

***The Go Project:  
Effects of Mental Stimulation in Early Education***

by

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**Abstract:**

The most important time for the development of critical thinking and creative problem solving is found in early education. Following several similar studies on chess education<sup>1</sup>, a summer Go teaching program was held at a Palos Verdes preschool to experiment benefits of Go teaching in abstract logic and cognitive thinking skills and to promote future of Go in an after school program in the school district. The Go teaching program was well received at the preschool and the WPPSI/OSLAT test between the teaching group and control group shown relative 12% improvement in child aforementioned skills.

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<sup>1</sup> See summary of research in proposal on pages 18, Appendix

**Summary:**

Testing of children from three to five years old at Mount Olive Lutheran Preschool shows an average improvement significantly greater than that of the control group. Each child was tested twice a week, with some absences in between. This data was later averaged to output a statistical result favorable to the hypothesis.

The children who learned Go performed better on the given test each week than the other children of same age and same setting.

The average difference was statistically significant at the 0.06 level, thus the probability is only six in a hundred that the results shown were due to chance.

The work was supported by my family and school statistics/psychology teacher to produce the outline and then to, with the help of many others, follow through with this project.

This study evaluated two months of my modified teaching program. I taught based off of my three years of prior experience at local school and public library, setting up milestones such as learning atari, hane, and counting points.

Students in the Go Study group showed higher percent gain than those who were not part of the curriculum. Both are assumed to start from the same average base score.

As sample size was below thirty, direct conclusions cannot be made. However some theories and explanations do exist.

**Acknowledgements:**

There are many people I would like to thank. First off I'd like to thank Ms. Kan Chaiyont for helping me organize a feasible model design for this test. Without her guidance, progress would have been slow and there would have been many more setbacks. Her inspiration is an essential part of the completion of this project.

Next, I would like to thank Mr. Andy Okun for his cooperation in not only setting me up with various contacts, such as Thomas Hsiang from Mind Sports. His aid in this project and helping me start as a teacher a few years ago was also very key part of this program.

Also, much of my appreciation goes out towards Mrs. Shari Keating, the principle of Mount Olive Lutheran Preschool, for when many others rejected my idea, she was very supportive and encourage enough to allow me to use her facilities. Her efforts to talk through the details and tests on each kid gave me a better understanding of what I was doing right and what I had been doing wrong. Her help allowed for the elimination of much human error.

Lastly I'd like to thank Mrs. Jennifer Chaffey for helping me the past few years set up the Go Club and facilitate all the resources and publicity my class needed to grow. Without her help and recommendations it would've been even harder to find willing and able preschool's for me to test at.

**Overview:**

Preschool students at Mount Olive Lutheran Preschool received instruction in playing Go. Students in the program improved scores on the test more than control groups. Gains were statistically significant at the 0.06 level.

**Background:**

The game of Go itself is one complicated enough that even someone who plays for decades still won't fully master it. Therefore the idea of teaching it to kids under the age of five at first seems impossible.

As such, I chose to simplify and teach with a 9x9 board. This way the kids could not only retain more about the game, but also it would be easier to keep their interest.

Also a key goal I kept in mind was that the focus was more on making them think and attempt to play out the game, not to learn and master it. This way it would be easier to show that the logical stimulation given by Go would have effects in developmental psychology at even the preoperational stage (ages up to 7).

Only a few adjustments had to be made such as teaching counting first and atari last. Overall the study went smoothly with little to no bumps.

The basic outline was to go in every Tuesday and Thursday, teach and play for thirty minutes, and then administer the test. Results would be recorded and tallied at the end of each week<sup>2</sup>.

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<sup>2</sup> See teaching plan in proposal on pages 19-20, Appendix.

**Selection of Subjects:**

This report evaluates the testing abilities of students enrolled in the Go curriculum. Subjects were mostly four years old, and had never touched this game before. All students tested had been enrolled in the preschool for the relatively same amount of time. Criteria stood as such:

1. Able to count basic numbers and follow instructions.
2. Stood on equal academic ground: holding the same average score for the first test. Outliers of more than 20% would be removed.
3. Had to be enrolled in the preschool for the full length of 8 weeks and appear on the scheduled days.

The final group was decided between the principle and me after discussing each kid's age and background, as well as considering the factors stated above. By including the most representative selection I can increase confidence in the result.

**Control Group:**

Control group was selected from the students who were

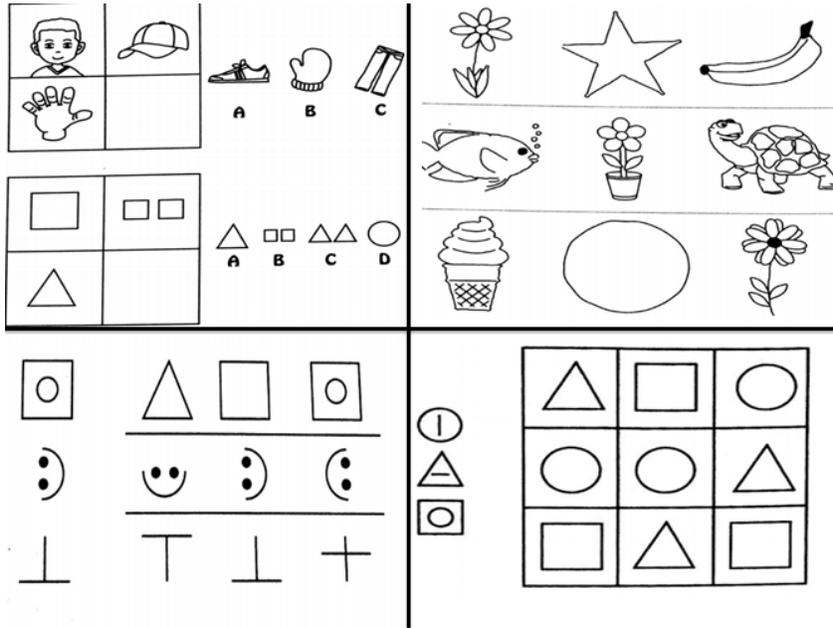
1. Enrolled during the summer at that preschool
2. Had not been a part of or seen the Go class or tests given

This group was randomly selected from a choice of ten students, eliminating bias. However there might have been some slight human error as described above, their answers matched a bit too consistently.

**Tests:**

Two versions of tests were given, both a combination of Wechsler Preschool and Primary Scale of Intelligence (WPPSI) and Otis-Lennon School Ability Test (OLSAT) questions. I alternated two versions of a test every other week. Below is the first version.

**Test Panel 1\***



The left side of the page focuses on Matrix Reasoning and Symbol Searching.

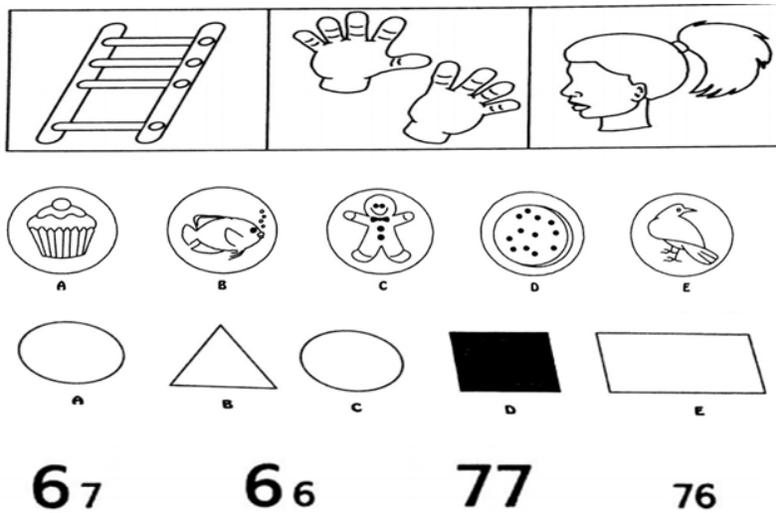
The right side of the page focuses on picture completion and picture concepts

All students did reasonably well here.

These assess Memory, visual-spatial reasoning, and cognitive skills.

*\*For version 2: It has a foot instead of a hand, two triangles instead of one, circle in square is black, smiley face faces other way, lines face down. Other questions stay same.*

**Test Panel 2\***

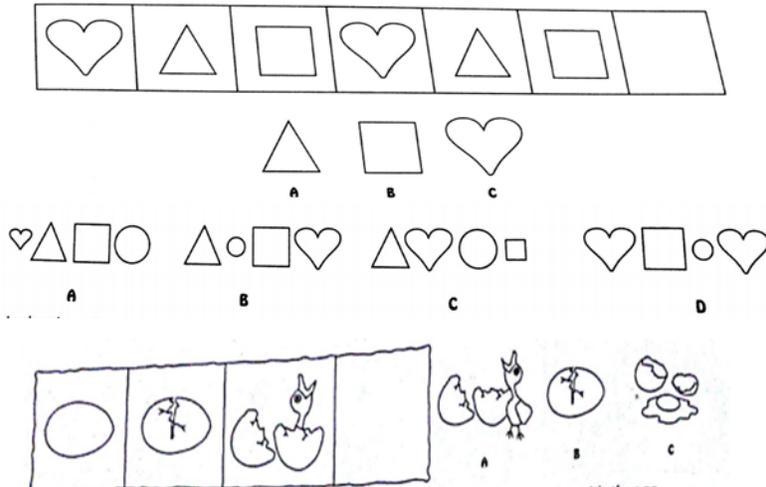


From top to bottom, these questions focus on Picture Completion, Verbal Reasoning, and Listening/Following Directions.

These assess Memory, language, and cognitive skills.

*\*For Version 2: It has a dog instead of a cookie, the circle is filled dark instead of the square, and the “66” are same size while “77” is two different sizes.*

Test Panel 3\*



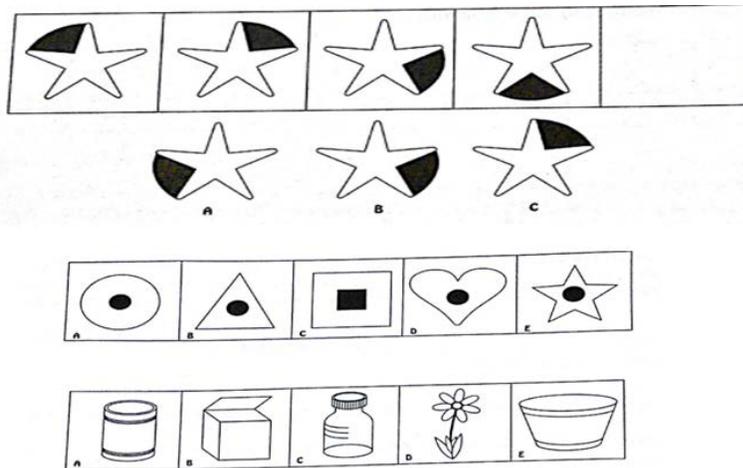
From top to bottom, these questions focus on Pattern Recognition, Picture Series, and Figural Classification.

The lowest score part of the test.

These assess knowledge/comprehension, visual-spatial reasoning, and cognitive skills.

*\*For version 2: The pattern is reversed, second question stays the same, and the third slide is depicted as A while the answer choice A is replaced with a flying bird.*

Test Panel 4\*



From top to bottom, these questions focus on Figural Classification and Figural Series.

These assess mathematics, visual-spatial reasoning, and cognitive skills.

*\*For version 2: The first question stays same, black square moves to heart, third question stays same.*

Scoring comes out of a 20 point grading scale, where all answers gave either 1 or 0 points. The exception being the top right and bottom right questions from the first panel, points were out of 2 for each question, most of the time kids got 1 out of 2 points.

**Results and Data Analysis:**

Below are tables and graphs depicting the results of statistical tests applied to the recorded data. Let  $t$  = scores of individuals part of the curriculum/not part of the curriculum (*significant at the 0.06 level*)

**t-Test: Two-Sample Assuming Unequal Variances**

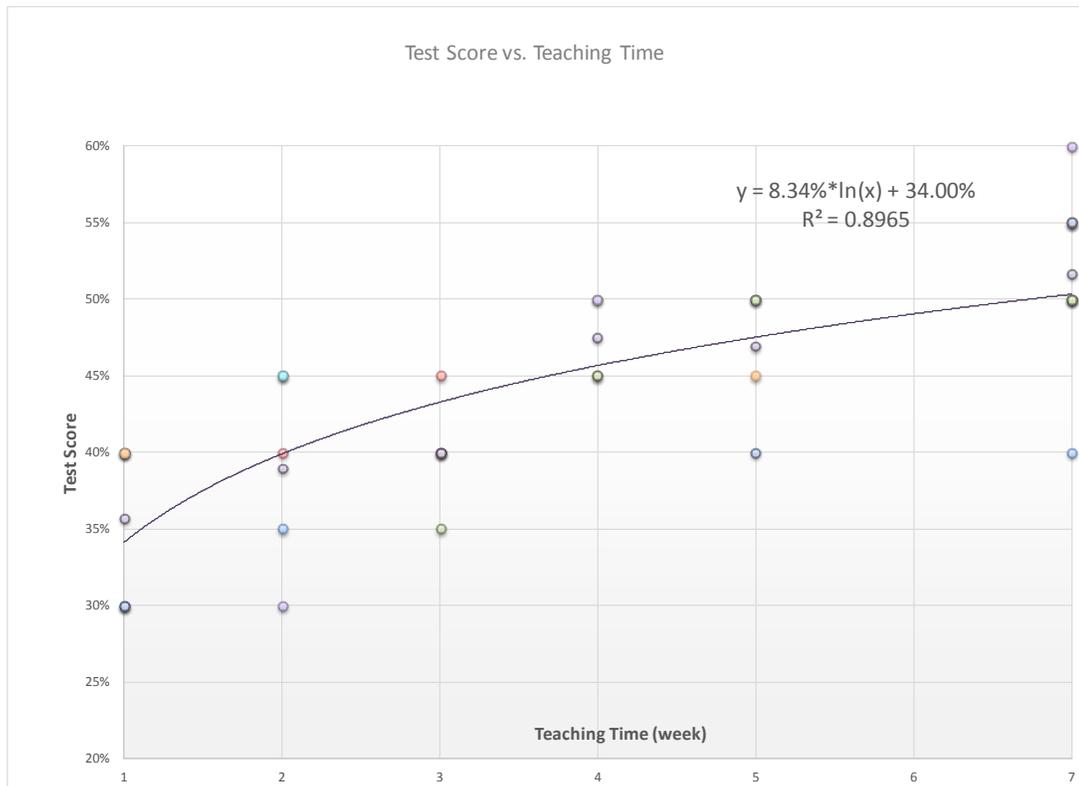
	<i>Control Group</i>	<i>Test Group</i>
Mean	0.4625	0.516666667
Variance	0.0022917	0.003125
Observations	4	9
Hypothesized Mean Difference	0	
df	7	
t Stat	-1.785687	
P(T<=t) one-tail	0.0586577	
t Critical one-tail	1.8945786	
P(T<=t) two-tail	0.1173154	
t Critical two-tail	2.3646243	

The calculated average of final scores for the control group was 46.25%. For the test group it was 51.66%.

The absolute difference in final scores was ~5%, and the relative difference was ~12%. As for time elapsed, there was an extra four weeks between time of test group's last data point and time of control group's last data point.

By this logic, the use of Go in even a short term program accelerates intellectual growth for this age group (3-5) by about three weeks. At this age, such an increase stands out as a significant boost.

Equation below was calculated using Microsoft Excel add-on "Solver". The exact function used is based on the Least-Squares Regression Line Method (LSRL).



### Observations

- The base test score is 34%
- After 1<sup>st</sup> week, the test score will increase the most by 5%, then the weekly improvement will slow down gradually.
- By 5<sup>th</sup> week to 2%; 10<sup>th</sup> week to 1%, 20<sup>th</sup> week to 0.50%, and 30<sup>th</sup> week to 0.30%.

### **Discussion/Observations:**

First thing of note is the possibility of human error while taking the tests. Looking back on the control group testing, it's highly likely that each kid followed the answer given by the one before, as almost the whole test matches. There was only slight variation in the answers, as opposed to testing over the summer where kids were more independent.

The hardest thing for the kids to pick up was by far the Atari. This is possibly correlated to the Piaget's theory that at their age, they don't have an understanding of conservation. Though this theory is debated, the most likely explanation for this behavior stays within this basic concept.

Furthermore, by contracting abstract logic in the form of Go we are opening the eyes of the kids to a stage they shouldn't reach for another seven years (Formal Operational). On top of this, allowing visualization of Go stones and the board as a castle (exact word used when teaching) allows for better imaginative play, a concept stressed highly by Vygotsky and Erikson for internal development.

Also, there was specific improvement in the picture concepts and matrix reasoning subtests, showing that spatial reasoning and cognitive skills were developed strongly during the test period. Students began to respond faster as well, though I had alternating tests, possibly showing improved memory and better developed mental schemas.

Something I wanted to try to teach but didn't work very well was the concept of sacrifice. Only the eight year old (a sibling of one of the test subjects) understood losing something to gain more of another. This may be a result of egocentrism, or possibly related to pre-conventional moral reasoning, a theory of Kohlberg. Unless I praised them for losing a piece to gain points, they refused to let an Atari piece die.

As mentioned in the background, the primary focus of this simplified program was to induce logical thinking at a higher stimulation level than they would normally receive in a day to day basis. The few teachers and principle noted how they hadn't seen some of the kids that focused before, and how intriguing it was to watch each face contort trying to analyze what was going on. Kids who participated in this class also were much more engaged in the testing portion than those who were not part of the class.

An interesting detail I also observed was the ability to predict the personality of the student through observing his or her play style. I tried this with five or six students after a session once while Mrs. Keating stood by, and my predictions were on point more than 60% of the time. Definitely does not imply causation, but there may be some correlation that can be further researched into in some other project.

Mentioned in part of my original proposal, it was my hypothesis that my results could rival that of an ongoing chess study from the 1990's in a two year program that Chess caused a statistically significant increase in scores at the 0.001 level. If my test of a two month period with a small sample size (note: std was no higher than 6% producing a small variance) was

statistically significant at the 0.06 level, then a future study of even greater scale might produce a result with stronger causation than even that of Chess.

Also, the preschool requested I continue teaching the program as a normal afterschool activity for the kids, showing that with or without the results preschools would appreciate the deviation from the normal sports or arts and crafts activities. This not only helps them stand out more, but also, as proven, boosts stimulation and possibly intellectual growth.

**Photos of Testing:**

Image above is of me teaching basic counting and territory management.

Image below is of me explaining the test and administering it one by one.



**Conclusion:**

From quantitative and qualitative analysis, it can be concluded that enforcing Go into early education below the ages of five does have significant results. Instead of advertising into the teenage age group, it may be better to start employing teachers into preschools with the premise of increasing intellectual growth.

However, as stated before, the scale of the group studied and time period is not enough to directly prove any of the discussed theories, further research is needed to fully confirm this result and better help us understand the power of playing Go.

**About the Researcher:**

My name is Andrew Hong, and I am currently in my senior year at Palos Verdes Peninsula High school. I have played Go for about six years now, after picking up the game in China and reaching 15 kyu on my own. Then Kevin Chao took me in as his student, and I reaching 2 kyu under his wing. From there I've gone to win many awards in tournaments like Coffee Cup, Arcadia Southern California Tournament, and Go Congress. Go to me is more than just a game, it's a stress reliever, a way to clear my mind and get ready for any task ahead, small or large. I've won numerous top three awards at US Open, Coffee Cups, and SoCal Regionals.

**Go Club** - Teaching and event organization in my community that has contributed much cultural and intellectual value.

I have extended this club from just a small classroom club that meets once a month to a community wide organization that is affiliated with the Palos Verdes Library District, South Bay Chinese School, and even Mount Olive Lutheran Preschool. This includes the still ongoing year long classes every Saturday, where student attendance has gone from two kids and one adult to 6 kids and 2-3 adults. This started back before the library both at the South bay Chinese school for a year, and also at my own PVPHS for a year. As for the Go club at Malaga Cove, all my resources will be left there including my teaching material. I will leave a younger high schooler to look over the club, and allow the students to continue and come in to play against each other and receive critique from a strong player, though probably not as strong as me. I will visit every break I have from college to teach, so every 5 or 7 weeks. Parents have requested I keep the club running so when their children come of age I can hand the control down to them, and thus the cycle repeats.

**Go Research Project** - On top of my three years of teaching, I have conducted an 8 week long research project at the Mt. Olive Lutheran Preschool have concluded that Go does help significantly in Early Education (Developmental Psychology). The preschool has requested that programs continue throughout the school year, proving my work to be a success.

My other hobbies include heavy weightlifting and participating in academic competitions with my friends such as Bay Math League.

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**Appendix:**

Below is the original proposal.

The Go Project:

Effects of Mental Stimulation in Early Education (WPPSI Testing)

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Education plays a big role in our society, especially with growing technology, we find ourselves in greater need of smarter minds. The most important time for the development of critical thinking and creative problem solving is found in early education. While the brain of the child develops, it adapts to and absorbs everything that happens around him or her. Any hands on experience or other such mental stimuli do leaps and bounds for this process.

I'm looking to not only create a study that benefits the community and opens eyes to how powerful of a learning tool board games such as Chess and Go are, but also to try and work towards implementing a new type of curriculum, one that will better nurture the minds of our communities younger children as well as introduce them to a new and influential culture.

#### Chess in Education:

To prove this I will first use Dr. Robert Ferguson's research paper "Chess in Education". John Artise in "Chess and Education" states:

"Visual stimuli tend to improve memory more than any other stimuli;... chess is definitely an excellent memory exerciser the effects of which are transferable to other subjects where memory is necessary."

The first example of this came from a study by Albert Frank, "Chess and Aptitudes", this tested the hypothesis that the ability to learn chess would influence five aptitudes, spatial aptitude, perceptive speed, reasoning, creativity, and general intelligence. He also researched to find what extent this could be developed. After the confirmation of the initial hypothesis, many other researchers followed this line of thought. Most notable was "Chess and Cognitive Development" by John Christiaen. Conducted in Belgium, this was one of the most influential works used by Dr. Ferguson. Using ANOVA, there was a proven difference between the test and control group of fifth graders that was significant at the 0.01 level. From here, Dr. Ferguson funded his first study, "Developing Critical and Creative Thinking Through Class". This study became widely referenced by other researchers such as Dullea.

A study by Dianne Horgan, "Chess as a Way to Teach Thinking" in 1987 used 24 elementary school and 35 junior high students to find the correlation between grade and skill. The conclusion came out as elementary players scored among the top ranked players, leading to the possibility that children could perform tasks just as complex (cognitively) as most adults, given the chance to learn and evolve. Years after this several studies by Ferguson and Margulies showed a significant causation at the ( $P < 0.05$ ) levels.

So what does all this prove? It proves that stimulants like Chess end up scoring higher on aptitude tests (like the Piaget's Tests) and other significant factors. It accommodates all modality strengths, provides a punishment and reward system for problem solving, and creates a pattern of thinking that breeds success. On top of that, children love games. It motivates logical thinking, and if implemented in early education, it will greatly help development in the early stages of the brain.

#### Proposal of using Go:

Chess is undoubtedly a powerful learning tool. In America it is widely known and acclaimed to have numerous benefits. However, such a game has its downsides. All the pieces are already pre-positioned on the board, and all move in very specific ways. This rigid ruling sets

some limits creativity. On the other hand, Go is a board game with a much larger scale, and has no preset pieces. This freedom allows for the students to play around with less confinement and test all possible creative results to the best of their ability. Also, the need to memorize special movements is removed in Go, putting less mental stress on memorization and further stimulating the spatial ability of their brain. Another upside to using Go for this experiment is to help spread culture through Palos Verdes. Being a 30% Asian community, exposure to such a game would be beneficial.

As it has already been proved that using board games as stimuli helps significantly promote growth of cognitive abilities in the brain, my project will focus on a more direct and specific section. I hypothesize that Go will not only be able to produce results similar to that of Chess, but may also show greater causation. To do this I will use statistical methods of testing and involved data gathering. The objective will be finding a statistically significant increase in cognitive ability, and also to test if length of exposure matters.

There will be an improvement in counting and spatial ability, as well as shape/pattern recognition. Exposure over longer periods of time is more beneficial than the initial two months, and will show an increase in attention span and an improved memory. A long term goal is to try and generate donations/funding for an afterschool program. This way someday we can bring a team to compete at the US Open Go Congress.

#### Method's of Testing:

To start out, we need to find a sufficient sample size to produce consistent results. The plan is to reach out to preschools as well as churches and ask if I could teach for 2 hours of the day, one to two days a week.

Each session will go as follows. I will spend ten minutes teaching (or re-teaching) the basics. Then I will set up five boards. Hopefully, there will be at least ten students willing to join. After simultaneously playing with each of them for an hour, we will take a fifteen minute break. Then we will resume and I will give them a fifteen question test. After two months of this testing, I will use the recorded results to perform a test of significance.

The difference between this project and my own teaching at Malaga Cove Library is that we will only be using 9x9 boards. Because these students will be less committed to the game and more committed to just having fun and improving slowly, a 19x19 board would be too complex and ineffective. To keep them interested, using a smaller board is better.

Table of Project Milestones:

Date	Milestone	Description
6/13	Get Approval from School and Parents	This requires passage through the board, and getting enough students on board to participate
6/20	Initial Aptitude Test(s) and Introduction of Go	The first day shall be a brief test, and then letting students play around with the game, and gain interest.
6/27	Atari/KO	The first basic concept of go, this will help spatial and logical cognitive ability
7/3	Review day Mini Tournament	To ensure they learned the basic concepts, and allow for a bit of healthy competition to inspire motivation
7/11	Hane	A second basic concept of go, this will help with reasoning and creativity.
7/18	Review day Mini Tournament	Again, to review all concepts, make sure students are on track, and pitch them against each other again.
7/25	Counting	The most important skill, influences organization, general intelligence, and perceptive speed.
8/1	Final Tournament (Award)	American Go Association President (Andy Okun) will be present to give awards and talk to Parents about Go.

Conclusion and Publication:

If the results come out with significant evidence of improvement, then I will go on to create a research summary and an article showing the procedure, findings, and a visual indicator of the study ( histogram, bar graph, or LSRL line).

The final step is to find a magazine to publish my results. I look forward to working with the PVLD, and wish to further extend my resources and efforts for the good of our community. My last hope is that if Montessori agrees the program is helpful, then I can work towards implementing Go as a crucial part of pre-K curriculum in providing better results and a produce smarter brains for the needs of future generations.

Advisor:

Mr. Okun, President of American Go Association