been attributed to environmental factors including the Socratic
method, curriculum, the student’s self-perception of autonomy and competence, and the competitive nature of law school (Rhode, 2001; Larcombe, 2012; Sheldon, 2007).

Studies have yielded results showing a negative correlation between a student’s perception of their ability to make their own decisions (self-determination and autonomy) and their competence, or eventual competence, at the topic they have chosen to study and the severity of depression they experience (Larcombe, 2012; Pritchard, 2003). Stated simply, the more confident, in control, and successful a law student feels during their time in law school, the less severe and/or less likely the student is to experience depression. Other studies have definitively linked abused pedagogies – like the Socratic method and its state of *aporia* – to the incidence of this depression (Sheehy, 2004; Sheldon, 2007). After reviewing the literature, it is fair to say that the state of *aporia* so necessary to the Socratic method also undermines a student’s feelings of competency in addition to its main function of inducing curiosity. Unfortunately, certain hallmarks of depression defined in the Diagnostic and Statistical Manual of Mental Disorders (DSM-V) cause sufferers to utilize negative, self-defeating, and ruminating thought processes. Should the student view the *aporia* brought on by the *elenchus* in front of their intelligent, competitive peers, he or she may experience humiliation and feelings of inadequacy. Instead of realizing that Socratic perplexity is a tool they can use to motivate themselves into exciting discoveries, they will likely falsely assume stupidity in themselves.

The uncharacteristically high rates of depression, anxiety, and dissatisfaction with one’s life reported within law school populations should be of particular concern to law school deans, administrators, prospective law students, current law students, attorneys,
and members of society at large. According to the American Bar Association’s website (ABA), nearly 1.5 million lawyers practice in the United States handling mergers, acquisitions, criminal defense cases, law suits, civil rights litigation, prosecution, contracts, wills, and other important avenues of society function. As clients, we inherently trust attorneys as authorities on legal matters and rely on them to protect our interests. If a significant portion of the individuals were depressed in law school as a result of changing the manner in which they think and value the world around them, then chances are high that a significant proportion of post-graduate law students – titled lawyers after passing the bar examination – continue to struggle with depression.

“Likely” is an understatement according to existing studies. Surveys of legal professional have yielded results indicating that depression and problems with substance abuse follow law students into their capacity as professionals (Benjamin, Kaszniak, Sales, & Shanfield, 1986; Eaton, 1990; Sheldon & Krieger, 2004; Tani & Vines, 2009). Studies have shown that only half of lawyers are satisfied with their work, lawyers are 3.6 times more likely to suffer from depression than those working in other professions, and, nationally, lawyers are the most frequently depressed profession when ranked against others (Eaton, 1990). The question then becomes whether people more prone to depression are drawn to the legal profession/law school, or if exposure to these institutions causes that depression. Benjamin et al.’s 1986 study provided evidence that legal education may actually be the cause. According to his study, law students entered law school with similar psychological profiles as students in other disciplines; however, once finished with their legal education, 20-40% of law students display some type of psychological dysfunction (Benjamin et al., 1986).
The American Psychological Association in its Diagnostic and Statistical Manual (DSM) include in the clinical definition of depression a requirement of impairment in everyday functioning. This includes negatively impacting or preventing the individual from carrying out work-related functions to the best of their ability. The repercussions of this impairment could be unforgivably detrimental to even one person, especially if they have hired the attorney to defend them in a death penalty case.

Critics of the Socratic method, however, have not only attacked the method on its capacity to induce mental health deterioration in law students. Recent critiques have finally begun questioning the methods actual purpose and its effectiveness (Ranciére, 1991; Goldin, 2011; Goldin, 2017). One of the foremost opponents of the Socratic method, Jacques Ranciére, accuses Socrates of concocting a “perfected form of stultification.” Where proponents such as Jordan Fullum and Mortimer Adler defend Socrates’ belief that inquiry and critical examination (the traditional Socratic method) are used to unlock some greater truth, philosophically speaking, or a student’s capacity to teach himself, Ranciére asserts that claim that Socrates merely wanted to break down his students’ ideas and replace them with his own philosophies. This is stultification in practice. Stultification is defined as the sublimation of a student’s intelligence to a teacher’s (Ranciére, 1991; Fullam, 2015). Lectures are a prime example of direct stultification, also known as explication. Students are expected to sit and listen to an authority on a topic – the professor – explain a concept that the student either does not know yet, or understands in some false fashion (Fullam, 2015). Fullam and other educational philosophers have conceded to the point that Socrates’ style of education in *The Republic* was mostly geared towards stultification, but that his earlier lessons (i.e. his
dialogues with Plato’s slave, Meno) and modern invocations of the Socratic method are informative of the Socratic method as a shaper of analytical ability, logical acumen, and a moral education. Modern invocations, in particular, purport the “spirit” of Socrates as an unprejudiced questioner and educator of students with the intent to make them masters of their own learning rather than focusing on exactly replicating Socrates’ dialogues within legal classrooms (Reich, 1998).

Furthermore, inquiries about the effectiveness of the Socratic method in teaching critical thinking skills, formal logic principles, and active learning habits in students have arisen since the 1960’s and 1970’s (Rhode, 2001; Goldin, 2017). During the time between 1960-1970, students at Harvard law school rebelled against the stuffy and demeaning tradition of the Socratic method (Friedland, 1996; Pulliam, 1968). Professors were made to feel demonized and students actively protested the use of the traditional case-study method until the rigid standards of Socratic instruction were loosened. Around this time, modifications of the method and alternative instructional techniques that could, eventually, replace the Socratic method in legal education began cropping up (Friedland, 1996; Kerr, 1999).

Though belief in the Socratic method’s effectiveness still prevails in widespread fashion – approximately 90 percent of surveyed law professors stated their reason for using the Socratic method was because they believed it was the most effective educational tool for legal education – researchers are now turning to developmental psychology, theories of learning, cognitive neuroscience, and experimentation with different instructional methods to determine if the Socratic method truly, effectively teaches students to reason soundly (Friedland, 1996; Battro, 2013; Fullam, 2015). In the
1990’s, inquiry into such matters was still considered rare, so study of the effectiveness of the Socratic method is still limited. For this reason, I chose to address the efficacy of the method in teaching logicality to add to this growing body of knowledge. Before jumping into the details of this pilot study, I first need to address certain cognitive and learning theories that undergird the Socratic method, the use of a syllogistic reasoning task to test logicality, and how these change over the developmental tract.

The Socratic method is aimed at bringing to light errors in a student’s reasoning. This forces learners to consider other perspectives, especially when confronted with counterexamples and counter-evidence. Once the questioning process of the Socratic method – known as *elenchus* – is internalized, the student has effectively learned to not only recognize diversity of opinions, but to actively seek those other perspectives out and analyze their relative strength. Thus, if the Socratic method is actually effective, we should expect to see a significant reduction in a person’s tendency towards myside bias and an increase in their net critical thinking skills (Birch, 2004; Bloom, 1956; Furlan, 2013). Myside bias has been defined as the “tendency to evaluate evidence, generate evidence, and test hypotheses” in a way biased towards one’s own beliefs (Furlan, 2013). A corollary of this is critical thinking, which has been defined as the ability to “decouple” prior beliefs and opinions from one’s evaluation of arguments. In order to avoid myside bias, one must develop a pattern of critical thinking. This pattern, in my opinion, is developed through the internalization of the *elenchus* process. Essentially, should the method be effective, students are trained to improve their metacognitive reasoning skills (Holper, 2013). Furthermore, and perhaps more directly applicable to this pilot study, we would expect to see a resistance to belief bias if the Socratic method truly teaches
students logicality. Belief bias has been defined as evaluating an argument based on its believability rather than its logical validity (Macpherson, 2007). This effect is caused by the conflict between a student’s real world knowledge and a valid conclusion that directly contradicts that knowledge. Building resistance to such reasoning errors relies on the implications that the dual-processing theory has for Socratic education.

Dual-process theories of cognition posit that we have two mental processes that mature differently through the natural developmental progression, and that these processes utilize different regions of the brain (Stupple, 2013). Type 1 processing is automatic, “cognitively economical,” and often relies on the use of heuristics to render decisions. Heuristics is simply the idea of mental short-cuts or rules, evolutionarily or experientially established, that we use to render quick decisions. This type of mental processing tends to produce judgment biases in adults. Under dual process theories, Type 1 reasoning is replaced by Type 2 processing as we mature. Type 2 processing is deliberate, analytic, and relies on principles of formal logic. This is the type of processing used in critical thinking. Interestingly, the claim that Type 2 processing replaces Type 1 processing with age may not necessarily be true (Furlan, 2013).

A study by Wim De Neys and Elke Van Gelder produced evidence that the dominant style of processing varies across the lifespan. Specifically, a person’s ability to inhibit Type 1 processing’s tendency towards considering the believability of an argument, rather than its validity, varies from children to young adults to elderly adults. Children generally rely on Type 1 processing, as they have not yet developed the cognitive maturity to analytically consider problems (De Neys & Van Gelder, 2009). When given a conflict syllogism – a argument which can be valid but contradict a
person’s real-world knowledge – children typically give the non-normative response that aligns with what they know about the world (De Neys, 2009). This changes in young adults. Young adults, according to De Neys were best able to inhibit inappropriate biases over children and older adults. This pattern fell into further adulthood after its initial rise in young adulthood (Furlan, 2013; De Neys, 2009).

The Socratic method, based on its proponents’ claims, should essentially teach students to inhibit Type 1 processing and improve Type 2 processing since the latter is based on logicality. If the Socratic method truly does teach logicality, we should see a net increase in a students’ Type 2 processing when reasoning. There is, however, a suggested Type 3 processing model (Stupple, 2013). Type 3 processing involves executive thinking, similar to metacognition, that allows a person to reconcile the difference in response outcomes between Type 1 and Type 2 processing. Based on its definition, this is the Type of processing most relevant to the Socratic method’s aims. Socrates’ utilized the *elenchus* to point out inconsistencies in a student’s reasoning. These inconsistencies were different response outcomes between their initial responses – attributable to Type 1’s reliance on heuristics – and responses the students gave later to Socrates’ detailed questions. Thus, the Socratic method produces resistance to belief bias and logical inconsistency.

In this study, logicality was the assumed outcome of Socratic instruction. This assumption is supported by literature surrounding the *elenchus*, critical thinking improvements in Socratic students, and both original and modern purposes of the Socratic method as detailed earlier in the thesis as detailed earlier in this thesis. If a person has developed logicality, he/she should be able to distinguish between logically valid or logically invalid arguments regardless of the abstract or unbelievable quality of
the premises and conclusion. So long as the conclusion logically follows from the premises, the student should recognize the argument as valid. To determine whether such an effect actually occurs as a result of exposure to the Socratic method, a syllogistic reasoning task is an appropriate measure.

**Hypothesis**

All things being equal, a base assumption in made about the Socratic method in this study: that it teaches logicality. Due to personal experience with the Socratic method and studies showing net gains in student’s ability to critically examine novel problems, my expectation is that the Socratic method will be shown to be effective. The more Socratic instruction a student has experienced, the better I expect their logical reasoning skills to be. Specifically, my hypothesis is, if a student has had a higher amount of Socratic classes, he/she will perform better on a syllogistic reasoning task.

**Methods**

**Participants**

Participants were 40 students and professionals in the Columbia, South Carolina, area. Analysis included responses that were entirely complete, looking at the number of problems the participant got correct on a syllogistic reasoning task. This analysis included 37 participants. A secondary analysis was carried out using the proportion of answers a respondent got correct. A few additional responses were included in this analysis, bringing the total number of participants up to 40. For the purposes of brevity in this methods section due to the large amount of variables considered, I will include the
demographics of the 40 participants as 37 of them are the same as was included in the first analysis.

Age was a variable of interest, as experience and development may potentially correlate with higher scores on a syllogistic reasoning task. For this reason, the participants were asked to provide their age. In order to maintain their anonymity, age choices were provided in cohorts. Of the 40 individuals who participated in the study, 33 were aged 18-24, 4 were aged 25-34, 2 were aged 45-54, and 1 participant was aged 55-64. Additional demographics included race/ethnicity and gender. Of the 40 participants, 1 was Asian/Pacific Islander, 2 were African American, 3 were Hispanic, and 34 were White/Caucasian. Gender breakdowns included 26 female participants and 14 male participants.

Information about participants’ educational history was also collected to rule out confounding variables. This information included: highest educational attainment, years of education (starting in grade 9), if the person had ever received Socratic instruction before, how many courses they have taken with a Socratic style, how many math courses the person has taken in which they have received a grade of at least C minus, and separate items asking if the person had ever taken a formal logic, philosophy, engineering, journalism, or computer science class. The latter questions in this array were used to rule out potential variables of interest since those types of courses teach similar thinking skills to Socratic classes. The exception in this list being formal logic courses, as students who’d take formal logic courses should, ideally, perform similarly to students with Socratic instruction because the method is intended to teach logicality.
Of the 40 participants, 22 were undergraduates, 7 were graduates, and 11 were professionals in the area. Participants were classified into one of these three groups by reported degree attainment and total years of schooling. Those who had completed 4-7 years of education starting in 9th grade were classified as undergraduates. This was supported with their reported degree attainment and the fact that USC’s undergraduate programs last for four years. Students who had completed 8-10 years of schooling were classified as graduates for the same rationales. The final classification – professionals – included predominantly lawyers and medical doctors in Columbia, SC, and was comprised of those individuals who had completed greater than 10 years of schooling and reported having a graduate/professional degree.

In terms of total schooling since 9th grade on its own, 1 participant reported having 4 years, 3 participants reported having 5, 13 reported having 7, 8 reported having 8, 3 reported having 9, and 7 reported having greater than 10 years. Over the duration of their education, 28 had taken a course in which the professor used the Socratic method and 12 had not. For the academic subjects of interests, 4 participants had taken an engineering course, 11 had taken a journalism class, 18 had taken a computer or programming course, 23 had taken a philosophy course, and 18 ad taken a formal logic course.

Participants were also asked to report their college major/area of study. Though more degree tracts exist, responses were categorized in to the following areas: business, criminal justice and/or law, English and communications, government and politics, health or medical, math, sciences, and social sciences. Of the 40 subjects, 2 reported business majors, 7 reported criminal justice or law-related majors, 5 reported English or
communications majors, 7 indicated a study in government and politics, 4 marked health or medical studies, 3 stated they were studying math, 1 reported a major in the physical sciences, and 11 reported majors in the social sciences.

Materials

The materials used in this study included a digital survey created by the researcher through surveymonkey.com, a 20 item syllogistic reasoning task comprised of questions from two existing studies, a Statistical Package for the Social Sciences (SPSS) software (version 23) from IBM to perform data analysis, a USB drive to store data and data analysis, and three $25 Visa gift cards that were given to three, randomly selected participants after the survey was officially closed on March 1, 2018. Additionally, Microsoft Excel was used to record data and those spreadsheets were later imported into SPSS. A calculator was used to determine the proportion of correct answers in certain instances.

Procedures

The digital survey as shown, in full, in Appendix A included an informed consent page, a demographic questionnaire, a survey of a participant’s educational history, and a 20-item syllogistic reasoning task. The final question of the survey was optional and it allowed participants to provide an email at which they could be contacted. The purpose of this question was to contact the winners of the lottery style award (gift cards) after the survey was closed. All respondents – nearly 70 – who took the survey and provided their email address, regardless of if they actually completed the survey, were eligible to win one of the gift cards. At no point were the participants asked to provide their name or personal identifying information. Age demographics were collected in cohorts to retain
the participant’s anonymity. Those who opted to provide their email were able to provide any email, not just their school or work email that could potentially identify them.

All email addresses provided and all of the survey data was stored on a 16 GB, PNY brand USB drive that was kept locked in a fireproof safe. Only the researcher had the key. Additionally, the only people allowed to view this information were the researcher, Amanda Grondin, and the research supervisor, Melanie Palomares. Contact information for both of these individuals was provided to participants via the informed consent page of the survey should he/she have any concerns about privacy or questions about the survey.

The syllogistic reasoning task used to assess a participant’s ability to reason logically and resist invalid, biased reasoning was generated using 12 questions from Morsanyi and Handley’s 2012 study, and 8 questions from Klauer and Singmann’s 2013 study. These questions, assigned a temporary number, were ordered in random array using a random number generator to determine each question’s place. For example, the number 8 was randomly generated when the researcher was looking to place a question in the first slot. The question temporarily number 8 would later be placed in that slot on the survey site. The reason for randomly ordering them was to prevent a large bloc of valid versus invalid or believable versus non-believable questions. Once the order of the questions was determined, the researcher created an answer key denoting each question’s argument as either valid or invalid. This answer key was stored in a word document saved to the USB drive. For each participant’s reasoning task, the researcher counted the number correct out of 20 and the proportion correct out of however many questions were answered. This data was recorded in an Excel spreadsheet.
A student version of SPSS, a statistics software, was used to analyze the data. Correlations were measured between the number of correct responses a participant got correct and the number of Socratic courses they reported taking. Secondly, the same kind of correlational analysis was run on the relationship between the overall proportion of questions a participant got correct and the number of Socratic classes they reported taking.

**Results**

*Table 1* shows the results of a series of Pearson correlation analyses. The main analysis of interest involved the total number of Socratic classes a person had when related to their score on the syllogistic reasoning task. This analysis revealed that there was a significant positive correlation between the total number of correct responses a participant gave on the syllogistic reasoning task and the amount of Socratic courses they had taken, \( r (32) = 0.457, p < 0.01 \). The scatterplot of this data is represented in *Figure 1*. This indicates that, as the person is continually exposed to the Socratic method, they will be able to more accurately assess the logical validity of an argument. These results support my initial hypothesis that the Socratic method is effective at teaching logicality. Then the same relationship – the relationship between performance on the task and Socratic instruction – was tested using the proportion participants got correct instead of the number, the results were similar, \( r (38) = 0.369, p < 0.05 \). This analysis is displayed in *Table 2* and the scatterplot for the data is represented in *Figure 2*. The reason the researcher also tested proportion was due to having a number of incomplete survey responses that still had valuable data. Participants in this category had nearly completed the reasoning task, but failed to do so for some unknown reason.
One surprising result occurred when testing the relationship between the total number of math classes a person had taken starting in 9th grade (passed with a C- or above) and their performance on the syllogistic reasoning task. Formal logic has been compared to math in that its construction and use in classrooms is formulaic. Sentences and arguments are represented by numbers, letters, and symbols in logic courses. Thus, the researcher expected to find a positive correlation between the two variables, even if the result was not statistically significant. Directly contrasting this sub-hypothesis, the results of the correlational analysis indicated a negative relationship between the variables, $r (32) = -.322, p > 0.05$. Similar results were found when running the correlation with the proportion correct, $r (38) = -.315, p > 0.05$. These results are represented in Table 1, Table 2, and Figure 4. Perhaps the reason for the surprising results is that students who major in mathematics or who take a large amount of mathematics courses think in a different manner than those who excel at logic itself. Essentially, the two – mathematics and formal logic – are not as similar as popularly believed. Alternatively, the Socratic method may not be teaching formal logic. Perhaps the method teaches argumentation and critical thinking rather than logicality. As of now, these explanations are mere conjecture and should be the focus of future study.

Additional data analysis was run to determine if mere exposure to the method (meaning the participant had taken at least one class featuring the Socratic method) was enough to create changes in a person’s ability to reason logically, or if they would need repeated exposures. These analyses are captured in Figure 3, Figure 4, Figure 7, and Figure 8. In order to ascertain this information, an independent-samples t-test was conducted to determine if performance on the syllogistic reasoning task differed between
those who reported having experienced a Socratic class at least once ($M = 13.50$, $SD = 3.658$, $N = 26$) and those who had never experienced the Socratic method ($M = 13.64$, $SD = 3.722$, $N = 11$). The results of this analysis indicate that mere exposure does not increase one’s performance on a syllogistic reasoning task, $t (35) = -0.103$, $p > 0.05$. When analyzed based on proportion correct rather than number correct, results were similar, $t (38) = 0.33$, $p > 0.05$. For the purposes of this thesis, it is important to note that a student, according to these results, needs a number of exposures to the Socratic method and the thinking it invokes in students before the benefits of the method can change their ability to logically assess and argument or claim. This somewhat contradicts my initial hypothesis about the effectiveness of the Socratic method, but this disparity can be moderated by the explanation of a need for continuous Socratic instruction before benefits of the method can be empirically observed.

Other factors were tested to rule out confounding variables. These factors included total years of education, degree attainment, total amount of math courses taken, race, gender, age, and if the person had taken a formal logic, journalism, engineering, computer programming, or philosophy class before. The reasoning behind the questions about specific types of classes was that those majors and kinds of courses use Socratic style instruction more than others. They also teach critical thinking skills and argument analysis, such as in the case of journalism classes. In all independent-samples t-tests run on these class-specific variables, results were insignificant, $p > 0.05$. Furthermore, formal logic has been likened to mathematics in that it is formulaic. For this reason, the relationship between participants’ performance on the syllogistic reasoning task and the total amount of math classes they have complete with a grade of at least C minus was
analyzed. The results of this correlational analysis were insignificant, $p > 0.05$. Analysis of a person’s total years of education yielded insignificant results as well, $p > 0.05$.

One surprising result to come of this study was that degree attainment had no clear effect on one’s performance on the reasoning task. The researcher expected that, if the Socratic method truly was effective, then graduate and post-graduate participants would fair better because these groups would include law students and medical students (the Socratic method is used in law schools and medical case studies). An independent-samples t-test indicated that this assumption was false.
Chapter VII: Discussion

(Of the pilot study and the overall thesis)

The implications of the pilot study included within this thesis are perhaps more subjective than desired. The data show a significant positive correlation between Socratic instruction and a person’s performance on a logic assessment; however, that relationship is only moderate. Taken in conjunction with Goldin’s study showing that the Socratic method is effective, but on for a fraction of total students, these results imply that the Socratic method may not be the best teaching method, in law schools or elsewhere. While we can rest assured that the Socratic method does seem related to a rise in logicality in its students, perhaps we should turn to alternative methods or consider modifying the Socratic method to produce weightier results on logical assessments.

Alternative methods are already being used in top-tier law schools (Friedland, 1996). A survey of Harvard professors revealed that, while the Socratic method is still firmly entrenched in legal pedagogy, lectures, role-playing, and dyad (group) work are all being experimented with in the context of legal curriculum (Friedland, 1996). The most promising of these different techniques appears to be role-playing teaching methods. To professors and students alike, role-playing exercises have “across the board” appeal (Friedland, 1996; Rhode, 2001). In advocacy-based role-playing exercise, students will be assigned to be prosecutors, judges, defense attorneys, defendants, or other litigants. Other times, students will role-play attorney-client interactions. The reason for the rising use of role-playing teaching methods, especially in skills-related and seminar classes is
due to the capacity of such exercises to teach lawyering skills (i.e., advocacy, client relations, oral argumentation, document drafting) while still shaping a student’s ability to think critically and reason through a presented problem (Friedland, 1996; Kerr, 1999).

Even better, the arguments students have to reason through move from the abstract concepts common to Socratic case study to practical issues in the day-to-day life of a lawyer. Regardless of which alternative method rises to prominence as the Socratic method loses traction in law schools, most professors and deans agree that legal institutions should use a mix of methods (Friedland, 1996). The opinions of these educators is based on the idea of the “three dimensional learner” and psychologically studied learning theories that state that not everyone learns in the same fashion. One method does not fit all students (Macpherson, 2007).

As discussed earlier in the body of this thesis, perhaps the problem is not with the Socratic method at all. Perhaps the mistake is ours and in how we have chosen to implement Socrates’ process of inquiry. In the United States, the Socratic method is almost entirely restricted to law schools (Pulliam, 1968; Friedland, 1996; Fullam, 2015; Mintz, 2006). Students from elementary through high school are expected to regurgitate facts in order to meet the demands of State-sanctioned examinations. While teachers in primary and secondary schools may want to help students learn information rather than just memorizing it, the practical reality of the matter is that the majority of class time must be spent on facts. Due to this reality, the primary educational method in lower levels of schooling is explication (Fullam, 2015). Educational philosopher Jacques Ranciére has asserted the notion that explication is a form of direct stultification that causes diminished curiosity and motivation in students. Maybe if we implemented some form of Socrates’
legacy at the primary educational level – such as Socratic questioning – then we may be able to head off the diminished drive students have to learn for the sake of learning.

Additionally, when a student’s first exposure to the Socratic method is law school, an already extremely stressful environment, it is unlikely that they will be able to thrive academically or emotionally (Larcombe, 2012). As Wangerin explained, most first year law students are still stuck in positions 1-4 of Perry’s positions of intellectual development. They see the world in black and white and expect an authority – or in this case, a professor – to tell them the correct answer or what to think. The whole idea behind a legal education is to train students “how to think like a lawyer” (Hartwell, 1990). Once graduated, a law student should be able to go forth into the legal profession and advocate for those who employ them. If they think there is always a right answer to a legal problem instead of recognizing that laws and normative responses are subjective answers to a given question, then their advocacy will be subpar. Relativism is essential to employing legal creativity to solve a legal issue. Thus, if we move a student’s exposure to Socratic method earlier in their educational career, they will be better positioned to handle the Socratic method in its purest form in law school.

**Limitations of the Pilot Study**

The limitations of the pilot study are relatively clear when looking at the data. The sample population used in the pilot study was very small due to the time constraints of this thesis. In order to determine a more robust correlation between how much Socratic instruction a student has and their subsequent performance on a syllogistic reasoning task, a larger sample size is needed.
Additionally, in the pilot study I mostly rely upon correlations to determine if the Socratic method is effective. While such data can imply effectiveness of the Socratic method, it does not adequately support the claim like a true experiment would. Thus, I suggest an experiment using different groups of students who have the same instructor be done in the future. In such an experiment, an instructor who has been trained in Socratic pedagogy would teach at least two course sections at a given university. One class section would be taught using the Socratic method for the duration of a semester and the other would be taught using the traditional lecture method. A test should be given at the beginning of the semester and at the end of the semester. The test should include a logic task (like the syllogistic reasoning task) and a critical thinking task (most likely some kind of essay prompts). This would allow researchers to claim causation instead of mere correlation.

**Reflection**

While I am encouraged by the positive results regarding the efficacy of the Socratic method, I am troubled by its limited impact on a class population. Originally, when I started this thesis, I saw the Socratic method as a technique used by strict professors intended to shame you into completing assigned tasks. Though the chances of being “cold-called” in a law school class likely drives students to complete outside work, I now realize that I should view is as a way to improve my cognitive processing and confidence in my ability to clearly articulate my thoughts. Overall, though the process of writing this thesis was daunting and stressful, I am grateful for the experience.
References


Furlan, S., Agnoli, F., & Reyna, V. F. (2013). Children’s competence or adults’
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confident confidence ratings. *Thinking & Reasoning, 19*(1), 54-77.


Appendix A

Effectiveness of an Educational Method

1. Informed Consent

Thank you for considering completing this survey. My name is Amanda Grondin, an undergraduate student in USC's honors college. This survey is being used in my Honors Thesis and I need as many responses as possible from you all to prevent biased or skewed results. Though there is no direct benefit from this study to you, the results may help generate future research into educational practices that may be outdated or encourage schools to modify a long-time practice. If you complete the survey you will be eligible to enter a contest for one of three $25 Visa gift cards.

The following survey will include three sections:
1. a demographic questionnaire,
2. a questionnaire about your achieved level of education and your experiences in educational settings, and
3. a brief syllogistic reasoning task.

The demographic questionnaire should take approximately 1-2 minutes to complete. Demographic questions will be used to determine the effects of extraneous factors (age, sex or gender, college major, profession, etc.) Following the demographic section will be a string of questions about your educational experiences in high school and college including the level of education you have attained and any exposure to a specific style of teaching. This teaching style will be described on the page before the questions begin. Answering these questions should take approximately 5-6 minutes. These questions will also be used to evaluate how differences in education may explain differences in responses on the final section that includes the syllogistic reasoning task. This final section will require more time to answer the questions, and will generally take you 10-20 minutes to complete. Overall this survey can take anywhere between 15-25 minutes to complete. The pace of response will not impact results on the syllogistic reasoning task. Finishing the task faster or slower is not an indicator of intelligence, so please answer all questions to the best of your ability.

Your participation is entirely voluntary. You may exit the survey at any time or choose to refrain from answering certain questions. You will not be faulted or punished should you choose to exit the survey before completion or omit certain demographic information.

If you have any questions about the survey, please feel free to contact me at agrondin@email.sc.edu or (704)224-6140, or you may contact my thesis/research director, Dr. Melanie Palomares, at palomare@mailbox.sc.edu or (803)777-5453.

1. If you have read and understood this informed consent page and consent to taking the survey, please select “I consent” below. Use the “next” button at the bottom of the page to navigate to the first page of the survey. If you do not consent, please select “no, I do not consent” and exit the survey page.

- [ ] I consent.
- [ ] No, I do not consent.
### Effectiveness of an Educational Method

#### 2. Demographic Questionnaire

1. What is your gender?
   - [ ] Female
   - [ ] Male
   - [ ] Other
   - [ ] I do not wish to disclose this information.

2. What is your age?
   - [ ] 18 to 24
   - [ ] 25 to 34
   - [ ] 35 to 44
   - [ ] 45 to 54
   - [ ] 55 to 64
   - [ ] 65 to 74
   - [ ] 75 or older

3. Which race/ethnicity best describes you? (Please choose only one.)
   - [ ] American Indian or Alaskan Native
   - [ ] Asian / Pacific Islander
   - [ ] Black or African American
   - [ ] Hispanic
   - [ ] White / Caucasian
   - [ ] Multiple ethnicity / Other (please specify)
### Effectiveness of an Educational Method

#### 3. Education Questionnaire

1. What is the highest level of school you have completed or the highest degree you have received?
   - [ ] Less than high school degree
   - [ ] High school degree or equivalent (e.g., GED)
   - [ ] Some college but no degree
   - [ ] Associate degree
   - [ ] Bachelor degree
   - [ ] Graduate degree

2. How many years of schooling have you completed starting from high school (9th grade)?
   - [ ]

3. If you are currently attending or have attended college in the past, what is or was your college major(s)?
   - [ ]

4. How many mathematics classes did you take and complete with a grade of C- or higher while you were in high school?
   - [ ]

5. How mathematics courses did you take/have you taken and completed with a grade of C- or higher while at college?
   - [ ]

6. Have you ever taken any formal logic courses (these typically have a philosophy course code)?
   - [ ] Yes
   - [ ] No
   - [ ] I'm not sure.
7. Have you ever taken any philosophy courses?
- Yes
- No
- I'm not sure

8. Have you ever taken any programming classes (i.e. computer programming)?
- Yes
- No
- I'm not sure

9. Have you ever taken any journalism classes?
- Yes
- No
- I'm not sure

10. Have you ever taken any engineering classes?
- Yes
- No
- I'm not sure
Effectiveness of an Educational Method

4. Education Questionnaire

1. Are you familiar with the Socratic method of teaching?
   - Yes
   - No
   - I'm not sure

2. If you answered “yes” to the previous question, how many classes have you taken in which your professor/teacher used Socratic instruction to teach the class?

3. Have you ever had a class in which a teacher taught the material by asking students questions and giving counterarguments to students answers to make them reconsider their position until some final conclusion was reached?
   - Yes
   - No
   - I'm not sure.

4. If you answered “yes” to the previous question, how many classes have you taken in which your professor/teacher used this style of teaching?

5. Please describe your understanding of the Socratic method of instruction (note that this method is different from purely discussion-based classes).
### Effectiveness of an Educational Method

#### 5. Syllogistic Reasoning Task

This portion of the survey will assess your formal logical reasoning skills. For each question read the premises (first two sentences) and then the conclusion. You are to assume that the premises are true regardless of real-world knowledge and beliefs. Your only job during this task is to determine whether the conclusion logically follows from the premises. If the conclusion does follow logically from the premises, then it is valid. Please read each question carefully and answer to the best of your ability. There will be no penalty for wrong or skipped answers, though only completed surveys will be used for data analysis. However, as your participation is voluntary, you are eligible to enter your name in the gift card lottery regardless of if you finish the survey.

1. Some hot things are vons.
   No vons are ice creams.
   Some ice creams are not hot.
   
   - [ ] Valid
   - [ ] Invalid

2. All hairy animals are mammals.
   All mammals are elgs.
   Therefore, all elgs are hairy.
   
   - [ ] Valid
   - [ ] Invalid

3. Some ice creams are vons.
   No vons are hot.
   Some ice creams are not hot.
   
   - [ ] Valid
   - [ ] Invalid

4. All ice creams are vons.
   All vons are cold.
   Therefore, all ice creams are cold.
   
   - [ ] Valid
   - [ ] Invalid
5. All teps are glasses.
   All unbreakable things are teps.
   Therefore, all glasses are unbreakable.
   - Valid
   - Invalid

6. No ice creams are vons.
   Some vons are hot.
   Some ice creams are not hot.
   - Valid
   - Invalid

7. Some vons are hot.
   No ice creams are vons.
   Some ice creams are not hot.
   - Valid
   - Invalid

8. All raks are clever.
   All police dogs are raks.
   Therefore, all police dogs are clever.
   - Valid
   - Invalid

9. All ice creams are vons.
   All vons are hot.
   Therefore, all ice creams are hot.
   - Valid
   - Invalid

10. All raks are stupid,
    All police dogs are raks.
    Therefore, all police dogs are stupid.
    - Valid
    - Invalid
11. Some vons are ice creams.  
No hot things are vons.  
Some ice creams are not hot.  
- [ ] Valid  
- [ ] Invalid

12. No vons are hot.  
Some ice creams are vons.  
Some ice creams are not hot.  
- [ ] Valid  
- [ ] Invalid

13. All elgs are mammals.  
All mammals are hairy.  
Therefore, all elgs are hairy.  
- [ ] Valid  
- [ ] Invalid

14. All chimps are apes.  
All erms are chimps.  
Therefore, all erms are apes.  
- [ ] Valid  
- [ ] Invalid

15. No hot things are vons.  
Some vons are ice creams.  
Some ice creams are not hot.  
- [ ] Valid  
- [ ] Invalid

16. All heavy animals are dufs.  
All dufs are elephants.  
Therefore, all elephants are heavy.  
- [ ] Valid  
- [ ] Invalid
17. All teps are glasses.  
All breakable things are teps.  
Therefore, all glasses are breakable.  
   ○ Valid  
   ○ Invalid  

18. All tiny animals are dufs.  
All dufs are elephants.  
Therefore, all elephants are tiny.  
   ○ Valid  
   ○ Invalid  

19. No vons are ice creams.  
Some hot things are vons.  
Some ice creams are not hot.  
   ○ Valid  
   ○ Invalid  

20. All apes are ems.  
All chimps are apes.  
Therefore, all ems are chimps.  
   ○ Valid  
   ○ Invalid
### Effectiveness of an Educational Method

#### 6. Survey Gift Card Lottery (optional)

You DO NOT have to put your name below. If you do not wish to, simply leave the textbox blank and submit your results.

1. If you would like to enter your name to win one of three $25 Visa gift cards, please enter your email address below. When the survey has ended, participants who have elected to enter themselves in the lottery will be randomly selected and contacted through their email should they win. Thank you, again, for completing this survey. Your time and responses are greatly appreciated.

   ```
Appendix B (data analysis)

Table 1.

Correlations Between Two Types of Classes and Performance on a Reasoning Task

<table>
<thead>
<tr>
<th>Measure</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Number of Math classes</td>
<td>---</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Socratic classes (#)</td>
<td>---</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td>3. Number Correct</td>
<td>-.322</td>
<td>.457**</td>
<td>---</td>
</tr>
</tbody>
</table>

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

Table 1. Pearson’s $r$ correlational analysis testing the relationship between the number of Socratic courses a participant had taken and the number of correct responses they gave on the Syllogistic reasoning task. There was a moderate, positive correlation between performance on the reasoning task and the amount of Socratic instruction a student had received, $r (32) = .457, p < 0.01$, two-tailed. This relationship is shown in the intersection of matrix column 2 and row 3 (number correct). Another Pearson’s $r$ correlational analysis testing the relationship between the total number of math classes a person had taken starting in 9th grade and the number of correct responses they gave on the Syllogistic reasoning task was conducted. Results were statistically insignificant; however, the negative correlation between the two variables was surprising and contradicted a sub-hypothesis held by the researcher, $r (32) = -.322, p > 0.05$.

Table 2.

Correlations Between Two Types of Classes and Performance on a Reasoning Task

<table>
<thead>
<tr>
<th>Measure</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Number of Math classes</td>
<td>---</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Socratic classes (#)</td>
<td>---</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td>3. Proportion Correct</td>
<td>-.315</td>
<td>.369*</td>
<td>---</td>
</tr>
</tbody>
</table>

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).
Table 2. Pearson’s $r$ correlational analysis testing the relationship between the number of Socratic courses a participant had taken and the proportion of correct responses they gave on the Syllogistic reasoning task. There was a moderate, positive correlation between performance on the reasoning task and the amount of Socratic instruction a student had received, $r (38) = 0.369, p < 0.05$, two-tailed. This relationship is represented in the intersection of matrix column 2, row 3 (proportion correct). An additional Pearson’s $r$ correlation was run to examine the relationship between the total number of math classes a person had taken starting in 9th grade and their performance on the syllogistic reasoning task. Performance was measured by proportion correct (rather than number correct), allowing for the use of some incomplete reasoning task data. Results were statistically insignificant; however, the negative relationship contradicted a sub-hypothesis held by the researcher, $r (38) = -0.315, p > 0.05$.

Figure 1. Scatterplot summarizing the correlational analysis in Figure 1. The relationship between the number of Socratic courses taken by a person and their performance on a syllogistic reasoning task was significant and positive, $p < 0.01$. 


Figure 2. Scatterplot summarizing the correlational analysis in Figure 1. The relationship between the number of Socratic courses taken by a person and their performance on a syllogistic reasoning task was significant and positive, $p < 0.05$.

Figure 3. Results of an independent samples t-test that analyzed if the performance on the syllogistic reasoning task differed between those who had taken at least one Socratic-styled course and those who had not. Those with Socratic instruction did not score significantly higher than those without it, $t(35) = -0.103$, $p > 0.05$. 
Figure 4. Bar graph of mean number of correct responses on the syllogistic reasoning task as a function of if the participant had received any Socratic instruction. The number of correct responses was not significantly higher in those who had received some form of Socratic instruction and those who had not, $p > 0.05$. There was, however, greater variability in the performances of those without Socratic instruction when error bars were added with a 95% confidence interval.

Figure 5. Results of an independent samples t-test that analyzed if the performance on the syllogistic reasoning task differed between those who had taken at least one Socratic-styled course and those who had not. Those with Socratic instruction did not score significantly higher than those without it, $t(38) = -0.033$, $p > 0.05$. 
Figure 6. Bar graph of mean proportion of correct responses on the syllogistic reasoning task as a function of if the participant had received any Socratic instruction. The number of correct responses was not significantly higher in those who had received some form of Socratic instruction and those who had not, $p > 0.05$. 