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Is There A Difference In Motivation And Mathematics Self-Efficacy Among Online Mathematics Instructional Video Viewers

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Introduction

Instructional videos featuring animated problem solving are one of the most helpful supplemental educational tools for students struggling with mathematics (Höffler & Leutner, 2007; Bolliger & Supanakorn, 2011). They are effective, inexpensive to produce, and increase understanding, while at the same time decreasing anxiety (Papa, Seaberg, Rees, Ferguson, Stair, Goldfeder, & Meurer, 2008). Students are viewing animated and previously recorded live demonstration videos from sites like Khanacademy.org, which is specifically developed for the purpose of providing high quality instructional videos for STEM (science, technology, engineering and mathematics) subjects. Their growing library of 3500 videos are designed with such quality that a learner anywhere in the world could develop a high school level math and science education, solely using this website (W. Bender, personal communication, December 13, 2011). YouTube.com also has an educational section (containing instructional/educational videos only) which provides content for every level of school, from Pre-Kindergarten to post-secondary and more. YouTube.com/education has channels like Khanacademy, with more than 12 million views; Sesame Street, getting over 18 million views; Spacelab, getting over 28 million views, and many more. PatrickJMT, one YouTube provider, has over 100,000 subscribers boasting over 45 million views and only focuses on high school mathematics.

However, despite the massive number of available and watched instructional videos, there are still significant numbers of students failing mathematics courses (Peterson, Hannushek, & Riddel, 2011). The millions of hits indicate that large numbers of learners are using their technology, cell phones, laptops, and tablets, to watch instructional videos before, during, and after class. The millions of views also indicate that many students realize that they need help and support to be successful in mathematics courses (Pell & Croft, 2008). Yet, there are significant numbers of students who fail to seek assistance which results in academic failure; this is especially true for minorities (Spencer, 2012). For instance, the current Georgia high school graduation rate is only 67.4% (Badertscher, 2012) and 20% of all US students who go on to college are defined as mathematically underachieving (Planty, Hussar, Snyder, Provasnik, Kena, Dinkes, Kewal-Ramani, & Kemp, 2008).

In an attempt to stop this academic decline, school systems, like Georgia's Fulton County, are converting to an all charter school district and moving toward the more rigorous and relevant Common Core Standards (Dodd, 2012). Also, educators are planning instruction which develops 21st Century Skills (Bellanca & Brandt, 2010). Utilization of these skills challenges teachers to create practical as well as relevant academic lessons, classroom activities, and coursework for the purpose of creating better future college students and/or workers, by focusing on critical thinking, analysis, synthesis, and application (Rongjin, Yeping, & Xiaoya, 2010). Science, Technology, Engineering, and Mathematics (STEM) based businesses are banding together to help encourage students to make better decisions in school now, so that they can make better pay and receive greater benefits in the future (Cashman, 2012). But experts say that the problems with under-skilled Mathematics students will only get worse (Morrison, DeRocco, Maciejewski, McNelly, Giffi, & Carrick, 2011).

Researchers have studied various characteristics that motivate students to use instructional technology (IT) in general, but the results are currently inconclusive and inconsistent and not specific to instructional videos. There have been studies on the relationship between IT's level of perceived benefits and its frequency of usage; that is the more helpful and beneficial a person thinks IT is, the more likely they are to use it (Kraut, Rice, Cool, & Fish 1998). One researcher says that there has not been enough study on the individual differences that are associated with a person's adoption of technology (Vishwanath, 2005). Particularly in education, there is little understanding as to what traits influence a student's adoption of technology (Bassilli, 2006).

The efficacy (Höffler & Leutner, 2007; Bolliger & Supanakorn, 2011), availability (Bender, 2011), and accessibility (Selleck, 2010) of mathematics instructional videos is established and/or known, but there still exists a substantial population of students who are foundering in mathematics (Badertscher, 2012). Why do some students view online mathematics instructional videos? What is the difference between students who watch these highly advantageous online mathematics instructional videos and those who do not? The goal of this study was to attempt to identify if there were some differences in motivation and mathematics self-efficacy between students who are viewing and learning from online mathematics instructional videos and those students who are not.

Participants in this proposed study included suburban high school students to determine if there were differences in motivation and self-efficacy between viewers and non-viewers of online mathematics instructional videos. Studies have been conducted on learned helplessness and test anxiety (Akca, 2011), as well as motivation and student achievement (Bude, Van de Wiel, Imbos, Candel, Broers, & Berger, 2007). There have also been studies on instructional videos as academic support tools (Höffler & Leutner, 2007), but no study focuses specifically on differences between viewers and non-viewers of mathematics instructional videos. Results of this study may help further the understanding of the characteristics, mindset, and dispositions of mathematics instructional video viewers beyond basic demographics, which may result in better marketing, development, authoring, and production ideas, therefore increasing mathematics instructional video appeal and consequently, increasing the audience as well.

Literature Review

According to Peterson, Hannushek, and Riddel (2011), 68% of students in the United States are not proficient in mathematics and may benefit from the resources and flexibility offered by online resources like instructional videos. However, despite millions of students having access to these resources, the lack of proficiency in mathematics remains. Currently, 20% of all American post-secondary students are enrolling in remedial mathematics coursework (Planty, Hussar, Snyder, Provasnik, Kena, Dinkes, Kewal-Ramani, & Kemp, 2008). Minorities, especially African Americans, are also greatly disadvantaged in regards to mathematics education, to the extent that 50% are low-achieving (Spencer, 2012). Experts warn American secondary, collegiate, and post-graduate educators that students are being passed on with increasing mathematical deficiencies (Wenner, Burn, & Baer, 2011).

Technology Access and Availability

Although instructional videos are not a cure all, they are helpful and prolific. Instructional videos offer key convenience and control aspects, like pausing and rewinding, resulting in their high value as support resources/supplemental tools (Höffler & Leutner, 2007; Bolliger & Supanakorn, 2011). In terms of availability, a simple YouTube search yields almost 1600 videos on a topic like “solving systems of equations elimination”. Whether you search for “law of cosines”, “distance rate time word problems”, or “Pythagorean theorem”, the number of quality results is at least in the hundreds. In other words, there are more than enough mathematics instructional videos available for students to use (Bolliger & Sopapakorn, 2011). Thanks to the Internet, these supportive resources are easily accessible and essentially universally available, exemplifying a concept in learning called “proximity” (Redmond, Thomas, High, Scott, Jordan, & Dockers 2011). The better/closer the proximity of supplemental materials are to a student working on a task, the more anxiety is reduced, because "proximity" is necessary for deep learning and required for academic success (Harel, 1998; Newby, Stepich, Lehman, & Russell, 2006).

Via YouTube alone, it is clear that there are enough instructional videos available. However, students may not have the technology to access them. Currently, the proliferation of technology is growing at an exponential rate, particularly with mobile or portable devices. Tablets, netbooks, laptops, and notebooks are out-selling desktops currently 2 to 1, and in just three more years are expected to reach consumer levels of as high as 9 to 1 (Selleck, 2010). Students are not just using Blackberrys, Apple, Windows Mobile, and/or Android devices solely for entertainment purposes, but increasingly, students are understanding that these handheld devices are highly helpful and convenient educational tools which enhance their learning experience (Song, 2011). Therefore, it is clear that students have the technology to access these powerfully effective mathematics instructional videos (Dreon, Kerper & Landis, 2011). With companies like Comcast providing $10 home internet for students who qualify for free/reduced lunch and/or free Wifi (Seward, 2013a; Seward, 2013b), and companies like Google proliferating free Wifi hotspots all over the country (Etherington, 2013), accessibility may no longer be an issue.

Classroom Instructional Videos Usage

In modern classrooms, students are using technology in and out of class more and more due to the rising popularity of flipping classrooms (Wilson, 2013). Flipping a classroom requires students to gain basic foundational knowledge, information, and skills at home, primarily via online instructional videos, and then come to class ready to apply that knowledge/skills with the help and guidance of the teacher (Lasry, Dugdale & Charles, 2013). The traditional instructional model entails gaining new skills with guidance and applying them to more difficult situations and problems at home without guidance; the flipped classroom is the opposite. Bloom's lower level acquisition and recall occur at home without help, and then analysis, synthesis, and application occur in the classroom with help (Myo-Kyoung, Patel, Uchizono, & Beck, 2012).

The flipped classroom's lynchpin, the online instructional video, helps mathematics teachers by freeing up more classroom time for application rather than concept identification and process repetition. The careful incorporation of online mathematics instructional videos helps teachers focus on higher order/critical thinking skills, advanced problem solving techniques, and provide students with better in class activities such as problem-based and project-based learning (Degrazia, Sullivan, Carlson L, Carlson D, 2001; Rongjin, Yeping, & Xiaoya, 2010; O'Brien, Wallach, & Mash-Duncan ,2011) . Thus, the effective utilization of online instructional videos can help educators provide students with a relevant mathematics education that is useful inside of the classroom and also applicable to the real world (Gasser, 2011).

Motivation and Mathematics Self-Efficacy

What variables could affect online mathematics instructional video viewing? One such variable, reluctance or lack of motivation, has been linked to student failure (Hirvonen, Tolvanen, Aunola, & Nurmi, 2012). Motivation, intrinsic or external, can take many different forms and compel a student to take responsibility for his/her failure and subsequently take action to improve his/her grade. Motivation refers to the drive, rationale, and/or energy directing an individual’s actions, behaviors, and efforts (Martin, 2008; Yau, Kan Man, Chen Alison Lai, 2012). This drive or rationale can originate from within a person (intrinsic) or from without (external).

Extrinsic motivation to succeed mathematically could include knowing that there are literally hundreds of thousands of jobs available for educated and technologically skilled Science, Technology, Engineering, and Mathematics (STEM) workers (Cancino, 2012; Cashman, 2012; Clabaugh, 2011). Parental and peer pressure, another form of extrinsic motivation, can also push students to do better in class (Aziz, Akhtar, & Hassan, 2013). Also, intrinsic motivation can have a significant impact on academic achievement (Ayub, 2010). Especially since a person's innate need to understand phenomena and personal ambitions, keys to academic achievement, have roots in intrinsic motivation (Deci & Ryan, 1985).

Another variable which could affect student viewing of online mathematics instructional videos could be self-efficacy. Self-efficacy refers to a person’s belief in his/her ability to succeed or achieve goals (Briley 2012), especially when there are barriers which could impede a person’s success (Tschannen-Moran & Woolfolk Hoy, 2001). In other words, people with high self-efficacy not only believe they can succeed in normal/everyday tasks, but even when something is perceived as difficult or more challenging, such as complex mathematics assignments, a student with a high level of self-efficacy will try anyway, due to strong confidence in their own capability.

A similar concept, which aids in the understanding of self-efficacy, is a person’s locus of control. This locus of control refers to whether an individual believes the key factors or determinants for his/her outcomes are outside or inside of his/her control or influence (Zaidi & Mosin, 2013). Thus a person with a high level of self-efficacy or internal locus of control believes that he/she is the key to success or controlling outcomes, resulting in high self-esteem (Bedel, 2012). A student’s level of self-efficacy when high can push them towards action, such as viewing online instructional mathematics videos, or if low, could prevent them from taking action to seek assistance in mathematics, a key to success in such a rigorous subject (Silinskas, Niemi, Lerkkanen, & Nurmi, 2013). Specifically, mathematics self-efficacy refers to an individual's ability to understand and utilize mathematics with confidence, inside and outside of the classroom (Briley, 2012).

Summary

Given that online mathematics instructional videos are established as effective supplemental instructional tools (Kay & Edwards, 2013) and students have the means to access the videos (Dreon, Kerper & Landis, 2011), it is worth researching to determine why mathematics proficiency is still waning in the United States (Peterson, Hannushek, & Riddel, 2011). There are thousands and thousands of available quality online mathematics instructional videos that can help students develop the STEM and technological skills that universities and the new workforce are requiring, but students are not taking advantage of this resource. "We can bring students their education and put it on a silver platter right in front of them, but if they don't want it, they're not going to eat it. How can we make our students crave it? How can we get them motivated and passionate about learning again?" (Mackie, 2012, p. 1). The animated and multimedia presentation of online mathematics instructional videos accommodate many different learning styles and therefore is a very effective instructional tool (Farooq & Regnier, 2011), and educators and content producers need to understand the characteristics of viewers and non-viewers of online mathematics instructional videos. Therefore this study attempted to answer the following three research questions:

1. Is there a difference in intrinsic motivation among online mathematics instructional video viewers?

2. Is there a difference in extrinsic motivation among online mathematics instructional video viewers?

3. Is there a difference in mathematics self-efficacy among online mathematics instructional video viewers?

This quantitative study was aimed to provide insight into motivation, mathematics self-efficacy levels, technology access, and online instructional videos viewing habits to determine if there are any differences between viewers and non-viewers of online mathematics instructional videos. Whereas previous studies have examined differences in instructional videos (Höffler & Leutner, 2007), motivation and student achievement (De Castella, Byrne, & Covington, 2013), technology access and student achievement (Harter, C. & Harter, J., 2004), and self-efficacy and student achievement (Bjornebekk, Diseth, & Ulriksen, 2013), this study will attempt to determine relationships between these variables. Discovering a difference in mathematics self-efficacy, motivation, and technology access will enable educators, content producers, webmasters, parents, school staff, and/or any vested individuals to be better able to increase viewership by tailoring marketing and content presentation.

Method

Participants

There were 118 students who participated in this study. Of the 118 participants, 83% were Black/African American, 8% were Mixed, 7% were Hispanic/Latin American, and 1% were White/European American. The racial breakdown of the school was 94% African American, 5% White/European American and Hispanic [data does not separate the two], and 1% Asian/Pacific Islander. In regard to participant socio-economic status (SES), 71% received free lunch, 14% qualified for reduced lunch, 24% paid full price for lunch, and 2% reported that they did not know. The overall school SES data was 62.8% free and 13.2% reduced, with a total student body of 537, as of fiscal year 2012 (Georgia, 2012). In regards to this study, there were 25 Freshmen (21%), 31 Sophomores (26%), 33 Juniors (28%), and 29 Seniors (25%) who participated. Lastly, 55 respondents (47%), were males and 63 (53%) were female.

This study took place at a small suburban Title 1 public charter school in South Fulton County Georgia. The English for Speakers of Other Languages (ESOL) percentage was 1% (Martin, 2011). The high school has been a Title 1 institution since its inception. Title 1 status indicates that a school receives special federal funds to address the needs of disadvantaged students (US Department of Education, 2004). There was no specific feeding neighborhood as this school is not zoned for any district. Students from all over Metro Atlanta can attend the school as long as they have transportation. The population of Metro Atlanta, Georgia was 54% African American, 36.3% White/European American, 5.2% Hispanic, 3.1% Asian and 1.4% Other (US Census, 2010). The study took place Spring 2014, the high school's fifth year of existence. The school has made AYP each year it has been eligible for measurement.

All students taking any of the following mathematics courses, Honors Pre-Calculus, Advanced Mathematical Decision Making (a new Common Core Georgia Performance Standard (CCGPS) math course), Math III, Analytic Geometry, and/or Coordinate Algebra, had the opportunity to participate in the study. This population contained special needs students, ESOL, free and reduced lunch students, regular, and honors kids, so an accurate cross-section of the total student body was represented.

Instrument

Data was collected via an online questionnaire, Appendix E, totaling 44 questions. The first section of the questionnaire, *Demographics*, gathered general data such as sex, race, grade level, and free, reduced, or full-price lunch status (Spencer, 2012; Thoron & Meyers, 2011). The researcher pilot tested the instrument with current and former high school students of different ethnicities, classification, as well as Individual Education Plan (IEP), and regular students. Changes made as a result of pilot testing was the addition of 'Don't Know' to the free reduced and full-price lunch status and 'Mixed' to the Race/Ethnicity question. The following were changes were also made in terms of modifying the *Online Mathematics Instructional Video Viewing* section of the instrument after pilot testing. The phrase ”[videos] outside of class, which were not shown/assigned by your math teacher” was added to the self-response questions regarding online mathematics instructional video viewing. This change helped to differentiate between videos watched because students were mandated by the teacher and videos students found and viewed via their own reconnaissance and effort. For example, “How many online mathematics instructional videos have you ever viewed?” was changed to “How many online mathematics instructional videos have you ever viewed outside of class, which were not shown/assigned by your math teacher?”

The *Online Mathematics Instructional Video Viewing* section gathered basic data on internet access, academic technology usage, mathematics technology usage, and specifically, viewing frequency of online mathematics instructional videos. Only item 5, which measures online mathematics instructional video viewing, was used for scoring. The other questions (6, 7, 8, 9, 10, and 11) were to provide anecdotal data. Higher scores indicate a higher frequency of online mathematics instructional video viewing. More information and discussion will follow in the "Analysis" section.

The *Intrinsic and Extrinsic Motivation* section was from Dr. Shawn Glynn, Professor of Science at the University of Georgia (UGA). This section contained 20 items covering intrinsic motivation and self-determination and extrinsic motivation in the form of grade and career. There was also a short self-efficacy portion as well, which is omitted for this study. Table 1 displays the items key, questions 11, 13, 15, 16, 20, 21, 23, 24, 25, and 27, measured intrinsic motivation, while questions 12, 14, 17, 18, 19, 22, 26, 28, 29, and 30 measured extrinsic motivation. The instrument was reliable and valid and can be delivered online. With a Chronbach's Alpha of 0.93 for internal validity and a Confirmatory Factor Analysis providing loadings in the moderate to high range, the instrument was reliable and valid (Glynn, Brickman, & Taasoobshirazi, 2009; Glynn, Brickman, Armstrong, & Taasoobshirazi, 2011). The higher scores on the instrument represent higher levels of that specific type of motivation. The instrument, while developed for Science, has been proved valid and reliable for other majors/disciplines and the word 'Science' was substituted for 'Math' in accordance with the instrument guidelines (Glynn, 2011). For example, 'Knowing Science will give me a career advantage' was changed to 'Knowing Math will give me a career advantage''.

Table 1

Categories for Questionnaire Items

Categories	Item Number
Intrinsic	11, 13, 15, 16, 20, 21, 23, 24, 25, 27
Extrinsic	12, 14, 17, 18, 19, 22, 26, 28, 29, 30
Mathematics Self Efficacy	31-44

The *Mathematics Self-Efficacy* section of the questionnaire was from Dr. Diane May, Professor of Mathematics at Shorter University. This section contains 15 items, was reliable and viable for online administration as demonstrated by a Cronbach's Alpha of .93 (May, 2009). The instrument, originally measuring mathematics self-efficacy and mathematics anxiety, established concurrent validity using Mathematics Self-Efficacy Scale (Betz & Hackett, 1983) and Mathematics Anxiety Rating Scale, short version, (Suinn & Winston, 2003), as such each of the two portions was valid on its own. The instrument was specifically designed for mathematics self-efficacy, so no modification was necessary. The pilot version or "Section II" was only utilized for this study. The full version, which included "Section I", contained questions applicable to college student and demographic data, i.e. UGA Math Placement Exam scores, number of high school math classes, and math classes required to graduate in your major. These questions were not applicable for this usage. The omission of "Section I" was not a determinant of the instrument's validity or reliability, as the validity of the self-efficacy portion was established via the scoring of the 15 mathematics self-efficacy items alone (May, 2009). Since this study only focused on mathematics self-efficacy, the anxiety items will not be included or scored. Higher scores on the self-efficacy items indicate higher levels of mathematics self-efficacy (MSE). Though there was a small self-efficacy portion in the Glynn "Motivation" instrument, it was not as thoroughly tested and validated as the May instrument. The May instrument required no rewording, was validated by two other Mathematics Self-Efficacy tests, MSES and Betz & Hackett, and was also longer, resulting in a more specific, accurate, and reliable test.

The combined/modified questionnaire was pilot tested multiple times by former and current high school students resulting in a questionnaire which required no more than ten minutes to complete and was mobile device compatible. All pilot testers indicated that the questions seemed to ask the same thing, just reworded. They also reported that the items were easy to understand. Also, in an effort to ensure that all participants are fully informed, electronic links to the parental and informed consent forms, as well as the assent form were included at the top of the questionnaire. Moreover, there was also the inclusion of a required question asking "Have you and your parents (minors) or you (age 18+) signed and returned the appropriate assent/consent form(s)?" This question must have been answered in the affirmative 'yes', to have proceeded with the questionnaire. The online questionnaire link could be found here: http://tinyurl.com/kzr25vd.

Procedure

Three days prior to opening the questionnaire for responses, the researcher submitted an informative morning intercom announcement regarding the study. The announcement was as follows:

> "Please help (researcher name) meet his graduation requirements by completing a brief online questionnaire. There is no obligation, penalty, or compensation for participation. If you have any questions or concerns, please visit his classroom or go to 'tinyurl.com/mcck5hs', that is 'tinyurl.com/mcck5hs' for more information. Thank you."

During this time, the researcher also spoke to the math teachers, instructing them to give consent forms (Appendix C) to students 18 and older, and the other two forms, Minor Assent and Parental Consent Forms (Appendices A and B) to all other students. The researcher let the educators know that they can place completed forms in their locked desks and then the researcher collected them at the end of the day and transferred them to the researcher's personal locked desk or file cabinet. Additionally, the researcher asked them to use an announcement similar to the one above and answer questions if any were raised. These instructions were also emailed to the instructors.

After those two days of preparation and informing potential participants, the questionnaire was available for two weeks. The researcher continued to request that the morning intercom announcement be made on Tuesday and Thursday to remind students to complete the questionnaire and posted flyers concerning the project (Appendix D). Data collection then began.

The researcher also, with permission from administrators and teachers, visited classrooms during his/her planning and lunch period each day to answer questions, as well as helped people find and take the questionnaire. The researcher finally submitted a different 'thank you and reminder' announcement on the last day the online questionnaire was available.

> "Thank you very much to those who have already participated in (researcher's name) research project. Today is the final day the online questionnaire can be completed, so please complete the questionnaire as soon as possible. Remember, there is no obligation, penalty, or compensation for participation, and if you have any questions, please visit his/her room or visit 'tinyurl.com/mcck5hs', that is 'tinyurl.com/mcck5hs' for more information. Thank you again."

During this entire time, the researcher and/or the Georgia Southern faculty supervisor were available to answer any queries via email, in person (for the researcher), or by phone, during the preparation and data gathering phases, approximately 17-21 days.

Data Analysis

A one way ANOVA test was conducted to test each of Research Questions 1-3. The ANOVAs investigated if there were differences in each of the dependent variables, intrinsic motivation, extrinsic motivation, and mathematics self-efficacy, for different levels of online mathematics instructional video viewing. The scoring of the dependent variables were as follows: intrinsic motivation (10 to 50), extrinsic motivation (10 to 50), and mathematics self-efficacy (14 to 70). As indicated previously, higher scores indicated higher levels of each variable. The single independent variable, online mathematics instructional video viewing frequency (Item 5) was scored (1 to 5). The categories for video viewing were as follows, Never; Rarely, less than once a month; Sometimes, 1-2 a month (once a month); Often, 3-5 a month (about one per week); Usually, 6 or more a month (more than one per week).

Results

This section reports the quantitative data from the questionnaire responses. One important change in the study, which had to occur, was the combination of the top two categories for instructional video viewing. Of the 118 participants who shared their online mathematics instructional video viewing habits, there were 43 who “never” viewed, 32 who “rarely” viewed, 32 who “sometimes” viewed, 4 who “often” viewed, and 7 who “usually” viewed videos. Table 2 shows the “often” and “usually” categories being combined in order for the statistical tests to be valid, applicable, and more reliable. This amassing resulted in an online mathematics instructional video viewing top tier category which now had a total of 11 entries.

Table 2

Item 5 (Online Mathematics Video Viewing) Entries

Original		Modified	
Rank	N	Rank	N
Never	43	Never	43
Rarely	32	Rarely	32
Sometimes	32	Sometimes	32
Often	4	Often	11
Usually	7		

The first research question sought to determine if there was a difference in intrinsic motivation among online mathematics instructional video viewers. Intrinsic motivation and video viewing was tested using ANOVA. Table 3 presents the descriptive statistics for intrinsic motivation by video viewing category.

Table 3

Descriptive Statistics for Intrinsic Motivation by Video Viewing Categories

					95% Confidence Interval for Mean	
Category	N	Mean	Std. Deviation	Std Error	Lower Bound	Upper Bound
Never	43	31.7674	7.11416	1.08490	29.5780	33.9569
Rarely	32	30.4688	7.45301	1.31752	27.7817	33.1558
Sometimes	32	34.3125	7.79759	1.37843	31.5012	37.1238
Often	11	39.9091	5.50372	1.65943	36.2116	43.6065
Total	118	32.8644	7.67047	.70612	31.4660	34.2628

Table 4 shows the presence of a statistically significant difference in intrinsic motivation among viewers of online mathematics instructional videos (F=5.342**, p=.002).

Table 4

ANOVA Summary Table -- Intrinsic Motivation and Video Viewing

Source	*SS*	DF	*MS*	F	p
Between	848.403	3	282.801	5.342**	.002
Within	6035.427	114	52.942		
Total	6883.831	117			

Table 5 shows that the actual differences in intrinsic motivation were between students who never viewed and often viewed (p=.007), as well as students who rarely viewed and students who often viewed (p=.002), each at the .01 significance level. There was a large difference of 8.14 points in the intrinsic motivation of those who never viewed instructional videos and those who often viewed them. Those 8.14 points account for 16.28% of the total possible score on this instrument's intrinsic motivation scale. The 9.44 point difference in intrinsic motivation between those who rarely viewed videos and those who often viewed them was even larger at 18.88%. It is important to note that the distinction occurred between the two lowest and highest categories, indicating that largest differences in intrinsic motivation seemed to be related to larger increases in video viewing.

Table 5

Post-Hoc Analysis, Bonferroni. Intrinsic Motivation and Video Viewing

Dependent Variable	(I) Videos	(J) Videos	Mean Difference (I-J)	Std. Error	Sig.
Intrinsic	Never	Rarely	1.29869	1.69872	1.000
		Sometimes	-2.54506	1.69872	.821
		Often	-8.14165**	2.45849	.007
	Rarely	Never	-1.29869	1.69872	1.000
		Sometimes	-3.84375	1.81904	.221
		Often	-9.44034**	2.54311	.002
	Sometimes	Never	2.54506	1.69872	.821
		Rarely	3.84375	1.81904	.221
		Often	-5.59659	2.54311	.179
	Often	Never	8.14165**	2.45849	.007
		Rarely	9.44034**	2.54311	.002
		Sometimes	5.59659	2.54311	.179

*. The mean difference is significant at the 0.05 level.
**. The mean difference is significant at the 0.01 level.

The second research question examined extrinsic motivation among online mathematics instructional video viewers. In Table 6, it is shown that there was no statistically significant difference in extrinsic motivation among viewers, (F=2.118, p=.102). In Table 7, again, it should be noted that although the cross-section of students who often view videos was smaller, there was a more accurate mean in terms of standard deviation. Also, the overall standard deviation (SD) of extrinsic motivation scores was lower than the SD of intrinsic motivation.

Table 6

ANOVA Summary Table -- Extrinsic Motivation and Video Viewing

Source	*SS*	DF	*MS*	F	p
Between	261.826	3	87.275	2.118	.102
Within	4697.267	114	41.204		
Total	4959.093	117			

Table 7

Descriptive Statistics for Extrinsic Motivation by Video Viewing Categories

					95% Confidence Interval	
Category	N	Mean	Std. Deviation	Std. Error	Lower Bound	Upper Bound
Never	43	39.7907	6.48646	.98918	37.7945	41.7869
Rarely	32	39.7500	6.19573	1.09526	37.5162	41.9838
Sometimes	32	42.4688	6.64775	1.17517	40.0720	44.8655
Often	11	43.7273	6.08426	1.83447	39.6398	47.8147
Total	118	40.8729	6.51041	.59933	39.6859	42.0598

Even though extrinsic motivation had a consistent pattern in which higher categories of video viewing had higher levels of extrinsic motivation, Table 8, these differences were small and never exceeded 4 points or 8% of total points. This 8 percent difference in extrinsic motivation is less than half of the 16 and 19 percent differences in intrinsic motivation and shows a much weaker relationship with video viewing. According to the data, extrinsic motivation, which includes grade, class work, and career motivation, was not associated with differences in video viewing.

Table 8
Post-Hoc Analysis, Bonferroni. Extrinsic Motivation and Video Viewing

Dependent Variable	(I) Videos	(J) Videos	Mean Difference (I-J)	Std. Error	Sig.
Extrinsic	Never	Rarely	.04070	1.49862	1.000
		Sometimes	-2.67805	1.49862	.460
		Often	-3.93658	2.16888	.433
	Rarely	Never	-.04070	1.49862	1.000
		Sometimes	-2.71875	1.60476	.558
		Often	-3.97727	2.24354	.474
	Sometimes	Never	2.67805	1.49862	.460
		Rarely	2.71875	1.60476	.558
		Often	-1.25852	2.24354	1.000
	Often	Never	3.93658	2.16888	.433
		Rarely	3.97727	2.24354	.474
		Sometimes	1.25852	2.24354	1.000

The third research question examined mathematics self-efficacy to determine if levels were different among online video viewers. Table 9 displays a statistically significant difference in mathematics self-efficacy among online mathematics instructional video viewers, (F=3.055*, p = .031). Also, please note that in Table 10, the SD of the Often category was less than other categories.

Table 9

ANOVA Summary Table -- Mathematics Self-Efficacy and Video Viewing

Source	*SS*	DF	*MS*	F	p
Between	1297.672	3	432.557	3.055*	.031
Within	16140.947	114	141.587		
Total	17438.619	117			

*. The mean difference is significant at the 0.05 level.

Table 10

Descriptive Statistics for MSE by Video Viewing Categories

					95% Confidence Interval	
Rank	N	Mean	Std. Deviation	Std. Error	Lower Bound	Upper Bound
Never	43	52.2791	12.54767	1.91350	48.4175	56.1407
Rarely	32	48.8125	12.04678	2.12959	44.4692	53.1558
Sometimes	32	52.6875	11.79786	2.08559	48.4339	56.9411
Often	11	61.3636	8.45308	2.54870	55.6848	67.0425
Total	118	52.2966	12.20852	1.12389	50.0708	54.5224

The difference in Mathematics Self-Efficacy (MSE) among video viewing was determined using the Bonferroni post-hoc analysis. Table 11 displays the difference occurring between viewers who rarely watched videos and those who often watched videos (p=.019). The 12.55 point difference in MSE between rare and often instructional video viewers totaled 17.93% of the total points on this instruments MSE scale. This was positive and informative because video viewing is also associated with increases in student achievement (Videos Help Teach Large Engineering Classes, 2013).

Table 11

Post-Hoc Analysis, Bonferroni. Mathematics MSE and Video Viewing

Dependent Variable	(I) Videos	(J) Videos	Mean Difference (I-J)	Std. Error	Sig.
MSE	Never	Rarely	3.46657	2.77801	1.000
		Sometimes	-.40843	2.77801	1.000
		Often	-9.08457	4.02048	.154
	Rarely	Never	-3.46657	2.77801	1.000
		Sometimes	-3.87500	2.97476	1.000
		Often	-12.55114*	4.15887	.019
	Sometimes	Never	.40843	2.77801	1.000
		Rarely	3.87500	2.97476	1.000
		Often	-8.67614	4.15887	.235
	Often	Never	9.08457	4.02048	.154
		Rarely	12.55114*	4.15887	.019
		Sometimes	8.67614	4.15887	.235

*. The mean difference is significant at the 0.05 level.

Discussion

Summary

The fact that we are living in a digital age is apparent because "Google", a search engine, is a now verb; Mark Zucherberg, founder of Facebook, perhaps the world's most popular social networking site, was Time Magazine's "Man of the Year" in 2010 (Dyrud, 2011); and online socializing continues to increase dramatically each year (The Nielsen Company, 2010). Therefore, it seems reasonable that students would also turn to online/digital sources, instructional videos, for academic assistance as well.

After reviewing the relevant literature and research, it was clear that millions of students were taking advantage of free online mathematics instructional videos, and that these videos in fact were valid, reliable, and effective supplemental tools. However, major deficits in US mathematics proficiency remained, and it was apparent in this study that there are some large populations of students who do not view videos. Further review of the research helped narrow down the focus of this study to two major characteristics, motivation (a drive or impulse to partake in an activity) and mathematics self-efficacy (confidence or belief in an individual's ability to learn, understand, and apply mathematics). Two valid, reliable, and established instruments measuring each of those variables were used to investigate their relationship with online mathematics instructional video viewing. After analyzing the data collected in this study, it turned out that only intrinsic motivation and mathematics self-efficacy levels were significantly different among certain types of viewers, while extrinsic motivation was not significantly different among any types of video viewers.

Implications

It is important that teachers and administrators understand that intrinsic motivation levels were significantly different between students who "never" and "rarely" watched videos and students who "often" watched videos, because further study of intrinsic motivation, particularly how to increase it, may encourage students to prepare and study more/better for class by viewing instructional videos. The differences are also important because they provide insight into the majority of the population at this school, students who do not view videos. Also, since the majority of this school’s students are African American, and African American students suffer from poor performance in mathematics (Spencer, 2012), perhaps it would be wise for teachers and administrators at schools with similar demographics to promote online mathematics instructional video viewing, since they are effective supplemental tools (Höffler & Leutner, 2007; Bolliger & Supanakorn, 2011).

By focusing on and bolstering student intrinsic motivation, other schools with high minority and free/reduced lunch populations may also observe this same increase in instructional video viewing. In other words, if the sample population's low viewership of online mathematics instructional videos is indicative of a more widespread lack of effort in STEM subjects, as US STEM statistics currently indicate, then instructors, staff, and administrators might want to invest more research and effort into determining and implementing ways of increasing intrinsic motivation in students as a means of “treating” low mathematics proficiency (Papa, et al., 2008).

Further study of intrinsic motivation may increase knowledge of why some students take advantage of online mathematics instructional videos while others do not, particularly the sub-categories: self-determination, self-efficacy, and curiosity/interest. Considering the data, it seems like investing in opportunities which will increase a student's intrinsic motivation may help increase the viewing of videos, and possibly even increase other types of student preparation and/or study habits. Such activities which may increase student intrinsic motivation are those which pique their interest and/or curiosity in STEM subjects, like field trips to places where STEM content knowledge is applied in unique and captivating ways, electronic mentoring, where professionals from the field communicate and interact with students using telecommunications software, or by participating in activities like robotics competitions, where students can see STEM really come to life (Stoeger, Duan, Schirner, Greindl, & Ziegler, 2013). Instructional video producers could also possibly increase curiosity/interest, a component of intrinsic motivation, by beginning and/or ending their videos with a relevant, unique, or captivating display/montage of STEM concepts in action.

Extrinsic motivation levels, which include grade, class work, and career influence, were not different in viewers of instructional online videos. This seemed to be in contrast to the amount of external effort applied to students, i.e. changing curriculum, swapping standards, linking test scores to teachers, and the dismissing/firing of administrators. This lack of a difference, however, does not definitively or permanently clear extrinsic motivation of having a relationship with video viewing, but just implies that more research is needed, probably research which is focused on its specific sub-categories. The lack of a difference in extrinsic motivation, outside forces and individuals, reinforces the sentiment expressed by Mackie, “We can bring students their education and put it on a silver platter right in front of them, but if they don’t want it, they’re not going to eat it.” (2012, p. 1).

Mathematics MSE was only different in students who rarely watched videos and students who often watched videos. While this is important, because it provides insight into ways teachers can increase viewership, it does not, however, provide an idea on how instructors, parents, tutors, etc. can convince or induce students to begin viewing videos. Possible methods of increasing MSE could be peer tutorial and more effective lesson/skill scaffolding by educators. A more specific and thorough study of Mathematics MSE may help provide instructors and content producers with ideas which may increase the understanding of what inspires students who rarely utilize online mathematics instructional videos to watch videos even more frequently.

Conclusion

Whereas it is clear that video viewing and technology, particularly mobile device usage, is on the rise, there has not been a lot of research into why students are turning to online mathematics instructional videos more often. The goal of this research project was to begin to examine potential relationships between instructional video viewing and characteristics of their viewers. Of course, as the proliferation of technology increases, so would video viewing. However, investigations into how those increases relate to the mindset and characteristics of the learners are few and far between. Thanks to Kraut, Rice, Cool, & Fish (1998) we know that the more a student thinks technology will help them, the more likely they are to use it, but there may be other personal beliefs, feelings, and inclinations, which may also have different levels among video viewers and/or technology users. As a result of this study, it was determined that there are differences in intrinsic motivation and Mathematics MSE (two internal learner characteristics) among viewers who rarely and often view online mathematics instructional videos, whereas no difference in extrinsic motivation was detected. These findings, therefore, could be considered justification for vested educators, administrators, communities, and policy makers to invest more effort, study, and energy directly into the student, through internships, conferences, activities, and field trips in order to increase STEM performance, rather than continue to attempt to affect student performance via external forces like changing standards and more standardized testing.

Ethical Consideration (Human Subject Protections)

The questions posed in this questionnaire were crafted to not be invasive, disrespectful or insensitive to SES, sexual orientation, and/or living situation, etc., so that any emotional risk to the respondent if any was minimal. Some participants may have also experienced discomfort when listing their classification/grade level if they have been held or kept back a grade or were experiencing trouble/difficulty graduating. There were no physical requirements associated with this instrument, nor compensation or reward for participation.

Limitations

This research study may have been affected by factors including student disposition, technology functionality, and technology proficiency. A student's personal feelings toward the content and/or teacher could affect his/her viewing of instructional videos. For instance, a student, whose favorite teacher is the mathematics instructor, may have watched videos to learn more. Therefore he/she could answer a lot of questions and be helpful to his/her peers, in order impress and win the favor of his/her favorite teacher. Also, a student who is naturally and/or exceptionally gifted in mathematics may not have viewed online mathematics instructional videos, regardless to his/her curiosity, a component of intrinsic motivation. Visual learners would also likely have a higher frequency of online mathematics instructional video viewing. Additionally, that student's level of mathematics self-efficacy was high innately and was not affected by any supplemental tools, instruction, or instructional video. A student's family income could also skew results because parents would afford better supplemental materials, thereby replacing the need to view the free online mathematics instructional videos on YouTube and KhanAcademy.

Other phenomena which might affect video viewing could have been those who strongly feel that they are learning and understanding mathematics better because of the videos. In other words, the video's perceived benefits motivate the students to watch more videos (Kraut, Rice, Cool, & Fish, 1998). It is also assumed that students had functioning technology and were proficient in its usage. Also, students with vision problems may have experienced lower viewership, regardless to motivation or mathematics self-efficacy. Moreover poor network quality (buffering delays), data limits, bandwidth truncating, or monitor/screen size and condition (cracked displays and/or dead pixels) might also have affected video viewing, regardless to motivation or self-efficacy.

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Appendix A

COLLEGE OF EDUCATION
DEPARTMENT INSTRUCTIONAL TECHNOLOGY
PARENTAL INFORMED CONSENT

Dear Parent or Guardian:

A study will be conducted at your child's school in the next few weeks. Its purpose is to determine differences in self-efficacy and motivation between viewers and non-viewers of online mathematics instructional videos. In particular, we will be asking whether children are motivated by grades or career goals, internet and technology access, and belief in their ability to learn and master mathematics. We will determine these differences by having students complete an anonymous online questionnaire.

If you give permission, your child will have the opportunity to take an online questionnaire, which takes less than 10 minutes to complete. Basic demographic data is collected first, age, grade, ethnicity, GPA. I also ask about internet availability, technology device access, entertainment and academic usage of those devices, and finally mathematics utilization. Next, I ask questions regarding motivation in terms of self-determination, career goals, and academic/GPA/grade motivation. Finally, I list questions about self-efficacy, a sort of academic term for self-confidence are asked which are specific to mathematics. For example, I believe I can learn mathematics and understand mathematics.

Your child's participation in this study is completely voluntary. The risks from participating in this study are no more than would be encountered in everyday life; however, your child will be told that he or she may stop participating at any time without any penalty. Your child may choose to not answer any question(s) he/she does not wish to for any reason. Your child may refuse to participate even if you agree to her/his participation.

In order to protect the confidentiality of the child, a number and not the child's name will appear on all of the information recorded during the experiment. All information pertaining to the study will be kept on Google secured servers, password protected computers, and/or encrypted files. Other than me, no one at your child's school will see the information recorded about your child.
If you have any questions or concerns regarding this study at any time, please feel free to contact Charles Edgar Hampton, Instructional Technology major, at 404-496-6244, or Dr. Randal Carlson, advisor, at (912) 478-5260.

To contact the Office of Research Services and Sponsored Programs for answers to questions about the rights of research participants please email IRB@georgiasouthern.edu or call (912) 478-0843.

If you are giving permission for your child to participate in the experiment, please sign the form below and return it to your child's teacher within 7 days. Thank you very much for your time.

Charles Edgar Hampton, M.Ed
Instructional Technology Major

Dr. Randal Carlson
Instructional Technology
Professor of Leadership, Technology,
and Human Development

Investigator's Signature____________________________

Child's Name: ____

Parent or Guardian's Signature: ____

Date: ____________________

Appendix B

COLLEGE OF EDUCATION
DEPARTMENT INSTRUCTIONAL TECHNOLOGY
MINOR'S ASSENT

Hello,
I am Charles Edgar Hampton a graduate student at Georgia Southern University, and I am conducting a study on Differences in Self-Efficacy and Motivation Between Viewers and Non-Viewers of Online Mathematics Instructional Videos.

You are being asked to participate in a project that will be used to learn about students who view or do not view online mathematics instructional videos. If you agree to be part of the project, you will take a short, 7 minute, online questionnaire. You will answer simple questions like: what grade you are in, what math grades you usually make, how do you feel about math, how useful do you think math is, and what motivates you to learn math. The online questionnaire is anonymous, meaning you don't' have to login to Google, give your name, or enter your student number like at lunch.

You do not have to do this project. You can stop whenever you want. If you do not want to complete the online questionnaire, it is ok, and you can go back to your regular assignment, and nothing bad will happen. You can refuse to complete the questionnaire, even if your parents say you can. None of the teachers or other people at your school will see the answers to the questions that I ask you. All of the answers that you give me will be kept in a locked cabinet in a room at Georgia Southern University, and only I or Dr. Judi Repman will see your answers. We are not going to put your name on the answers that you give us, so no one will be able to know which answers were yours.

If you or your parent/guardian has any questions about this form or the project, please call me at 404-496-6244 or my advisor, Dr. Randal Carlson, at (912) 478-5260. Thank you!

If you understand the information above and want to complete the questionnaire, please sign your name on the line below:

Yes, I will participate in this project: <u>Differences in Self-Efficacy and Motivation Between Viewers and Non-Viewers of Online Mathematics Instructional Videos</u>

Child's Name: ____

Investigator's Signature: _____________________________________

Date: _______________

Appendix C

COLLEGE OF EDUCATION
DEPARTMENT OF INSTRUCTIONAL TECHNOLOGY
INFORMED CONSENT FORM

1. Greetings, my name is Charles Edgar Hampton. I am a graduate student at Georgia Southern University. I am completing the requirements for my Education Specialists Degree in Instructional Technology and am conducting an anonymous research project via online questionnaire.

2. Purpose of the Study: The purpose of this research is to determine if there are differences in motivation and self-efficacy between viewers and non-viewers of online mathematics instructional videos.

3. Procedures to be followed: Participation in this research will include completion of a simple online questionnaire available through Google Docs. The form does not collect any significant identifying information, only gender, age, grade level, race, grade level, free or reduced lunch status, overall GPA, math standardized testing history, and usual mathematics grade. The online questionnaire uses a simple 1-5 ranking scale, representing whether a person Never, Rarely, Sometimes, Usually, or Always agrees with the attached statement. The questionnaire takes no longer than 10 minutes and most finish it in about 7 or less. This is all that is required for participation.

4. Discomforts and Risks: There is a minor risk of embarrassment due to participants having to disclose and possibly come to terms with poor academic performance, i.e. in the beginning when they provide some academic background information, selecting a low GPA, high number of failed tests, and poor usual mathematics grades may prove to upset or sadden sensitive participants. Some participants may also experience discomfort when listing their age if they have been held or kept back a grade or are experiencing trouble/difficulty graduating.

I, Charles Edgar Hampton and researcher, can be contacted to discuss any discomfort via phone at 404-496-6244, text message at 404-692-3443, or via email at ch05648@georgiasouthern.edu

5. Benefits:
a. The benefits to participants include having a chance to accept who they are as a mathematics student, the opportunity to find out what and how they are motivated and how confident they are.
Those who struggle with mathematics are informed of a helpful resource they may not have considered before. And others may become more determined after confronting their mathematics performance.
b. The benefits to society include becoming more aware of the mindset of students who take initiative to improve via viewing online mathematics instructional videos and those who do not. Also, the identification of these differences can be highly beneficial to parents, teachers, administrators, content producers, etc, since they will know the motivation and self-efficacy levels of those currently not viewing online mathematics instructional videos and can adjust marketing, presentation, and production accordingly.

6. Duration/Time required from the participant: the online questionnaire, the only requirement for participation, takes less than 10 minutes to complete.

7. Statement of Confidentiality: The data collected via the online questionnaire will only be accessible to me through my Google account. Since there is no need to sign in and only one place to manually time in information other than race, confidentiality of participants will be well protected. The data will be securely maintained on Google's server for a minimum of 3 years, in accordance with IRB guidelines. I

will also have to download the numerical data in csv and/or excel format for data analysis to my home PC and/or work laptop, which are both password protected, will also have a password on the data files once downloaded and possibly be encrypted.

8. Right to Ask Questions: Participants have the right to ask questions and have those questions answered. If you have questions about this study, please contact the researcher named above or the researcher's faculty advisor, whose contact information is located at the end of the informed consent.
For questions concerning your rights as a research participant, contact Georgia Southern University Office of Research Services and Sponsored Programs at 912-478-0843.

9. Compensation: Participants will not be compensated for their participation.

10. Voluntary Participation: Students at the high school are not required and will not be penalized for failing to participate in this research study. If a teacher uses class time to complete the online questionnaire, as a warm-up, for instance, I will provide each grade level with an appropriate assignment with a similar duration, i.e. a few equations with an answer key for the teacher appropriate to the standards of the grade taught.

11. Penalty: Again, there is no penalty for declining to participate. However, if class time is used to complete the questionnaire, some students may consider the alternative assignment a form of penalty/punishment for non-participation.

12. You must be 18 years of age or older to consent to participate in this research study. If you consent to participate in this research study and to the terms above, please sign your name and indicate the date below OR,
a. I am asking your permission for your child to participate in this study, and will provide him/her with a simplified "assent" letter/verbal description before enrolling them in this study
b. Provide assent letter or written documentation of the verbal briefing you will give the child (if he/she is too young to read)

You will be given a copy of this consent form to keep for your records. This project has been reviewed and approved by the GSU Institutional Review Board under tracking number H14225.

Title of Project: Differences in Self-Efficacy and Motivation Between Viewers and Non-Viewers of Online Mathematics Instructional Videos

Principal Investigator: Charles Edgar Hampton, M.Ed., 404-496-6244, ch05648@georgiasouthern.edu

Faculty Advisor: Dr. Randal Carlson, (912) 478-5260, rcarlson@georgiasouthern.edu

______________________________________ ______________________

Participant Signature Date

I, the undersigned, verify that the above informed consent procedure has been followed.

______________________________________ ______________________

Investigator Signature Date

Appendix D

Please help Mr. Hampton!

Complete a brief online questionnaire.

No obligation, penalty, or compensation for participation.

Questions or concerns, please visit his classroom.

tinyurl.com/kzr25vd

Thank you.

Appendix E

Differences in Motivation and Self-Efficacy Among Online Mathematics Instructional Video Viewers

Have you and your parents (minors) or you (age 18+) signed and returned the appropriate assent/consent forms?*Required

- Yes
- No

Differences In Online Mathematics Instructional Video Viewing--Consent

Consent Needed

You and/or your parents have not signed and returned the appropriate assent/consent forms, then please find, print, sign and return the forms, which can be found here: Informed Consent Form: http://tinyurl.com/mcck5hs Parental Assent Form: http://tinyurl.com/ldn77a3 Minor Assent Form: http://tinyurl.com/mdaeheq You can also sign, photograph and email the signed forms to my email address: ch05648@georgiasouthern.edu. This also can work as a picture message, just enter the email address instead of a phone number.

Have you and your parents (minors) or you (age 18+) signed and returned the appropriate assent/consent forms?*Required

- Yes
- No

Differences in Online mathematics Instructional Video Viewing--Demographics

1) What is your racial background/ethnicity*Required

- Asian/Pacific Islander/Asian American
- Black/African American
- Hispanic/Latin American
- White/European American
- Mixed

2) What is your sex/gender?*Required

- Male
- Female

3) How much do you pay for school lunch?*Required

- Free
- Reduced
- Full Price
- Don't know

4) What is your classification/grade level?*Required What is the classification/grade level of your homeroom class?

- Freshman
- Sophomore
- Junior
- Senior
- 5 or more years

Online Mathematics Instructional Video Viewing

Please answer the following questions using the scale to indicate how often you view online mathematics instructional videos not shown/assigned by your math teacher. For question 5 only, use the following scale to categorize viewing frequency:

Never;
Rarely, less than once a month,
Sometimes, 1-2 a month (once a month);
Often, 3-5 a month (about one per week);
Usually, 6 or more a month (more than one per week).

5) How often do you watch online mathematics instructional videos outside of class, which were not shown/assigned by your math teacher? Youtube, KhanAcademy.org, purplemath.com, etc.*Required

	1	2	3	4	5	
Never	○	○	○	○	○	Usually

Please use the following scale for questions 6-11:

1-Never; 2-Rarely; 3-Sometimes; 4-Usually; 5-Always

6) How frequently do you have internet access at home?*Required

	1	2	3	4	5	
Never	◉	○	○	○	○	Always

7) How often do you use these technology devices for academic purposes?*Required Writing papers, Spark Notes, Visit Academic Websites, Help with Homework, etc.

	1	2	3	4	5	
Never	○	○	○	○	○	Always

8) How often do you use these technology devices for mathematics purposes?*Required For example, Watching online videos; graphing; sine, cosine, tangent calculations; video chat with group members; trying to get help; searching for and/or reading instructions/steps/process and/or worked out examples; etc.

	1	2	3	4	5	
Never	○	○	○	○	○	Always

9) Why do you watch online mathematics instructional videos outside of class, which were not shown/assigned by my math teacher?*Required Please read all choices. You may also select more than one.

- To help me when I don't understand
- To learn a new skill/method
- To improve my existing knowledge
- Because I do not pay attention in class
- Because I can not pay attention in class
- I do not watch them.

10) If you do watch online mathematics instructional videos, how did you start/find them?*Required Please read all choices. You may also select more than one.

- Google, Bing, or search engine, you searched for 'special right triangle ratios' and you saw a video and clicked it.
- Friend's recommendation; A person on your age, social, and/or academic level
- Non-Academic Person's recommendation; Relative, Neighbor, Social Media Friend/Follower, etc.
- Academic Person's recommendation; Teacher, Teacher's Assistant, Administrator, Counselor, etc.
- Textbook and/or Website recommendation
- I do not watch them.

Intrinsic and Extrinsic Motivation

In order to better understand what you think and how you feel about your high school math courses, please respond to each of the following statements from the perspective of ‘‘When I am in a high school math course...’’ The scale is 1-Never; 2-Rarely; 3-Sometimes; 4-Usually; 5-Always adapted from the Science Motivation Questionnaire II © 2011 Shawn M. Glynn

11) The Math I learn is relevant to my life*Required

	1	2	3	4	5	
Never						Always

12) I like to do better than other students on Math tests*Required

	1	2	3	4	5	
Never						Always

13) Learning Math is interesting*Required

	1	2	3	4	5	
Never						Always

14) Getting a good Math grade is important to me*Required

1 2 3 4 5

Never Always

15) I put enough effort into learning Math*Required

1 2 3 4 5

Never Always

16) I use strategies to learn Math well*Required

1 2 3 4 5

Never Always

17) Learning Math will help me get a good job*Required

1 2 3 4 5

Never Always

18) It is important that I get an ''A'' in Math*Required

1 2 3 4 5

Never Always

19) Knowing Math will give me a career advantage*Required

1 2 3 4 5

Never Always

20) I spend a lot of time learning Math*Required

1 2 3 4 5

Never Always

21) Learning Math makes my life more meaningful*Required

1 2 3 4 5

Never Always

22) Understanding Math will benefit me in my career*Required

1 2 3 4 5

Never Always

23) I prepare well for Math tests and labs*Required

1 2 3 4 5

Never Always

24) I am curious about discoveries in Math*Required

1 2 3 4 5

Never Always

25) I enjoy learning Math*Required

1 2 3 4 5

Never Always

26) I think about the grade I will get in Math*Required

1 2 3 4 5

Never Always

27) I study hard to learn Math*Required

1 2 3 4 5

Never Always

28) My career will involve Math*Required

1 2 3 4 5

Never Always

29) Scoring high on Math tests and labs matters to me*Required

1 2 3 4 5

Never Always

30) I will use Math problem-solving skills in my career*Required

1 2 3 4 5

Never Always

Mathematics Self-Efficacy

For this section, the scale is as follows: 1-Never; 2-Seldom; 3-Sometimes; 4-Often; 5-Usually
Mathematics Self Efficacy and Anxiety Questionnaire II © 2009 Diana Swanagan and Shawn Glynn

31) I feel confident enough to ask questions in my mathematics class.*Required

1 2 3 4 5

Never Usually

32) I believe I can do well on a mathematics test.*Required

1 2 3 4 5

Never Usually

33) I believe I can complete all of the assignments in a mathematics course.*Required

1 2 3 4 5

Never Usually

34) I believe I am the kind of person who is good at mathematics.*Required

1 2 3 4 5

Never Usually

35) I believe I will be able to use mathematics in my future career when needed.*Required

1 2 3 4 5

Never Usually

36) I believe I can understand the content in a mathematics course.*Required

1 2 3 4 5

Never Usually

37) I believe I can get an "A" when I am in a mathematics course.*Required

1 2 3 4 5

Never Usually

38) I believe I can learn well in a mathematics course.*Required

1 2 3 4 5

Never Usually

39) I feel confident when taking a mathematics test.*Required

1 2 3 4 5

Never Usually

40) I believe I am the type of person who can do mathematics.*Required

1 2 3 4 5

Never Usually

41) I feel that I will be able to do well in future mathematics courses.*Required

1 2 3 4 5

Never Usually

42) I believe I can do the mathematics in a mathematics course.*Required

1 2 3 4 5

Never Usually

43) I believe I can think like a mathematician.*Required

1 2 3 4 5

Never	Usually

44) I feel confident when using mathematics outside of school.*Required

	1	2	3	4	5	
Never						Usually