IOSR Journal of Research & Method in Education (IOSR-JRME)
e-ISSN: 2320–7388, p- ISSN: 2320-737x Volume 10, Issue 5 Ser. III (Sep. – Oct. 2020), PP 39-48
www.iosrjournals.org

The Effectiveness of Khan Academy Videos in Teaching Mathematics at the first-year level of University

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Abstract:
A number of innovative approaches are being employed at the university level in an effort to improve academic performance in underprepared students especially in high risk courses such as Algebra, Calculus and Statistics. This study was designed to ascertain whether tutoring first-year university students with the aid of mathematics tutorial videos from Khan Academy is more effective than tutoring students in the traditional problem-solving demonstration and discussion approach and thus can be a plausible alternative teaching strategy that can be employed by universities to improve Mathematics performance among freshmen. Comparison of the mathematics performance of two groups ($N_1=N_2=29$) of first-year university students was done using independent samples t-test, one group being tutored by a professional tutor using problem solving demonstrations and discussions and the other group being tutored also by another professional tutor but with the aid of mathematics tutorial videos from Khan Academy. The researcher compared mean gains as well as mean retention of the two groups. Subjective feedback was also obtained from students in the group that was tutored with the aid of videos to determine how students felt about the use of mathematics tutorial videos and their effectiveness in helping them to learn mathematics content.
The data analyzed show that the mean gain and retention for students tutored in the traditional manner and those tutored using the video tutorials were statistically the same(comparison of mean gain: $t(56)=-.676$, $p=.502$; comparison of mean retention: $t(56)=-1.673$, $p=.100$. The use of mathematics tutorial videos from Khan Academy did not produce significantly better mathematics performance than traditional tutoring by a professional faculty member. However, students found the videos helpful.
***Key Words**: Mathematics Tutorial Videos, Khan Academy, First-year University, Mathematics.*

Date of Submission: 12-09-2020 Date of Acceptance: 29-09-2020

I. Introduction

In most universities, students in the first year of a bachelor's degree in science or computing are required to study some mathematics and/or statistics. Poor performance of freshmen science students in mathematics courses is a major concern for many universities. For example in several Australian universities students who opt to study the various sciences are placed into the same first-year mathematics and/or statistics classes as is the practice in most universities around the world. The result is that even though some students perform very well, a large proportion fails these first year mathematics courses. Most believe that the situation is worse than it was a decade ago, and all are concerned about the high failure rates (Rylands&Coady, 2009). This problem of poor performance in early university mathematics and in particular among science students is not unique to Australia only but a similar trend is observed in the United States, the United Kingdom, Ireland, Sweden, Hong Kong, and Guyana (Walker & Plata, 2000; Hoyt & Sorenson, 2001; Adelman, 2004; Amstrong& Croft, 1999; Kitchen,1999; Hourigan&O'Donoghue, 2007; Gill, O., O'Donoghue, Faulkner &Hannigan, (2010); Wilson &MacGillivray, 2007; Brandel, Hemmi&Thunberg, 2008; Luk, 2005).

Various measures of success with improving students' performance in and engagement with university level mathematics, particularly in the first year, have been investigated. Some focus on entrance qualifications and the correlation to performance in first-year university mathematics while others focus on strategies that could be employed while the students are already at university. This study engaged the problem of poor mathematics performance of first-year university natural sciences students employing the latter approach. It took the form of an action research utilizing mathematics tutorial videos from an online source, namely, Khan Academy. Its purpose is to determine whether learning mathematics at the first-year level of university using mathematics video tutorials is more effective than traditional tutoring by a faculty member.

Video and Multimedia Learning

Several theories of learning have examined the dual coding of verbal communication, including visual, auditory, or articulatory codes, and nonverbal communication, which may include shapes, sounds, kinesthetic actions, and emotions (Berk, 2009). The theories have been linked to multimedia and the research has tested various classroom applications. The following is a summary of pertinent research findings for the use of videos.

Multimedia Learning Theory

Over the past decade numerous studies have accumulated that investigated the effects of multimedia strategies on learning. Multimedia typically refers to the presentation of material in two forms: auditory/verbal and visual/pictorial. The strategies have included PowerPoint®, games, and computer-assisted video learning in a variety of content areas, in addition to auditory and video media (Berk, 2009). Mayer's (2001) cognitive theory of learning is activated through five steps: (1) selecting relevant words for processing in verbal working memory, (2) selecting relevant images for processing in visual working memory, (3) organizing selected words into a verbal mental model, (4) organizing selected images into a visual mental model, and (5) integrating verbal and visual representations as well as prior knowledge. His theory represents an amalgam of Chandler and Sweller's (1991) cognitive load theory, Baddeley's (1999) working memory model, and Paivio's (1991) dualcoding theory (Berk 2009).

The results of Mayer's research indicate that the contiguous presentation of verbal and visual material as in videos with integrated dialogue or narration is most effective for novices and visual learners. That is, the use of meaningful video clips in teaching may be most appropriate for introductory courses, introducing complex topics in any course, lower achieving students, and visual/spatial learners (Berk, 2009).

The empirical findings of research on the effectiveness of videos embedded in multimedia classes or modules are very encouraging. Numerous studies in specific areas such as teacher education have produced significant results favoring videos. However, research in other areas is sparse. Over the past four decades most studies have concentrated in the mental and physical health fields, especially psychology and psychiatry, counseling, and medicine. The only other areas that received moderate attention are political science and management/leadership (Berk, 2009) .

A sprinkling of applications has appeared in 10 other areas, including nursing , sociology, health intervention, interpersonal communication, visual literacy, critical thinking, writing, second-language learning, active learning, and multicultural diversity and sensitivity training (Berk, 2009).

All of these studies furnish instructions and descriptive or experimental evidence of the effectiveness of the video applications to college teaching. Overall, most of the investigations support the dual-coding theory that more is better: multimedia auditory/verbal and visual/pictorial stimuli increase memory, comprehension, understanding, and deeper learning than either stimulus by itself. Learning in the pictorial conditions tested (video and audiovisual) was superior to learning in the verbal (audio) conditions. This is consistent with the picture superiority effect (Berk, 2009).

Video and Mathematics Learning

In one research paper the authors lamented that in many mathematics classes video is hardly more often used than it was two generations ago, although the technology for delivering it has widened to include compact disks and the Internet. They contrasted the use of videos in the humanities with mathematics and concluded that mathematics educators seem to have neglected the medium. Yet they say that there are strong reasons for harnessing the benefits of video in teaching and learning mathematics; the most important is that video communicates on an affective as well as an intellectual plane, to change students' ideas about the nature and utility of mathematics. So they suggested that at a time when fewer students are interested in studying mathematics and some of the brightest seem to be using the subject to get the high marks needed for entry into medicine or law, mathematics educators need to do as much as we can to increase interest in the subject (Petocz& Wood, 2001).

In the aforementioned research paper Petocz and Wood (2001) elaborated on the subjective feedback received from students about their perceptions of the use of mathematics tutorial videos. In the paper they indicated that they trialed video segments for videos that they were making with groups of secondary and university students (and sometimes groups of teachers) and evaluated the completed videos. They have also used focus groups of secondary students and teachers to make comparisons between videos of different styles. They have asked a large group of first-year university students to view several videos and write an essay discussing the role of video in mathematics education. The comments from these sources yield some insight into what students learn from video.

There was evidence that seeing the video clips had an immediate effect on some students' attitudes. Petocz and Woods found that students respond positively to real or realistic situations, especially when these situations were of interest to them and presented in an entertaining way. They also liked computer graphics and

visual presentations. Students responded negatively to a fast pace, to high background noise level and to a lack of perceived mathematical content. They felt that it was important to have written materials to back up the video. Some features polarised people's reactions, the most obvious example being the use of humour, liked by some and hated by others. Generally, teachers and students concurred in their impressions. However, there was one interesting disagreement. When they showed an excerpt from the first video in the Against All Odds series to a group of mathematics head teachers, they felt that it was too frenetic and would not appeal to students. Yet the video-clip pace and style evoked a more positive response from the students: in fact it was their favourite. Petocz and Wood thought that this is an important finding, because it is usually the teachers who select the material, and they could unwittingly censor some materials that appeal most strongly to students. Many of the students' reactions are congruent with principles of good teaching and learning. Their comments and overall positive response show that well-made video-based materials can successfully aid learning in mathematics. One particular feature of video is the variety of teaching and learning styles that they encourage. They also found that it is hard to please all students all the time (Petocz& Wood, 2001).

In summary, all of the studies considered furnish descriptive or experimental evidence of the effectiveness of the video applications to college teaching. Overall, most of the investigations support the dual-coding theory that more is better: multimedia auditory/verbal and visual/pictorial stimuli increase memory, comprehension, understanding, and deeper learning than either stimulus by itself. Learning in the pictorial conditions tested (video and audiovisual) was superior to learning in the verbal (audio) conditions (Berk, 2009) .

However the researcher would like to draw attention to the insufficiency of research to measure the impact of videos at the university level in the area of mathematics education. Petocz and Wood (2001) lamented the limited use of videos in mathematics education both at the secondary and college levels.

Khan Academy

Khan Academy is an online learning platform started by a former hedge fund manager, Salman Khan in 2006, with the stated mission of "changing education for the better by providing a free world-class Education for anyone, anywhere". Khan Academy offers more than 5,500 instructional videos—of which approximately 3,500 are about math. Details about the many other features of Khan Academy can be found at https://www.khanacademy.org/about. (Light & Pierson, 2014).

Khan Academy in Schools

One study (Murphy, Gallagher, Krumm, Mislevy&Hafter, 2014) examined how Khan Academy and a group of California schools collaborated to pilot innovative approaches to teaching and learning in classrooms. The study found a positive association was found between more Khan Academy use and more problem sets completed and two outcomes: (1) improvements in student test scores, and (2) improvements in three of the four self-reported non- achievement outcomes – math anxiety, math self-concept, and academic efficacy (i.e., belief in one's ability to succeed in academic endeavors) (Murphy et al., 2014).

There is interest in using Khan Academy as a tool to improve education in the developing world. However, there is a lack of research around the use of Khan Academy outside the United States. A research study by Light & Pierson (2014) sought to explore the use of the Khan Academy in a developing country context. Academy. Their research is an exploration of the ways in which Chilean mathematics teachers are integrating Khan Academy into their lessons and how that use is impacting teaching and learning (Light & Pierson, 2014).Since the Chilean schools are only using Khan Academy in mathematics, they limited their focus to math teachers.The mathematics teachers described positive effects on student learning (Light & Pierson, 2014).

The two studies on the use of Khan Academy in America and Chile indicated that the large repository of mathematics tutorial videos and tools of Khan Academy holds much promise of impacting positively on the mathematics performance of elementary and high school students. But what about the impact of these videos and other tools of Khan Academy on the mathematics performance of early university students? The researcher in this study recognized this need and wanted to begin investigations into the effectiveness of Khan Academy at the level of early university. In this particular study the focus will be on the use of the tutorial videos alone and not on the other tools provided by Khan Academy. In time those will be investigated as well.

Relevant Questions being addressed in the Study

1. How does the gain of students tutored with the aid of mathematics tutorial videos from Khan Academy compare to the gain of students tutored by a faculty member in the traditional manner using problem solving demonstrations and discussions?
2. How does the retention of the students tutored with the aid of mathematics tutorial videos from Khan Academy compare to the retention of students tutored by a faculty member in the traditional manner using problem solving demonstrations and discussions?

3. What are the impressions of students of Khan Academy mathematics tutorial videos?

II. Material And Methods

The study involved a quantitative and qualitative approach. The quantitative part of the study followed the Pretest-Posttest Control Group Design. While the data for a qualitative assessment of the outcomes employed the use a questionnaire.

Participants

The study had 58 first-year calculus students registered at the University of Guyana in the academic year 2015-2016.

Experimental Treatment

The treatment consisted of ten two-hour tutorial sessions during which mathematics video tutorials from Khan Academy website were played for the students to view and then they were required to complete a worksheet provided beforehand by the lecturer. The students could have requested that the videos be stopped or replayed to clarify their understanding of the subject matter being discussed. They were allowed to ask relevant questions and these were answered by replaying parts of the videos and the lecturer supplementing the explanations given. The sessions lasted five weeks. The tutorials for the control group were taught by a faculty member, and these sessions were primarily problem solving demonstrations and discussions. These sessions were of the same duration as the treatment. The control group were provided the same worksheets as the treatment group to complete. All students benefitted from a weekly one hour lecture during which the topics for the week were introduced and worksheets were provided.

Instruments for collecting Data

There was a pretest before treatment was administered. The posttest was divided into ten quizzes that were administered at the end of each tutorial session. There was also a retest that was administered during the conduct of the study. The test was constructed by the researcher. It consisted of 30 multiple choice questions (see appendix 2). There were also a questionnaire that was used to collect subjective feedback from students in the treatment group (see appendix 3).

The Procedure

1. Permission was sought from the registrar of the University of Guyana as well as from the students to conduct the study by the researcher.
2. Pretest was administered the first week of semester by the researcher to all students in the study.
3. All students were randomly placed by the researcher into two groups – control and treatment. Equivalence of groups based on scores in the pretest was ensured.
4. In the second week tutorial sessions began and continued until the sixth week. The Quizzes were administered after each tutorial session. The posttest score for each student was the total score for all quizzes done. Attendance at sessions were recorded for all students.
5. A retest was conducted in the 8th week of the semester. The questionnaire for students of the treatment group was given to be completed at the end of the retest.

III. Result

Pretest Comparison of Control and Treatment Groups

Before treatment begins an independent t-test comparison of the pretest mean scores of the control group and the treatment group was conducted to ensure that the control group and the treatment group were equivalent i.e there is no significant difference between their mean scores in the pretest. The tables below show the results of this test:

Table 1

Pretest Group Statistics

	Group	N	Mean	Std. Deviation	Std. Error Mean
PretestScore	Control Group	29	7.5172	2.45852	.45654
	Treatment Group	29	7.2759	2.23442	.41492

Table 2

Test for Equivalence of Control and Treatment Groups based on Pretest Scores

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Pretest Score	Equal variances assumed	.114	.737	.391	56	.697	.24138	.61692	-.99445	1.47721
	Equal variances not assumed			.391	55.496	.697	.24138	.61692	-.99470	1.47746

The independent samples t-test for a difference of means at the 95% confidence level, shows that the null hypothesis (i.e the assumption that means of the two groups are equal) is not rejected ($p=0.697 > 0.05$). Therefore, there is no significant difference between the means of the control and the experimental groups according to this t-test. Therefore the two groups were equivalent at the beginning of treatment.

Posttest Comparison of Control and Treatment Groups

To answer the first research question:

1. How does the gain of students tutored with the aid of mathematics tutorial videos from Khan Academy compare to the gain of students tutored by a faculty member in the traditional manner using problem solving demonstrations and discussions?

The following analysis was conducted:

After the posttest the gain of each student in the treatment group and control group was calculated by finding the difference between their pre-test and post-test scores. A comparison of the mean gain for the treatment group and the control group was analyzed for any difference of means using an independent samples t-test comparison. Here are the outputs from SPSS 20:

Table 3

Posttest Descriptive Statistics for Control and Treatment Groups' Gains

	Group	N	Mean	Std. Deviation	Std. Error Mean
Gain Scores	Control	29	10.4828	4.28969	.79658
	Treatment	29	11.3793	5.71598	1.06143

Table 4

Independent Sample t-test of Control and Treatment Gains

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Gain	Equal variances assumed	1.681	.200	-.676	56	.502	-.89655	1.32709	-3.55503	1.76193
	Equal variances not assumed			-.676	51.944	.502	-.89655	1.32709	-3.55962	1.76652

The independent samples t-test for a difference of means at the 95% confidence level, shows that the null hypothesis is not rejected ($p=0.502 > 0.05$). There is no significant difference between the mean gain of the control and treatment groups. Therefore, there is no difference in the mean gain of students tutored using Khan Academy video tutorials and those tutored by a faculty member.

Comparison of Retention of Control and Experimental Groups

The answer the second research question:

2. How does the retention of the students tutored with the aid of mathematics tutorial videos from Khan Academy compare to the retention of students tutored by a faculty member in the traditional manner using problem solving demonstrations and discussions?

The following two sets of analyses were performed:

1. After the retest the retention of each student in the treatment group and control group was calculated by finding the difference between their pretest and retest scores. A comparison of the mean gain (now referred to as mean retention) for the treatment group and the control group was analyzed for any difference of means using an independent t-test comparison.

2. The Pearson's correlation coefficient between gain and retention for the control group was calculated. The same was done for the treatment group. The rationale for this step is because means could be distorted by extreme values and the previous t-test comparison may not be able to indicate the relationship between gain and retention for individual students in the two groups.

The output from SPSS 20 is as follows for the first step:

Table 5

Retest Descriptive Statistics for Control and Treatment Groups' Retention

	Group	N	Mean	Std. Deviation	Std. Error Mean
Retention Scores	Control	29	8.9310	5.50280	1.02184
	Treatment	29	11.3448	5.48554	1.01864

Table 6

Independent Sample t-test of Control and Treatment Retention

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Retention	Equal variances assumed	.000	.992	-1.673	56	.100	-2.41379	1.44284	-5.30415	.47656
	Equal variances not assumed			-1.673	55.999	.100	-2.41379	1.44284	-5.30415	.47657

The hypothesis test for a difference of means at the 95% confidence level, shows that the null hypothesis is not rejected ($p=0.100 > 0.05$). So the independent samples t-test for a difference of mean retention between the control and treatment groups indicates that there is no significant difference between the means of the control and the experimental groups' retention. Therefore, there is no difference in the mean retention of students tutored by a peer tutoring program and those tutored by a faculty member.

The output from SPSS 20 is as follows for the second step:

Table 7

Pearson's Correlation Coefficient for Control Group Gain and Retention

Correlations			
		Control Gain	Control Retention
Control Gain	Pearson Correlation	1	.781**
	Sig. (2-tailed)		.000
	N	29	29
Control Retention	Pearson Correlation	.781**	1
	Sig. (2-tailed)	.000	
	N	29	29

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

The correlation coefficients r = .781 for the Control group is significant (p=0.01) and indicate a strong positive correlation exist between the gain and retention for this group of students. This means that the gain and retention scores for the control group are strongly related and therefore one is a good predictor of the other. It means that a student with a low gain score will most likely have a low retention score and conversely a student with a high gain score will most likely have a high retention score.

Table 8

Pearson's Correlation Coefficient for Treatment Group Gain and Retention

Correlations

		Treatment Gain	Treatment Retention
Treatment Gain	Pearson Correlation	1	.742**
	Sig. (2-tailed)		.000
	N	29	29
Treatment Retention	Pearson Correlation	.742**	1
	Sig. (2-tailed)	.000	
	N	29	29

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

The correlation coefficients r = .742 for the Treatment group is also significant (p=0.01) and similarly indicate a strong positive correlation exist between the gain and retention for this group of students. This means that the gain and retention scores for the treatment group are strongly related and therefore one is a good predictor of the other. It means that a student with a low gain score will most likely have a low retention score and conversely a student with a high gain score will most likely have a high retention score.

The researcher used Fisher's method (1921) to compare these two correlation coefficients calculated above for any significant difference. The hypothesis tested and the formulae used are stated below:

Two Independent Samples

H∅: $\rho_1 = \rho_2$

$$r' = (0.5)\log_e\left[\frac{1+r}{1-r}\right]$$

Second, compute the test statistic this way:

$$z = \frac{r_1' - r_2'}{\sqrt{\frac{1}{n_1 - 3} + \frac{1}{n_2 - 3}}}$$

Third, obtain *p* for the computed *z*.

Using an online program that employed this formula the researcher obtained the following results:

Table 9

Significance of Difference of Pearson's Correlation Coefficient

Sample A		Sample B		
r_a =	.781	r_b =	.742	Reset
n_a =	29	n_b =	29	Calculate
z =	0.34			
P	one-tailed	0.3669		
	two-tailed	0.7339		

(Lowry, 2016)

(Lowry, 2016)

The p-value (p = 0.7339 > 0.05) indicate that the two correlation coefficients are not significantly different for the two groups of students. Therefore retention by one group is not greater than the retention of the other.

In summary both of these correlation coefficients (.781 for Control group and .742 for Treatment group) are significant (p=0.01) and indicate a strong positive correlation exist between the gain and retention for both groups of students. This additional analysis complements the t-test result that relies on means which can be distorted by extreme values of a few students. Also t-test analysis of difference of mean retention of the two groups does not reveal the relationship between gain and retention for individual students in each of the two groups but the correlation coefficient does. So the strong positive correlation gives the researcher much insight between gain and retention for individual students in any one group. The strong correlation coefficients calculated for each group means that a student with a low gain will most likely have low retention and a student with a high gain will most likely have a high retention irrespective of the group they are in.

Subjective Feedback From Students

A questionnaire was used to elicit from students subjective feedback to be able to shed light on the third research question:

3. What are the impressions of students of Khan Academy mathematics tutorial videos?

The first part of the questionnaire sought to get their views on the video and audio quality of the tutorial videos. The responses were graded as follows: Very Poor (VP), Poor (P), Fair (F), Good (G), Very Good (VG).

Table 10

Student Feedback on Audio and Video Quality

Item	Response/Number of Students				
How would you rate the quality of the video and audio?	VP	P	F	G	VG
Video	0	0	12	14	3
Visibility	0	3	7	12	7
Audio	0	0	7	18	4
Volume	0	0	10	13	6

The responses show the majority of students thought that the audio and video was of good quality.

The second part of the questionnaire sought to elicit from students how they felt about the videos. The responses to this section of the questionnaire indicate a bias that the students found the videos to be interesting, informative, and helpful and that they thought that it contributed to them doing better in the course. However they did not find it to be enjoyable.

Table 11

Student Impressions of Videos

Item	Response/Number of Students				
	Not at all	Somewhat	Fairly	Interesting	Very Interesting
Were the videos interesting?	1	7	8	10	3
	Not at all	Somewhat	Fairly	Enjoyable	Very Enjoyable
Were the videos enjoyable?	3	5	16	5	0
	Not at all	Somewhat	Fairly	Informative	Very Informative
Were the videos Informative?	0	0	10	15	4
	Not at all	Somewhat	Fairly	Helpful	Very Helpful
Were the videos helpful?	0	3	10	11	5

IV. Discussion

This study was in response to the poor performance of freshmen science students in mathematics courses in many universities. In view of the trend of poor mathematics performance among first-year university students this study sought to compare the mathematics performance (in Calculus) of a batch of first-year Natural and Agricultural Science students tutored by a faculty member in the traditional manner using problem solving demonstrations and discussions to those that were tutored also by a faculty member but with the use of Khan Academy mathematics tutorial videos. It was designed to determine whether learning mathematics using the latter strategy produced greater gains and/or retention than being tutored by a faculty member using the traditional method. The researcher also wanted to find out how students felt about the mathematics tutorial videos from Khan Academy.

The data analyzed show that the mean gain and retention for students tutored in the traditional manner and those tutored using the video tutorials were statistically the same. The findings of the study in American Elementary and High Schools by Murphy et al. (2014) made claims of achievement gains. However these gains were associated with more Khan Academy use and more problem sets completed on the website. Therefore since just the tutorial videos were used in this study there is no contradiction in the findings of this study and the one by Murphy et al (2014). What this study is clearly indicating is that the use of the mathematics tutorial videos apart from the other tools and resources of Khan Academy did not produce significantly greater achievement gains than traditional teaching. However the aforementioned finding indicate that Khan Academy tutorial videos could be embedded within the traditional instructional practices thus creating a varied yet equally effective learning environment.

Further rigorous research using more of the Khan Academy tools and resources in combination with the tutorial videos are certainly needed to adequately evaluate the effectiveness of Khan Academy on Mathematics performance at the elementary, high school and the university level since the studies in the American and Chilean Elementary and High schools (Murphy et al. 2014; Pierson& Light, 2014) were implementation not evaluation studies. The authors of those studies clearly acknowledged that they did not conduct a rigorous evaluation of Khan Academy's impact on learning during the study period of the American study, including any use of randomized control trials, which would have required Khan Academy tools and resources to remain unchanged during the study and for teachers and students to use Khan Academy the same way. Instead Khan Academy was principally used as a supplementary tool—not as the core primary curriculum—so the effects of Khan Academy cannot be separated from those contributed by other elements of the math curriculum (Murphy et al., 2014).

As regards the impressions of students of the Khan Academy video tutorials; they found them to be informative and helpful but not enjoyable. In both the American and the Chilean studies (Muphy et al., 2014; Pierson & Light, 2014) reported that the use of Khan Academy resources were very helpful to both teachers and students. Therefore the subjective feedback from students corroborate the findings in those studies.

V. Conclusion

In conclusion, the findings in this study have led the researcher to conclude that for this population (First-year University of Guyana Berbice Campus Natural and Agricultural Sciences students of 2015-2016) the use of a mathematics tutorial videos from Khan Academy did not produce a significantly better mathematics performance than the traditional tutoring by a professional faculty member. However the students did find the videos helpful.

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