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An Evaluation of the Effectiveness of the Khan Academy Videos for Teaching Mathematics at Menzi High School

Naman Barman
SIT Study Abroad

AN EVALUATION OF THE EFFECTIVENESS OF THE KHAN ACADEMY VIDEOS FOR TEACHING MATHEMATICS AT MENZI HIGH SCHOOL

Naman Barman

Advisor: Christine McGladdery

Menzi High School

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Abstract

The goal of this practicum is to evaluate the effectiveness of the Khan Academy videos as a tool for teaching Maths in a low-resourced school. The Khan Academy is a nonprofit organization based in California whose mission is to produce engaging videos for students to learn Maths, science, and other subjects. The Khan Academy videos have garnered more than 350 million views on YouTube and have thus proven to be a valuable learning tool for many students. This project analyzes the effectiveness of these videos for teaching Maths to Grade 9 students at Menzi High School, a low-resourced school in the Umlazi township of Durban.

For three weeks, students watched and learned Maths from the Khan Academy videos, which were displayed on a projector in the classroom. The videos chosen complemented their usual lessons in Maths and matched the school's educational curriculum, along with the South African education curriculum, so that students fulfilled the school's requirements. In the end, students were assessed with a short quiz after watching these videos to determine the effectiveness of these videos in teaching Maths. Student input on the Khan Academy videos was also taken by having students fill out a questionnaire.

The results indicate that the Khan Academy videos were effective for teaching simpler Maths concepts to students, but were not as effective for teaching more difficult Maths concepts. The results also convey that many students have a weak foundation in Maths, which might be influencing their ability to understand high level Maths concepts. Lastly, the results show that although students believed that the Khan Academy videos have certain flaws, they also believed that the videos provided a valuable learning experience for them.

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Introduction

Sir Kenneth Robinson is right: "Education goes deep with people, like religion and money." Robinson is an international leader in the field of education who came out with a popular TED talk on education systems worldwide (Robinson, 2007). In his talk, he argues that education is a fundamental part of human nature – and that education should feed peoples' spirits and passions. The importance of education is even seen in the Ottawa Charter for Health Promotion (1986), which states that education is a "fundamental condition and resource for health." In this manner, receiving a strong education is crucial not only for getting a diploma and job, but is also arguably a strong factor in determining one's health and quality of life.

Although education serves such an important role in our society, the South African educational system is regarded by many as one of South Africa's biggest failures. John Daniel (Feb. 2013) described education as "a national disaster," and the Africa Institute of South Africa argues that education "remains largely in a poor state of affairs" (Modisaotsile, 2012). Thus, because education is currently in such a broken condition, I became eager to try something innovative – to use short, engaging videos to teach students. The videos I would use are produced by a nonprofit organization called the Khan Academy, whose mission is to provide a world-class education in Maths, science, history, economics, and many other subjects. These videos are available online at www.khanacademy.org and are free for anyone to watch.

The Khan Academy project began in 2005 as an accident, when Sal Khan (the founder of the Khan Academy) uploaded a couple of videos onto YouTube to help his cousin learn about Maths. Other people around the world started watching his videos as well, and soon, Khan's videos were the first set of educational videos that were going viral on YouTube. Now, Khan and

his team have made it their mission to educate others through video, and his organization (the Khan Academy) has gradually gained immense popularity worldwide. Its YouTube channel has more than 350 million views, and the Khan Academy videos have also been successfully implemented in many high-resourced schools in the United States as a tool for teaching students (Khan, 2012).

With such a powerful tool in hand and significant educational problems in South Africa, I wanted to determine whether the Khan Academy videos could provide a rigorous learning experience for students even in a low-resourced, urban school in South Africa. For this reason, I decided to partner with a Grade 9 Maths teacher at Menzi High School in the region of Umlazi township, south of Durban, to use the Khan Academy videos to complement the teaching of Maths. The Umlazi township was established as a residential area for Black South Africans under the apartheid system. The school is low-resourced in terms of facilities and teachers. The average class size is 70 students, and all the students are Black, with most of them coming from low-income families. My hypothesis is that the Khan Academy videos can be an effective tool for teaching mathematics even in a low-resourced school like Menzi High School, and my project will test the validity of this hypothesis.

Ultimately, this project is relevant because it attempts to play a small role in solving some problems within the educational system in South Africa. Three weeks is clearly not enough time to determine whether the Khan Academy videos are an effective solution, but it will hopefully give some insight into the successes and failures of using these videos as a tool for teaching. Future studies can then be conducted to determine the validity of this model of education.

Methodology

Participants and Setup

208 Grade 9 students (ages 13-15) from Menzi High School in Umlazi participated in watching the Khan Academy videos to learn Maths. All students also took assessment quizzes over a three week period. The Khan Academy videos were displayed on a projector in the school's computer lab using the school's projector, a laptop, and speakers. Because the computer lab was shared with other teachers, students were not shown the videos every day. During the days when the computer lab was not available, students practiced Maths problems in their usual classroom. The following videos were shown to the students during the three weeks. These particular videos were chosen since they matched the requirements of the Grade 9 Maths South African educational curriculum (and were also requested by the Maths teacher).

Title of Khan Academy Video	Concept Covered (from S.A. Grade 9 Maths Curriculum)	Length of Video
Language and notation of basic geometry	9.3.1 Recognizes, visualizes, and names geometric figures and solids	12:57 (12 minutes, 57 seconds)
Lines, line segments, and rays	9.3.2 Describe interrelationships of properties of geometric solids (straight line geometry)	3:37
Language and notation of the circle	9.3.1 Recognizes, visualizes, and names geometric figures and solids	11:11
Angle basics	9.3.2 Describe interrelationships of properties of geometric solids (straight line geometry)	6:48
Complementary and supplementary angles	9.3.2 Describe interrelationships of properties of geometric solids (straight line geometry)	8:30
Angles at the intersection of two lines	9.3.2 Describe interrelationships of properties of geometric solids (straight line geometry)	7:18
Angles formed by parallel	9.3.2 Describe interrelationships of	7:06

lines and transversals	properties of geometric solids (straight line geometry)	
Triangle example 1	9.3.2 Describe interrelationships of properties of geometric solids (straight line geometry)	6:02
Triangle example 2	9.3.2 Describe interrelationships of properties of geometric solids (straight line geometry)	4:54
Triangle example 3	9.3.2 Describe interrelationships of properties of geometric solids (straight line geometry)	5:41
Equilateral and isosceles example problems	9.3.1 Recognizes, visualizes, and names geometric figures and solids	6:26
Introduction to angles (old)	9.3.2 Describe interrelationships of properties of geometric solids (straight line geometry)	9:56
Angles (part 2)	9.3.2 Describe interrelationships of properties of geometric solids (straight line geometry)	9:05
Angles (part 3)	9.3.2 Describe interrelationships of properties of geometric solids (straight line geometry)	9:48
Simple equations	9.3.3 Introduction to Equations	11:05
Linear equations 4	9.3.3 Introduction to Equations	7:39
Slope	9.3.3 Introduction to Equations	8:28
Taking percentages	9.3.3 Introduction to Equations	9:55

The Khan Academy videos are designed to be watched online at www.khanacademy.org. However, since Internet was not easily accessible at this school, these videos had to be downloaded offline beforehand. Videos were downloaded from a web site titled “Khan Academy on a Stick” (khan.mujica.org), which supports compact server solutions to play the Khan Academy videos offline. The Khan Academy on a Stick web site is licensed under a Creative Commons Attribution-NonCommercial-ShareAlike 3.0 Unported License, so the offline videos

can be used for anything except commercial purposes. All of the Khan Academy videos were downloaded and neatly stored on a 16 GB hard drive.

The Khan Academy videos were initially set up in the Maths classroom itself. The classroom had an outlet for plugging in the projector, and the school had a portable white board that could be used to display the video from the projector. However, the Maths classroom had many windows which caused too much sunlight to come into the classroom, which made it difficult to watch the Khan Academy videos. We attempted to temporarily cover the windows with black plastic paper, but because there were so many windows, this became a challenging task. The only classroom in the school which had very few windows was the computer lab, and thus, we decided to display the videos in that room. The computer lab was smaller than most classrooms with only about twenty chairs, so the majority of students had to stand while watching the videos.

Nonetheless, once this arrangement was figured out, setting up the videos became easy. The projector was plugged in to the outlet and connected to my laptop, which had all the Khan Academy videos compactly stored in a 16 GB hard drive. There were four windows in the computer room, but these were easily blacked-out by using small exercise books.

In this manner, students watched videos over the course of three weeks to complement their usual learning in the classroom. The videos did not replace teacher instruction; they simply served as an extra tool for teaching. In fact, the concepts covered in the videos would often have to be explained many times again in order for them to be truly internalized.

Case studies

To determine the effectiveness of the Khan Academy videos in teaching Maths, a case study was conducted. Students were shown one Khan Academy video on a topic they had never been taught in class, and immediately after watching the video once, they were given a short quiz. The quiz had three questions which aimed to test the concepts covered in the video. No questions were answered by me after the video was shown in order to ensure that my teaching would not influence the results.

Before watching the video, students were instructed that they would have a quiz on the video they were about to watch, and that this quiz was being conducted in order to determine the effectiveness of the Khan Academy videos. Students were informed that their names would not be published and that confidentiality would be maintained, but the data from their quiz results would be used as part of the study. Students were also told that they were not allowed to talk to other students while completing the quiz; however, they were allowed to use a calculator and any notes they wrote while watching the video.

This case study was conducted twice with two different topics. Of the 208 Grade 9 students, 69 students were in section 9A, 69 students were in section 9B, and 63 students were in section 9C. Thus, students were chosen by section: the 69 students from section 9A were shown the video titled "Slope," and the 63 students from section 9C were shown the video titled "Taking Percentages."

While teaching Maths to students during the course of the three week period, I also began to notice that many students struggled with basic arithmetic. For some, simple addition was still difficult; for others, multiplying fractions was difficult. Since these were concepts that students

were expected to know by Grade 9, these “gaps” in their Maths education were indirectly influencing their performance in Grade 9 Maths. Thus, to determine where these “gaps” lay for most students, I gave a short quiz on basic arithmetic to the 69 students in section 9B. This particular case study did not test anything regarding the Khan Academy videos; it simply aimed to look for where the major weaknesses lay in the students' Maths education.

Limitations of case studies

These two case studies (the Khan Academy video case study and the basic arithmetic case study) have many limitations. First, students were not randomly selected; they were simply chosen by which section they were in. Moreover, the sample has a very limited scope (Grade 9 students in Menzi High School) and so the results of this data can not be extrapolated to the population of all students in South Africa. The results can only truly speak to the effectiveness of these videos for Grade 9 students in Menzi High School; the study would have to include many more students from different schools in order to be extrapolated to a large range and have more validity.

Second, there are a variety of extraneous factors that may have influenced the results. For example, the Grade 9 Maths teacher mentioned that students had never been taught the concepts of “slope” and “taking percentages” before. However, it is possible that students may have learned these concepts through some other means, which would thereby confound the results. Another extraneous factor that may have influenced the results is cheating. Although students were informed that they had to complete this quiz on their own without any help from others, the quiz was administered in a small classroom where students sat very close to each

other (three students per table). Thus, the occasional peeking at someone else's paper and the occasional whispering could have been going on during the time of the assessment. Future studies should place students farther from each other during the administration of the quiz in order to minimize the risk of cheating. Ultimately, there is also small chance that some students did not understand the instructions since instructions were given in English with an American accent. However, the school does usually teach Maths in English, so the probability of this being a major extraneous factor is very small.

The questions within the case studies also have their own flaws. The quiz on the Khan Academy videos (slope and taking percentages) had only three questions each. Although this was done to ensure that I was not taking up too much class time to conduct my own study, three questions is clearly not enough to determine how well a student understood the concept. The questions were also written by me (the person administrating the quiz, and the person conducting the research study) and so there is inevitably some researcher bias in how the questions were written and administered. Nonetheless, despite these flaws and biases, this was the best I could have done given the circumstances I was in, and I do believe that the results of these case studies do hold some validity.

Lastly, the case studies do not have a control group to compare to. While I initially tried to arrange for a control group, the Maths teacher and I agreed that certain students would be missing out on a unique learning experience and that it would not be fair to these students. Many of these students were excited to watch the videos, and so we decided to show the videos to all three sections. However, the results of the case studies can be compared to the students' results from their last term paper, and I believe that this term paper will serve as a valid baseline for how

well these students usually perform on their Maths exams.

Questionnaire

In addition to these case studies, students were also asked to fill out a questionnaire at the end of the project to gain student feedback regarding the Khan Academy videos. In part one of the questionnaire, students were presented with five statements and were asked to rate how much they agree with each statement on a scale of one (strongly agree with statement) to six (strongly disagree with statement). In part two of the questionnaire, students were asked to answer two questions: what they liked about the Khan Academy videos, and what they did not like about the Khan Academy videos. The questions in part two were purposely designed to be more open-ended than the questions in part one in order to gain students' personal input. Students were given many examples to make sure that they understood how the questionnaire works.

The questionnaire also has its limitations. It only asks to rate five statements, which is not going to provide a comprehensive overview of the effectiveness of the Khan Academy videos in teaching Maths. Moreover, for many students English was not the first language they learned, so asking them to answer these questions in English may have been a challenging task and might have limited them from fully expressing their opinion. Nonetheless, the questionnaire does provide considerable insight into whether students understood the videos despite the language barrier, whether they gained a valuable learning experience, and how important education is regarded in their family.

Findings and Analysis

Overview of South Africa's education system

The South African government spends a large portion of the federal budget on its education system. In fact, the government spends more money on education (18.5% of the federal budget) than on any other area which government provides like health care, defense, and housing (Modisaotsile, 2012). With so much capital being poured in to the educational system, how come only 54% of students passed the 2012 National Senior Certificate for Grade 12 Maths (Motshekga, 2012)?

The latest publication of statistics by the government provides more insight into this question. The task of educating students largely rests on the shoulders of the government. There are approximately 12.6 million students in South Africa – of which about 11.8 million attend public schools. To serve so many students, the government has employed about 390,000 teachers in 24,000 schools, which results in a student-teacher ratio of 29.2 to 1, student-school ratio of 475 to 1, and teacher-school ratio of 16.3 to 1. Within South Africa, KwaZulu-Natal has the highest percentage of students, teachers, and schools (Education Statistics in South Africa, 2013). While the government can strive to make these ratios smaller, these ratios seem to be reasonably favorable for student learning on paper, for having 1 teacher for 29 students is a challenge, but it is not a completely unmanageable task.

However, in reality, it seems that the student-teacher ratio is far larger. At Menzi High School, there was an average of 70 students per teacher. When I asked the Head of the Maths Department whether this was unique to Menzi, she expressed that overcrowding is present in almost every school in Durban: “overcrowding is the norm, not the exception.” Thus, whether

the statistics published by the government match the reality of the situations in these schools is questionable, and makes one wonder where the money allocated for education actually ends up going.

Overview of Menzi High School

Menzi High School is classified as a "disadvantaged" school because it is given few resources by the government. There were no Maths textbooks provided for the Grade 9 students; they were only provided a notebook in which they could write down notes and homework problems. This made it difficult for students to learn and read at home, and students would often rely on class notes for learning their Maths concepts. Each classroom had a chalkboard and tables for students to sit at, but other than that, the resources within the classroom were limited (little electricity, no fan, no computers). The school had toilets, but toilet paper and soap was not provided by the school; students were expected to bring their own toilet paper and soap. Lastly, the school did not have a cafeteria. Local vendors would come and sell food during break time, but the majority of the food was unhealthy (hot dogs, cakes, chips, lollipops, fat cooks). Nevertheless, fruit was sold as well, which was a healthy snack for students to eat. These foods were cheap (2-5 rand) which made it affordable for students to buy.

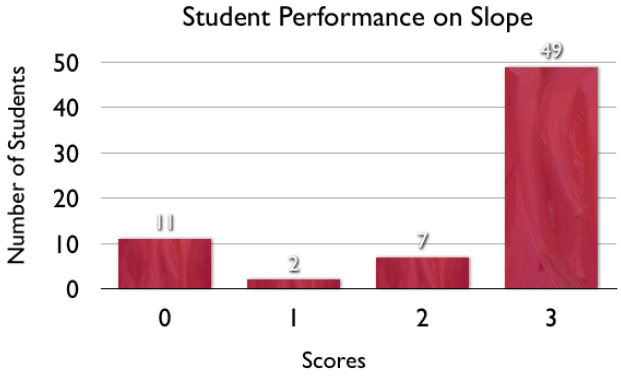
Despite this term "disadvantaged," the school had many advantages which I greatly admired. Every morning, the school would come together to sing a prayer or two, and the school would resonate with the sounds of students and teachers singing together. The school had a strong sense of community in that students could talk to many of their teachers about their personal problems. Students would respectfully greet their teachers, and teachers would greet their students. Many teachers worked tirelessly throughout the day (often teaching five periods

per day) and made it a point to go to class unless there was a meeting. However, there were many times when teachers were unable to attend class for some reason, and in that case students would just sit in class and wait for the time to pass. The principal was strict with his teachers and students, thus making it harder for teachers and students to fall behind. Overall, one of the biggest strengths of the school was that it provided a safe space for students to interact with one another, which was much safer than being on the streets.

Khan Academy Video Case Study

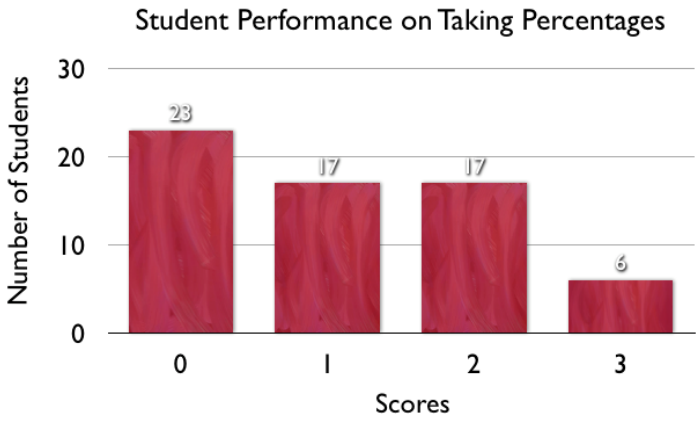
To determine the effectiveness of just the Khan Academy videos themselves in teaching Maths (without any extra teacher instruction from me or the Maths teacher), a case study was done in which the video on "slope" and "taking percentages" was shown and a quiz was given immediately after. This quiz had 3 questions (see Appendix 1 for specific quiz questions). Thus, a score of 3 would represent a perfect score; a score of 2 would be substantial; a score of 1 would be moderate; and a score of 0 would indicate that student did not understand how to calculate of slope at all. Student performance on the slope video can be seen in the graph and table below.

Mean	2.36
Median	3
Mode	3
Standard Deviation	1.12



From these results, it is evident that the majority of students understood how to calculate the slope. 49 out of 69 students answered all three questions correctly, and both the median and mode are 3 out of 3. At the same time, some students did not understand the concept of slope at all (11 out of 69 students).

The case study was repeated again with a different group of students and a different video. The video on "taking percentages" was shown this time, and student performance can be seen in the graph and table below. This quiz also had 3 questions (see Appendix 1 for specific quiz questions), and so the scores would represent the same level of proficiency as the last quiz.

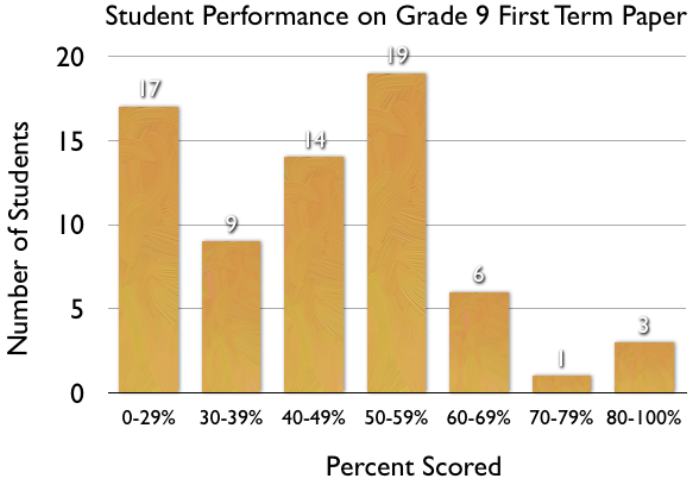


Mean	1.1
Median	1
Mode	0
Standard Deviation	1.01

In this study, students did not perform as well. The mode of the study is 0, and the largest portion of students (23 out of 63 students) scored a 0 out of 3. Very few students (only 6 out of 69 students) scored 3 out of 3.

The two case studies convey quite contrasting results, for students performed much better on the slope quiz than on the percentages quiz. This discrepancy can most likely be attributed to the level of difficulty of each video. Calculating slope is arguably an easier concept for most people than taking percentages. Since the videos were only shown once, understanding how to take percentages from just one view of the video was not easy for most students. Thus, the results indicate that showing a Khan Academy video once is effective in teaching a simpler Maths concept, but is not as effective for teaching harder Maths concepts. It is important to note that the students had not been taught the concepts of slope or taking percentages before, which is why these videos were chosen. Future studies should test whether showing the Khan Academy video more than once for harder Maths concepts is more effective. Perhaps the students needed to just watch it one more time, or perhaps the concept is simply too difficult for students to understand by watching a video.

A baseline that can be used to compare these case study results is the student scores from their Maths term one paper. This term paper was administered by the KwaZulu-Natal Department of Education to Grade 9 students at Menzi High School in March 2013. This term paper counts toward students' Maths grades, and thus serves a fairly good indicator for how these students have performed without having the Khan Academy videos as a learning tool. Many students also probably studied for this term paper (unlike the case study quizzes) and so their scores will most likely reflect the peak of their knowledge. The following table and graph display how well students performed.



Mean	44.5
Median	48
Standard Deviation	17.1

When analyzing this data, it is interesting to note that the qualification for passing is having a score above 30%. Through this lens, the results seem positive since 75% of the students (52 out of 69 students) did pass. However, the standard for passing has been placed fairly low, and makes one question whether these students really know enough Grade 9 Maths to move on to Grade 10 Maths. Does knowing 30% of the material in Grade 9 prepare someone for learning Grade 10 Maths? During a discussion with the Maths Head of Department teacher, she argued that this standard is too low (Makhaye, 2013). She mentioned that the standard for passing used to be 40% about five years ago, but recently it has been decreased to 30%. This may have been done to increase the pass rate without actually having to increase the quality of education. She believed that this standard is too low and 30% should not be qualified as passing. In the end, the reality is that only 10 out of the 69 students knew more than 60% of the material, which indicates that there is definitely a need for improvement. When comparing the results of the Khan Academy case studies to the results of the Grade 9 term paper, it seems evident that the Khan Academy videos might be an effective learning tool, especially in helping students understand the simpler Maths concepts.

Basic Arithmetic Case Study

Lastly, a case study was conducted to test students' performance on basic arithmetic questions. These are simpler questions that students should have learned in primary school (according to the Revised National Curriculum Statement Grades R-9); they include questions on basic addition, subtraction, multiplication, division, fractions, percentages, and decimals. For this quiz (see Appendix 1 for specific quiz questions), students were not allowed to use a calculator, talk to each other, or use any notes.

The results on this quiz were high: students averaged a 9.22 out of 11 questions, and the mode was 10 out of 11 questions. However, what is interesting is to analyze which questions were the most difficult for students, and the results indicate that question 6 and question 9 were challenging. Question 6 asked "what is 9/2 divided by 3/2" and only 59.2% of students answered this correctly; question 9 asked "what is 20% of 50" and only 52.1% of students answered this correctly. Question 6 tests the concept of dividing fractions, and having this "gap" of not knowing how to divide fractions can be detrimental to one's future Maths education; question 9 presents a simple percent problem, but again, many students struggled with this. This can partly explain why students did not perform well on the "taking percentages" quiz, which had questions on taking percentages in equations. And if a student does not even know how to take a percentage, it is difficult to expect him or her to know how to use percentages in equations.

This was one of the biggest complaints presented by one of the Maths teachers I had a discussion with at school one day – that Maths teachers are expected to teach high-level concepts to students who have a weak foundation in Maths. And once the gaps begin to accumulate, it

becomes even more difficult to learn Maths. For this reason, he argued that most students are scared of Maths, and as a whole, the school usually performs lower in Maths than on other subjects in the national exams (Ndwalane, 2013).

This weak foundation was most clearly obvious to me when I noticed that almost all students use their calculator to calculate very simple problems (like “5 minus 2” or “4 times 3”). The issue is that most students do know how to do these simple problems in their heads; however, they almost always choose to input these problems into their calculators. This dependency on their calculators for simple problems is another indicator of the weak Maths foundations many students have, which thereby makes it difficult to eventually learn harder Maths concepts.

Student Input from Questionnaire

Students' input on the Khan Academy videos as a learning tool was gained by having all 208 Grade 9 students fill out a questionnaire at the end of the program. The results from part one of the questionnaire can be seen in the table below. The rankings of the statements were from 1 to 6, with a rank of 1 indicating strongly agree and a rank of 6 indicating strongly disagree.

Statement	**Average Rank (from 1 to 6)**
1. I am able to understand Sal Khan's language (English).	1.5
2. I am able to understand Sal Khan's accent.	2.1
3. I believe that Sal Khan is talented at taking difficult concepts and explaining them in a simple manner.	1.9

4. I pay more attention watching videos by Khan Academy than listening to my teacher teach us in class.	2.5
5. Education is very important in my family.	1.4

The results from the first two statements show that the language barrier was not a significant problem for most students: most students understood English (average rank of 1.5) and Sal's American accent (average rank of 2.1) very well. Once this barrier is eliminated, the ultimate question to ask is whether students find Sal Khan to be an engaging teacher (question 3) and are able to pay more attention by watching his videos (question 4). The results from these statements indicate that the majority of students did believe that the Khan Academy videos are an effective tool for learning Maths. The last statement on the importance of education conveys that many students have a desire to learn, and they regard education to be important in their families. Thus, students are willing to learn; it is just that sometimes they are not given the right resources and opportunities for performing well.

In the second part of the questionnaire, students were asked to write about what they liked about the Khan Academy videos, and what they did not like. These questions were purposely left open-ended so that students could write their personal opinions. Each response was read, and the top three responses for both questions can be seen in the table below.

Top 3 Likes	**Top 3 Dislikes**
1. Explains difficult concepts really well (written by 34% of students)	1. Sal Khan talks too quickly (written by 37% of students)
2. Made me understand Maths (written by 18% of students)	2. It was hard to hear the videos (written by 19% of students)
3. Enjoyed listening to his voice and accent (written by 16% of students)	3. There was nothing I did not like about the videos (written by 18% of students)

The responses for the top three likes reinforce the results found from part one of the questionnaire: many students believed Sal Khan explains difficult concepts well (34%), helps people understand Maths (18%), and has a pleasant voice and accent (16%). However, the responses for the top three dislikes provide some interesting results which were not found from part one. The number one dislike was that Khan talks too quickly (37%), which was felt by a significant portion of students. This is one of the disadvantages of playing the Khan Academy videos on a projector, since everyone must watch the video together, and so students can not pause, rewind, or fast forward the videos unless they ask the teacher to do so. A future study could have students watch the videos separately on the computers so that they have the ability to control the pace of the video, and then test if this problem of Khan speaking too quickly still exists.

The second major dislike was that it was hard to hear the videos (19%). It is true that some students would often chat during the videos even though I would attempt to keep them quiet. Since the class sizes are so large, it is difficult to keep every student quiet. As a result, the occasional chatting in the classroom did indeed make it harder to hear the videos. One solution would be to use better speakers, or simply enforce a stricter policy of remaining quiet in the classroom.

The third major dislike was that there was nothing to not like. At first, I was going to not include this as a valid response to this question; however, the fact that so many students (18%) wrote this statement made me feel that it was important to include this answer. Whether these students were simply avoiding answering the question or truly felt that the Khan Academy videos

were an excellent learning tool is clearly up to interpretation.

Literature Review

Khan, Salman. The One World Schoolhouse: Education Reimagined. 12 Oct. 2012.

The One World Schoolhouse is a book written by the founder of the Khan Academy, Mr. Sal Khan, who outlines his vision for the future of education. Khan argues that the most effective form of education is an "on-demand, personalized education" where students can watch videos and do exercises at their own pace. This will reduce the number of "gaps" in students' education since students can go back and learn concepts if they need to and also reinforce difficult concepts by watching the videos more than once and doing more practice problems. Sal also argues why the Khan Academy videos are an effective tool. First, he notes that the average attention span of most people is about ten minutes. During these ten minutes, most people are fully tuned in, but after that time their focus begins to gradually diminish. Since the Khan Academy videos are on average about ten minutes in length, the amount of knowledge absorbed by people during this time is arguably higher than the amount of knowledge absorbed during hour-long lectures.

Second, and most importantly, Sal has a unique teaching style that seems to resonate with many people. Sal points out right away: "I teach the way I wish I was taught. The lectures are coming from me, an actual human being who is fascinated by the world around him." Perhaps it is for this reason that his YouTube channel has over 350 million views and is the most-watched educational library on the Internet. This book relates to this study since the Khan Academy videos were used as an educational tool, and this book provides evidence as to why these videos

are an effective solution. The book also outlines the potential of the future of education systems worldwide, which thus makes it valuable for future studies that wish to experiment with new ideas like an "on-demand, personalized education."

Education Statistics in South Africa. Department of Basic Education. Mar. 2013.

This document provides important statistics regarding the South African educational system. Almost all children attend primary school now (98% of South African children attend school), and the task of educating these students rests largely on the shoulders of the government. There are approximately 12.6 million students in South Africa – of which about 11.8 million attend public schools. To serve so many students, the government has employed about 390,000 teachers in 24,000 schools, which results in a student-teacher ratio of 29.2 to 1, student-school ratio of 475 to 1, and teacher-school ratio of 16.3 to 1. Within South Africa, KwaZulu-Natal has the highest percentage of students, teachers, and schools. When carrying out this study, these statistics were helpful in comparing Menzi High School to other schools in South Africa.

Modisaotsile, Brenda M. The Failing Standard of Basic Education in South Africa. Africa Institute of South Africa. Mar. 2012.

This document describes the failures within South Africa's education system. Modisaotsile cites studies which show that 20% of teachers in South Africa are absent on Mondays and Fridays, that students often repeat courses due to substance abuse, and that low levels of literacy and numeracy among students still exist today. Modisaotsile also suggests many policy recommendations. For example, drug awareness campaigns and sex education

should be part of the formal curriculum, teachers should receive better training and be given more incentives, and many more. Ultimately, this document is relevant to this study since it highlights the failures within the education system, and how the Khan Academy videos might be one of many solutions that is needed to make the education system have more successes.

Ottawa Charter for Health Promotion. World Health Organization. 21 Nov. 1986.

The Ottawa Charter for Health Promotion is a highly respected document in the field of health care. It is an international agreement signed at the First International Conference on Health Promotion in 1986, which states the basic requirements and necessities needed for nations to have effective health care. What is particularly interesting is that education is considered a "fundamental condition and resource for health." In this manner, this document reinforces the importance of education in our society. While many people believe that education is necessary to obtain a job in the future, this document argues that education goes far beyond that; it argues that education is vital for experiencing a healthy living and a greater quality of life. Education is a truly important aspect of humanity, and it is essential to remember this vision when carrying out research projects in the field of education.

Recommendations for Further Study

Future studies looking to analyze the effectiveness of the Khan Academy videos for teaching can do a variety of things to hold more validity and reliability. The study can be done with a larger sample size and with students from different schools who are randomly selected to participate in the study, for this would create a sample which could then accurately reflect its

population. If the school has access to a computer lab, then the study could have each student assigned to one computer where he or she can watch the videos individually, and then evaluate whether this solves the problem of the videos being too fast and hard to hear. In addition, if the school also has access to Internet, then the study could have students do the Khan Academy exercises online (in addition to watching the videos), which reinforce the material learned in the videos. Streaming videos online would use many megabytes per second, but completing exercises would not require many megabytes, and would thus may be an economically reasonable proposition.

Regardless of access to computers and Internet, the study should also design the quiz to have more questions and be written by a third party who has not seen the Khan Academy videos (to minimize researcher bias). The case study should also be repeated as many times as possible in order to test the reliability of the Khan Academy videos for teaching Maths. Lastly, it would be interesting to conduct this study at a primary school to determine if the Khan Academy videos are also effective for younger students. Since many students come to high school with a weak foundations in Maths and are unable to do basic arithmetic without a calculator, finding a reasonable solution for the lower grades would be extremely beneficial for the South African education system.

Students interested in conducting a future study at Menzi High School should work with Ms. Nkateko Chauke, the English teacher at Menzi High School. She is extremely proactive and helpful in making sure students get placed in the class they want to teach. She will also ensure that the school is a safe and comfortable environment to work in, and is thus a truly incredible resource to have during one's stay at Menzi High School.

Regarding recommendations for Menzi High School, the school should do its best to encourage students to not use their calculators for solving simpler Maths problems. The school might also want to consider having an after-school program which reviews basic arithmetic for students struggling with this. Lastly, the school should do its best to arrange for textbooks and give more homework problems to students, so that students can receive more practice. In the end, though, it is important to note that I was only at this school for three weeks, so my recommendations should be taken very lightly and with caution.

Conclusion

The goal of this practicum was to determine the effectiveness of the Khan Academy videos for teaching Maths in a low-resourced high school. From using a few simple technological tools (a projector, a laptop, and speakers), the Khan Academy videos were elegantly displayed during class time for Grade 9 students to watch and learn Maths from for three weeks. The videos complemented the usual lessons given by the Grade 9 Maths teacher and served as an additional learning resource for students.

This preliminary study on the effectiveness of the Khan Academy videos conveys many interesting results. The videos were effective for teaching simpler Maths concepts to students, but were not as effective for teaching harder concepts. This study only showed the video once to these students though, so perhaps the videos actually can be more effective if shown more than once or are presented with additional resources. Overall, students rated the Khan Academy

videos quite highly and claimed that they pay more attention watching videos by Khan Academy than listening to a teacher teach in class.

While this is only a short preliminary study, the results suggest that the Khan Academy videos do have a potential place in the South African education system. With a few adjustments, the Khan Academy videos can serve as an additional tool for providing a valuable learning experience for students. In the end, education should feed peoples' spirits and passions (Robinson, 2007) – for education truly is a "fundamental condition and resource for health" (Ottawa Charter, 1986) and a means for living a greater quality of life.

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Appendix A: Student Quizzes

Quiz on Slope

1. Calculate the slope between the points (2,4) and (3,8).
2. Calculate the slope between the points (5,7) and (4,1).
3. Calculate the slope between the points (3,3) and (5,5).

Quiz on Taking Percentages

1. What is 20% of 50?
2. What is 0.6% of 40?
3. 10 is 25% of what number?

Quiz on Basic Arithmetic

1. 13 + 29 =
2. 47 – 12 =

3. 9 x 5 =
4. 45 ÷ 9 =
5. 1/3 x 5/9 =
6. 9/2 ÷ 3/2 =
7. 0.2 x 60 =
8. 0.8 ÷ 4 =
9. 20% of 50 =
10. 18 x 41 =
11. 256 ÷ 8 =

Appendix B: Daily Logs

Day 1

- Presented my idea to Head of Maths Department, Maths teachers, and principal
- Project was approved
- Figured out logistical issues (what Grade to teach, how many classes per day, etc)
- Ate a delicious fat cook
- Time: 7 hours (7:15 A.M – 2:15 P.M.)

Day 2

- First attempt to show Khan Academy video
- Showed it in usual Maths classroom but unable to see the video since classroom was too bright and hard to see black background of Khan Academy video
- Tried to black out the classroom with black paper but that was still not very effective
- I felt bad that a whole period was wasted, but the teacher was not worried at all. She was very supportive. I told her I would try to figure something out.
- I walked around the school and looked for ideas about what I could do
- Realized that computer lab has only four windows and is thus a darker room (but smaller)
- Time: 7 hours (7:15 A.M – 2:15 P.M.)

Day 3

- Tried showing video in computer lab and it was much more successful
- Video quality was great but audio was sometimes hard to hear since students were often chatty during the videos

- Showed videos to Grade 9 – they were laughing and felt challenged
- Time: 7 hours (7:15 A.M – 2:15 P.M.)

Days 4, 5, 6

- Process was getting smoother
- Realized that videos were not enough though; I still had to review what happened in the videos and give them more practice problems
- Thus, videos served as a preliminary tool for teaching the Maths concept, which I then explained further with practice problems
- Time: 7 hours (7:15 A.M – 2:15 P.M.) each day → 21 hours total

Day 7

- Maths teacher lets me take over class and stops showing up. She spends her time grading papers and catching up on other work
- By now students are very familiar with me and are more excited to watch the Khan videos
- Maths is still confusing and scary for them, but it's getting better
- Time: 7 hours (7:15 A.M – 2:15 P.M.)

Days 8, 9, 10

- Other teachers start using computer lab as well, so I do not always get a chance to show videos
- Thus, I begin teaching Maths by hand using games. Student get extremely excited and make lots of noise as we play games. I have to make sure our class does not get too noisy so that other classes do not get disturbed.
- Playing games is effective in getting in more practice while still having fun
- I realize that students are dependent on their calculators. Even to solve a problem like "4 minus 2," they use their calculators. They love their calculator too much, and it's harming them from solving problems quickly and efficiently. Something is going wrong at basic primary level for teaching Maths.
- Time: 7 hours (7:15 A.M – 2:15 P.M.) → 21 hours total

Days 11, 12

- Showed Khan Academy videos to Grade 10 classes since teacher was absent.
- Still showed videos to Grade 9 students.
- Time: 7 hours (7:15 A.M – 2:15 P.M.) → 14 hours total

Day 13

- Had discussion with Head of Maths Department (Makhaye) about the low pass rate in South Africa. Pass rate used to be 40%, but recently it has moved down to 30%. Makhaye felt that this is an extremely low standard for passing, and is scared that people who only know 30% of their subject will be in charge of building bridges and computers

and working in the government. She believes pass rate should be much higher.
- Time: 7 hours (7:15 A.M – 2:15 P.M.)

Day 14
- Gave the offline Khan Academy videos to Teko (English teacher) so that students who want to continue watching the videos can do so on her laptop
- Showed the last set of Khan Academy videos
- Time: 7 hours (7:15 A.M – 2:15 P.M.)

Day 15
- Last day at school
- Said my goodbyes and thank you to the principal, teachers, and students
- Took pictures of school and students
- Time: 7 hours (7:15 A.M – 2:15 P.M.)

Total: 105 hours

Appendix C: SIT Study Abroad Statement on Ethics

(Adapted from the American Anthropological Association)
This document must be read, signed, and submitted to the AD prior to ethics review meeting.

In the course of field study, complex relationships, misunderstandings, conflicts, and the need to make choices among apparently incompatible values are constantly generated. The fundamental responsibility of students is to anticipate such difficulties to the best of their ability and to resolve them in ways that are compatible with the principles stated here. If a student feels such resolution is impossible, or is unsure how to proceed, s/he should consult as immediately as possible with the Project Advisor and/or AD and discontinue the field study until some resolution has been achieved. Failure to consult in cases which, in the opinion of the AD and Project Advisor, could clearly have been anticipated, can result in disciplinary action as delineated in the "failure to comply" section of this document. Students must respect, protect, and promote the rights and the welfare of all those affected by their work. The following general principles and guidelines are fundamental to ethical field study:

I. Responsibility to people whose lives and cultures are studied

Students' first responsibility is to those whose lives and cultures they study. Should conflicts of interest arise, the interests of these people take precedence over other considerations, including the success of the Independent Study Project (ISP) itself, for if the ISP has negative repercussions for any members of the target culture, the project can hardly be called a success. Students must do everything in their power to protect the dignity and privacy of the people with whom they conduct field study.

The rights, interests, safety, and sensitivities of those who entrust information to students must be safeguarded. The right of those providing information to students either to remain anonymous or to receive recognition is to be respected and defended. It is the responsibility of students to make every effort to determine the preferences of those providing information and to comply with their wishes. It should be made clear to anyone providing information that despite the students' best intentions and efforts anonymity may be compromised or recognition fail to materialize.

Students should not reveal the identity of groups or persons whose anonymity is protected through the use of pseudonyms.

Students must be candid from the outset in the communities where they work that they are students. The aims of their Independent Study Projects should be clearly communicated to those among whom they work.

Students must acknowledge the help and services they receive. They must recognize their obligation to reciprocate in appropriate ways.

To the best of their ability, students have an obligation to assess both the positive and negative consequences of their field study. They should inform individuals and groups likely to be affected of any possible consequences relevant to them that they anticipate.

Students must take into account and, where relevant and to the best of their ability, make explicit the extent to which their own personal and cultural values affect their field study.

Students must not represent as their own work, either in speaking or writing, materials or ideas directly taken from other sources. They must give full credit in speaking or writing to all those

who have contributed to their work.

II. Responsibilities to Hosts
Students should be honest and candid in all dealings with their own institutions and with host institutions. They should ascertain that they will not be required to compromise either their responsibilities or ethics as a condition of permission to engage in field study. They will return a copy of their study to the institution sponsoring them and to the community that hosted them at the discretion of the institution(s) and/or community involved.

III. Failure to comply
When the AD(s) feel that the student has violated this statement of ethics, the student will be placed on probation.
In the case of egregious violations, students can be subject to immediate dismissal under the conditions of the SIT STUDY ABROAD dismissal guidelines.

I, Naman Barman, have read the above Statement of Ethics and agree to make every effort to comply with its provisions.

Date: April 1, 2013

Appendix D: ISP Application for Review of Research with Human Subjects

Spring Semester 2013
School for International Training - Study Abroad
South Africa: Community Health, Program

Complete all questions (complete on separate pages where applicable, and staple to this cover sheet). Submit this document with your ISP proposal and related document to your Academic Directors.

1. Name: Naman Barman
2. Program: SFH Durban Social Policy and Community Health
3. Student Phone: 0837001337
4. Title of ISP: An Evaluation of the Effectiveness of the Khan Academy Videos for Teaching Mathematics
5. Site of ISP: Menzi High School
6. Funding Source, if any: 200 rand per day provided by SIT
7. ISP Advisor Name, Title, and Contact Telephone: Christine McGladdery, Biology Teacher, 079-880-4686
8. Brief description of the purpose of the study. Critically evaluate the effectiveness of the Khan Academy videos for teaching mathematics in a low-resourced, urban school.

Brief description of procedures relating to human subjects' participation:

How are participants recruited? And is an inducement offered?

I am partnering with a Maths teacher at Menzi High School to allow students to be part of this project. The project will not interfere with the school curriculum; instead, it will actually mirror the school curriculum so that students and teachers do not fall behind. No inducements will be offered.

What is the age range of the participants?

Students in Grade 9 to Grade 12 (ages 12-18) will be participating. The Grades will be selected by the Maths teacher so as to minimize disruption and provide the benefit as seen to be appropriate by the teacher in charge.

What is the gender breakdown of the participants?

Participants are both male and female, and should be roughly evenly distributed.

What are other relevant characteristics of subjects, including (but not limited to) institutional affiliation if any?

Subjects are students at Menzi High School and are mostly from the Umlazi area. Most subjects speak fluent English and will most likely come from low-resourced areas.

What is the number of participants?

About 50 students will participate in this study.

If there is a cooperative institution, how was their permission obtained?

Principal obtained from principal and Maths teacher.

What will subjects be asked to do, and/or what information will be gathered?

Subjects will be asked to watch the Khan Academy videos on Maths during class, and take tests on the material presented in the videos to determine the effectiveness of the videos.

If subjects are interviewed, who are the interviewers?

Subjects will not be interviewed. However, they will be asked to fill out a questionnaire at the end of the program about the Khan Academy videos in order to get their feedback.

In what language(s) will you interview participants? How will interpreters be paid?

Questionnaires will be in English. No payment will be given.

How will the interviewers be trained and paid?

I will be handing out the questionnaires, so no interviewers will be necessary for this project.

Protection of human subjects. Before completing this section, you must read and agree to comply with both the SIT Study Abroad Statement of Ethics, SIT Human Subjects Policy, and the program's additional Human Subject Research Guidelines.

12. Have you read and do you agree to comply with the SIT Study Abroad Statement of Ethics, SIT Human Subjects Policy, and the Human Subject Research Guidelines in the SCRHM course and handbook?

Yes.

13. Do subjects risk any stress or harm by participating in this research? If so, why is this necessary? How will these issues be addressed? What safeguards will minimize the risks?

Because subjects are minors and are part of an organization with conditions, there is managed

risk within the study. Students will be participating in an educational program which could potentially influence their Grades and future career. Moreover, the school has standards to meet, and so I must be cognizant of the Maths syllabus, school rules and expectations, and students' own expectations. Nonetheless, the risk is still quite minimal since I will be cooperating with a regular Maths teacher who has accustomed to the school's culture. Despite these risks, the study is expected to benefit the subjects since the benefits of learning Maths through the Khan Academy videos could potentially outweigh its cost.

Since this is an educational program, student scores will be collected and analyzed, which leads to the potential risk of compromising student confidentiality. However, student scores will not be publicized to other students or persons outside the school – they will only be seen me, the Maths teacher, and other administrators within the school who may need access to these scores.

This project is also going to present a unique approach to teaching, which may come across as challenging the original Maths teacher's way of teaching. The teacher will be safeguarded, though, by ensuring that the teacher will not be looked down upon for her methods of teaching. In fact, I will actually be collaborating with the teacher, so it will not be a "me" versus "the teacher" scenario; rather, we will work together to teach Maths to the students.

The principal and the school will also be safeguarded by ensuring that slanderous comments are not directly made toward them in my final paper and in the classroom setting. Lastly, anonymity of students, teachers, principal, staff, and the school will be maintained in my project. Different names will be used for all of these to ensure that the study poses as minimal risk as possible.

14. How will you explain the research to subjects and obtain their informed consent to participate? Append your Informed Consent Form.

    I will first explain to the subjects that the goal of this project is to determine the effectiveness of the Khan Academy videos for teaching mathematics to students. I will then tell the subject that he/she will be asked to watch the Khan Academy Maths videos during class, and then do short quizzes to determine their learning efficacy. Subjects will be informed that the scores on these quizzes may be given to the regular Maths teacher, which may or may not be used to determine their final Grades (depending on the teacher). I will also tell the subjects that I will be collaborating with the regular Maths teacher, so if there is any hesitation, they can always go their Maths teacher if they are not comfortable speaking with me. I will not be seeking parental consent, since I will be working with the teacher within the normal school curriculum. The teacher and principal are the professionals in charge of teaching and if they do not believe the proposal is likely to lead to good educational outcomes they will refuse to allow the project, thus fulfilling their mandate to parents and the government to always act "in the best interests of the child". The study is not of the children per se, it is of the effectiveness and usefulness of Khan videos as a teaching aid in a low-resourced school.

15. If subjects are minors or not competent to provide consent, how will it be obtained?

Although the project involves teaching the curriculum to minors, the minors themselves are not the subject of the study. The Khan videos are a teaching aid that the math teacher may choose to use if he thinks it may be effective, thus it is the teacher and principal who need to give consent. They will be asked to provide written consent for me to show the videos and administer and Grade the tests. They will also be asked to give consent to have the aggregated Grades used to determine the effectiveness of the videos.

16. How will subjects be informed that they can refuse to participate in aspects of the study or may terminate participation whenever they please?

The subjects here are the principal and the math teacher. The normal teaching process is not something students can opt in or out of.

17. If subjects are students or clients or program partners, how will you protect them from feeling coerced due to the (if only perceived) power differential?

Because I will be collaborating with a Maths teacher, I will act more like an assistant teacher in the classroom. Thus, the amount of power I exert will not be much as the teacher. Nonetheless, I will be cognizant of the space in which I am in, and be sure not to use my "power" to purposely hurt any individuals. I will do my best to be part of the group and adapt to the culture of the school so as to minimize the power differential.

18. How might participation in this study benefit subjects?

The study will help subjects learn mathematics for three weeks in an efficient and engaging way. The student will also make students aware of the Khan Academy's resources, which they can use in the future if they choose to do so.

19. Will participants receive a summary of results or other educational material?

    Each student will receive a summary of their own score and how much progress he or she has made during the course of the three-week program. Teachers and the principal will receive a summary of all the student scores, along with a copy of my final ISP project, so that they can determine the effectiveness of the program for themselves and whether they wish to continue running a program like this.

How will the following be protected?

a. Privacy (protecting information about participants): Refers to an individual and their investment in controlling access to information about themselves.) 50 – 100 words

Privacy of students, teachers, staff, principal, and all other people involved in the school will be maintained. I will not ask questions outside the scope of this project (about their family life, personal life, etc.). I will simply attend school to teach Maths and analyze student scores. Student scores will be put in the final ISP, but will be strictly put in as numbers and data without any attachment to students names.

b. Anonymity (protecting names and other unique identifiers of participants): Names should not be attached to the data, unless subject chooses to be identified. 50 words

Anonymity of students, teachers, staff, principal, and all other people involved in the school will be maintained. Their names will not be used in the ISP; instead, different names will be used to protect their privacy. Student scores, however, will be given to the teacher since the teacher will have to assess students' progress and give Grades to students.

c. Confidentiality (protecting data about participants): How is access to data limited? Consider how coding will kept separate from information obtained; how data will be stored and when will it be destroyed; whether data will be used in the future and, if so, how permission for further use will be obtained? 50 -100 words

Confidentiality of student scores will be rigorously maintained. Student scores will be collected and analyzed, but will be kept separate from student names. Data of scores will be stored on research's computer on Excel spreadsheet, but names will be destroyed immediately after all data is collected. If data needs to be used in the future, I will obtain permission from the school before doing so. If anyone asks about student scores and performance, I will not give out that information. I will not tell other students about each others' scores as well. My goal is to create a positive learning environment where every student feels that they can improve and be successful.

12. Are there any other details or procedures of the study that should be known by the ISP Ethics Review Committee, and if so, discuss. 1-1000 words

No.

By signing below I certify that all of the above information (and that attached) is true and correct to the best of my knowledge, and that I agree to fully comply with all of the program's ethical guidelines as noted above and as presented in the program and/or discussed elsewhere in program materials. I further acknowledge that I will not engage in ISP activities until such a time that both my ISP proposal as well as my Human Subjects Research application are successful and I have been notified by my Academic Directors to this effect.

Naman Barman
Student's name (printed)

Naman Barman
Student's name (signature)