Research Proposal

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Introduction

Many students today struggle to maintain a suitable level of engagement in class in order to a.) complete tasks and b.) complete tasks at a level that meets grade level expectations. In my own experience, the reluctant learners in my classroom frequently are the students functioning below grade level. These students often have met with such little success in the past that they are unwilling to try tasks even when materials are provided for them at their own ability level. From my conversations with colleagues and conclusions that I have drawn from reading scholarly articles on related topics, a reduced level of student engagement and declining success in the classroom is a widespread and growing concern of many educators today. Educators are dealing with more and more diverse sets of learners in their classrooms each year and consequently are looking for new ways to better meet their students' needs. Through the use of technology and more specifically, web tools that allow teachers to cater to individual student needs and ability levels, educators may be able to increase both the level of student engagement and the number of students meeting with academic success.

Problem Statement

I plan to examine the Khan Academy online learning environment as a teaching tool in order to gain insight into the implications it has on student engagement and academic achievement in math. This online program offers supports grounded in learning theory with built in scaffolding features, as well as continuous assessments allowing the program to individually target the students' zone of proximal development. As my topic of inquiry examines both the use of technology to engage students, as well as serve as a means to individualize instruction and impact student achievement, it is very relevant to today's educators, making it a worthwhile topic

to examine more closely. The Khan Academy will not be used ***instead*** of a classroom based math program, rather it will be used to ***supplement*** the regular program.

Research Questions

With educators expressing concerns about a lack of student engagement as well as an increasing achievement gap between learners, teachers are reexamining their educational frameworks. This study will examine how individualized instruction through the use of the Khan Academy online learning resource will impact the level of student engagement and achievement. The primary research question is how does individualized instruction through the use of the Khan Academy to supplement the regular math instruction in a classroom setting impact the level of student engagement and student achievement in a single curricular unit of math? Sub-Questions include:

I. When using individualized instruction in math through the use of the Khan Academy, how does the level of student engagement change over time?

II. As this is an online learning resource and students may use the resource outside of the parameters of the school day, a.) are students using this resource outside of the school day and b.) how does the additional time spent using this resource impact student engagement and achievement in the math unit?

Critical Review of the Literature

The literature included in this review was selected from three main sources; the University of British Columbia Library, the ERIC database, and the EBSCOhost database via the Okanagan Regional Library. For my research, I chose to include documents that pertained

directly to the Khan Academy and its use in the classroom (of which there were very few), self-paced learning through technology, as well as articles with a more general focus on the impact of differentiation through the use of technology in educational settings. I also confined the literature used within this review to articles that were published within the last 10 years.

The Khan Academy

Catering to the needs of all learners in a classroom setting is a challenging task faced daily by educators. Technology, and more specifically web tools that allow for individualized instruction, have the potential to help teachers meet the needs of their learners more effectively. The Khan Academy is a web tool that is currently attracting a great deal of attention. Some of the advantages of a program like Khan's are the 'just-in-time' aspects of it that allow students to receive support on concepts that they need immediate help on. Students can watch videos or work through tutorials and practice questions for a particular math concept until they feel like they have a firm grasp on the idea or process allowing students to fill in gaps in their own knowledge before progressing on to more advanced concepts (Kronholz, 2012). In addition to the convenience of the program, the site has built in gaming features like earning energy points and acquiring badges that 'seem to be the real learning motivators' (Kronholz, 2012, p. 18). Another appealing aspect of the program for both educators and students alike is that the site continually provides instant feedback (Kronholz, 2012). Students can quickly see their own progress and are rewarded for their successes, and supported through their difficulties via many built in scaffolding features. The author notes a few areas of weakness in regard to the Khan Academy and it is partially for these reasons that I have designed this study to use the Academy as a supplemental resource for math instruction, rather than a stand-alone resource. The Khan Academy does not include any project based lessons and it is 'not great at helping kids

conceptualize math' (Kronholz, 2012, p.19). Although the pilot studies mentioned by Kronholz suggest that the Khan Academy is positively impacting students' math achievements, she acknowledges that it is 'far too early to claim success' (Kronholz, 2012, p. 21) and that there is a need for further investigation into the impact of learning via the Khan Academy, particularly for low-performing students.

In Schroeder's summary of the next generation of massive open online initiatives, the Khan Academy is featured fifth in his list of twelve initiatives. In his description of the Khan Academy, he praises it for its adaptive learning features noting that each time a student completes a problem, the system tracks both the learning and the time spent on the task. The data gathered by the system is used to suggest the next step for each individual learner based on their performance and in this way, guides students to make progress (Schroeder, 2012). It should be noted that only the strengths of the Khan Academy were shared by Schroeder.

Internet Based Technology Use in the Classroom

Technology on its own is not going to automatically enhance student achievement or increase student engagement. McManis and Gunnewig propose that three criteria must be met in order for teachers and students to benefit from technology. The technology must be developmentally appropriate for the students, it must include tools to enable teachers to use it successfully, and it must be integrated into the classroom and curriculum. When children use computers in the classroom, they have a natural tendency to help one another, providing information and explanations to solve problems (McManis and Gunnewig, 2012). Within the structure of the Khan Academy, students that advance their skills beyond the unit expectations can become the class experts and can be assigned as coaches for other students. The affordances

of the Academy allow for just such student collaboration and social cognition skill development. McManis and Gunnewig also convey what makes technology appropriate and successful in the classroom namely features such as being responsive to the students' developmental level, having educational value, engaging the students through interactivity between the child and the program, as well as monitoring the child's progress (2012). The Khan Academy does very well when checked against this criteria.

Stanford, Crowe, and Flice postulate that using technology in the classroom can both simplify and enhance differentiation of instruction as a means of meeting the demands of today's diverse classrooms (Stanford et al., 2010). Technology can be used as a way to help close the achievement gap between learners and 'the computer-based format can be motivating for students' (Stanford et al., 2010, p.4). The authors see technology when used to cater to individual student needs, as a means to develop independent learning skills in students while supporting student goal setting as well (Stanford et al,. 2010). Although the authors do not mention the Khan Academy specifically, they conclude that 'technological advances allow teachers to tailor curricula to individual students quickly and effectively' (Stanford et al., 2010, p.7), which appears to be a capability of the Khan Academy.

In Cox's comprehensive review of the technological and educational research changes that have taken place over the last 40 years, he notes 'significant evidence of a positive impact of IT on students' learning in mathematics in classes where IT was being integrated into the mathematics curriculum' (Cox, 2013, p.8). Additional findings that pertain to my proposed study indicate that students being taught using technology for specific curricular purposes outperform students taught the same curriculum through traditional methods on a post-test (Cox, 2013).

Cobb's examination of using internet-based technology in the classroom focuses on an urban setting in the United States, but his investigation and findings are relevant to the proposed study herein. While investigating computer aided instructional practices, Cobb found that 'significant increases occurred in student achievement for students in the treatment group who used internet-based software that differentiated instruction based on student needs and targeted learning outcomes' (Cobb, 2013, p. 40). Although the computer program used in Cobb's study was not the Khan Academy, due to the similarities between the affordances described by Cobb and those offered within the Khan Academy, his findings are noteworthy for the purposes of this proposal.

Self-Paced Math Instruction

Edwards' guide to an individually paced classroom for math instruction provides insight into the value of coupling differentiation and technology in the area of mathematics. According to Edwards, when comparing traditional instruction to online alternatives 'students considered self-pacing to be the number one positive result from using technology in the classroom' (Edwards, 2013, p.232). He also notes that self-pacing benefits students at all levels of ability, as those that require more time to master a skill have the freedom to take the extra time needed, while advanced learners can move ahead without being slowed down to the pace of the majority (Edwards, 2013). Edwards does note a number of concerns associated with a shift to student-centered learning through the use of technology. If not done correctly, the teacher-student relationship can deteriorate due to the role that is being filled by the technology. Students can also take advantage of the freedom of self-paced learning and work at a level below their actual ability. Finally, with technology readily available to students, they may be tempted to delve into off task activities online instead of their lesson work (Edwards, 2013).

Limited Canadian Research

After completing my research into the topic, it became apparent that there is little information available in regard to scholarly research of the use of the Khan Academy in the classroom. In addition to that, the amount of information available specifically about educational practices in Canada was very sparse. In Abrami et al.'s Review of e-Learning in Canada, a number of points were made that lend strength to my argument that not only is my proposed research of interest and value, it would serve to help fill a gap in the research base in this area. From their review, Abrami et al. concluded that 'what works in e-learning settings are underrepresented in the Canadian research literature' (2008). The authors note that it is challenging to draw conclusions from research documents as the perception of the impact of technology's role on learning varies depending on the document being examined (Abrami et al., 2008). Some of the points made in their review further support the call for more research in this area. Their review conveys that network based technologies produced higher impact scores than straight integration of technology in educational settings and that student manipulation of technology in pursuit of educational goals is preferable to teacher manipulation of technology (Abrami et al., 2008). Their noted implications for K-12 practitioners is that when implemented appropriately, technology has a beneficial impact on student learning and may facilitate the development of higher level thinking skills (Abrami, et al., 2008). Based on the information gathered in their review, they state that 'some educators suggest that e-learning has the potential to transform learning, but there is limited empirical research to assess the benefits' (Abrami et al., 2008).

Research Method

This proposed study will take the form of a quasi-experimental study. The math unit that the study will focus on is the grade five multiplication and division unit. The duration of this unit and thus this study, not including the pre-test, will be five to six weeks in length.

The Control Group

In a classroom of 30 students, 15 students will be randomly selected to be in the control group. Each lesson will begin with a review of background knowledge and/or previously taught skills. New concepts will be taught via modeling, hands on activities where applicable, using a scaffolding model where teacher support is gradually reduced until the students are able to work independently. Students will receive instruction and remediation only from the teacher and will complete all daily assignments, unit assessments and homework using paper based tasks. Periodic formative assessments will be completed throughout the unit in order to track student progress and flag those students in need of more targeted remedial support.

The Treatment Group

The other 15 randomly selected students will receive the same initial instruction in our regular math lessons as is noted above for the control group, but the students in the treatment group will complete their daily math assignments and activities online using the Khan Academy. Their homework will be additional time spent on the Academy practicing the targeted math skills. Students in the treatment group will be encouraged to use the built in tutorials within the Khan Academy for remedial purposes, although the teacher will step in to work individually with students whenever a skill is flagged in the system as a concern. Students struggling to master unit concepts will receive additional support from the teacher throughout the unit as needed. The

Khan Academy provides educators (the site uses the term coaches) with detailed information in regard to student progress using a colour coded system. See Figure 1 below for an example of the student progress grid. The lightest blue colour on the grid indicates that a student has simply practiced the skill. The second lightest shade of blue indicates that the student has reached level one on the skill. A slightly darker blue indicates that level two has been reached, while the darkest blue indicates skill mastery. Skills marked in red indicate that the student has attempted the skill and is struggling.

Figure 1: Sample of the Khan Academy's (whole class) student progress grid.

Both the control group and the treatment group will be asked to complete some paper based tasks throughout the unit as a means of formative assessment. Students in both groups will be completing identical assessments for these skill check-ups, as well as the same diagnostic assessment for both the pre and post-test.

Participants

In order to feasibly carry out the study, the students involved in the study will be those in my own classroom. The study participants will be 30 students in grade five, ranging from 10 to 11 years of age. Although the students will not be randomly selected, random assignment within the study population will be used. Using simple random sampling, 15 students will be randomly selected to be in the control group and 15 students will be randomly selected to be in the treatment group. It should be noted that if the composition of my class is such that there is one or more subgroups of learners identified based on their ability level in math, proportional stratified sampling will be used. This decision will be made after the pre-test data has been analyzed. Based on the results of this assessment, if two distinct levels of achievement among the learners is apparent, subgroups will be established prior to the creation of the two study groups. This type of selection will allow for a more equal distribution of learner ability levels between the control and treatment groups. Having all of the low or high achieving students in either the control or treatment group could compromise the internal validity of the study and/or skew the study results and steps may need to be taken to prevent this.

Permission & Ethical Concerns:

I will first need to obtain permission from my administrator and/or the school district to conduct a study of this nature within my classroom. I will also need to receive permission from each of the participants' parents via a consent form. Parents will sign the form (if they choose to) and be spoken to directly about their child's involvement in the quasi-experimental study at the fall parent-teacher conferences. Once parental permission is obtained, I will move forward with establishing the control and treatment groups. Parents will need to be contacted a second time

and be informed of their child's placement in either the control or treatment group. I will be requesting that the control group's parents refrain from establishing Khan Academy accounts for their children until the completion of the study in order to prevent validity concerns in regard to the study's results.

I feel that there would be little ethical risk in this study as the control group is not being harmed or poorly taught. The control group is receiving regular instruction and is not being asked to go without anything that they would otherwise receive in a regular math unit. The students in either group are not being subjected to anything that they would not potentially be subjected to in any classroom today. The inherent risks on the Khan Academy website are very low as well, as the site has no social networking features and does not allow for open communication among users. The students' accounts are password protected and the site is free from advertisements.

Limitations & Concerns:

When/if the results of the study were published, it would be difficult to protect the identity of the participants from individuals familiar with me and/or my students. Colleagues reading the study would know the individuals in my class based on the dates indicated in the study. They would not however know which students were involved in which group as the confidentiality of the participants would be protected in the research report. There is a potential validity concern in regard to the use of the Khan Academy outside of the school day. As the researcher cannot possibly monitor the students' use of the website at home apart from what the Khan Academy data indicates, there is the possibility that students may get additional help at home from an adult or older sibling. There is also the potential that the students in the control

group may be using the Khan Academy outside of the school day, despite my request to parents to refrain from establishing accounts for their children until after the study. There is also the potential for both the novelty effect as well as the John Henry effect to come into play as the study unfolds, since I plan on having both the treatment group and the control group within the same classroom.

There is little chance of pre-test treatment interaction being a factor in the study, as the pre-test entails a mix of mathematical concepts that the students are expected to complete during the computation portion of the assessment. The multiplication and division questions will not be taken out of the context of the test and delivered in isolation, instead the students will complete the computational portion of the assessment including questions in all four number operations. The data for the multiplication and division questions will then be isolated and evaluated for the purposes of the study. Although the same test will be used as both the pre and post-test, it is unlikely that after 6 weeks have passed, the students will recall the exact questions that they were previously exposed to on the initial assessment and thus, have any sort of advantage on the post-test that they did not have on the pre-test.

Instruments and Materials

All students, regardless of which group they are a part of, will complete the same pre-test prior to the commencement of the study. Students will complete the computational portion of the Vancouver Island Net Diagnostic Math Assessment (DMA). The assessment data gathered through the use of this tool will be used to establish a baseline for each student prior to any unit instruction. The same assessment will be given to the students at the conclusion of the unit in order to determine the amount of academic progress made by the two groups of participants. The

difference between each participants' pre and post-test scores will be determined and the average or mean of each groups' collective growth will be calculated, compared and analyzed.

The level of student engagement for the treatment group will be measured by recording the amount of time that the students spend working on their math skills on the website, by recording the completion rate of online tasks, and the students' success rate on those tasks will also be recorded. Each of these areas will be measured using the information collected and provided by the Khan Academy program itself. From within the site, educators can quickly see where an individual student is at in their progression toward skill mastery and can even examine the supports used by the student on the site, such as viewing a video tutorial. The students' level of success will be determined by their scores on their class and homework assignments using the Khan Academy, formative assessments done in class, as well as post-test scores.

In addition to the treatment group being monitored for skill progression, the amount of time spent on the Khan Academy website will also be tracked. Instructors can use the 'Activity' tab on the website to view student activity by the minute. The site breaks up the 'time spent' data into one of two categories; time spent on the site during normal school hours and time spent on the site outside of the normal school day. Figure 2 below shows an example of what a whole class 'Activity' graph may look like. Further information about the students' time spent on the site can be gathered by accessing the 'Activity' graph for each individual student. The information shared using this feature of the website can be seen below in Figure 3. This information regarding student progress and engagement will be gathered over the course of the unit in order to examine fluctuations in either of these measures over time.

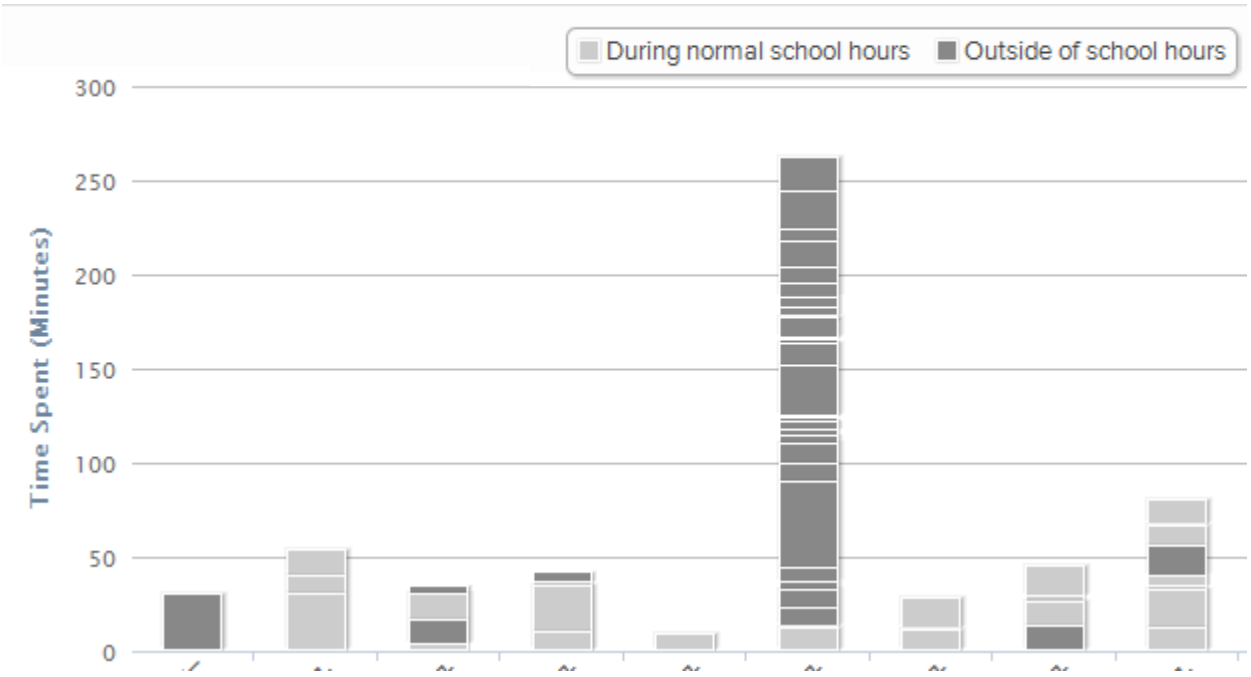

Figure 2: Sample of a whole class 'Activity' graph on the Khan Academy.

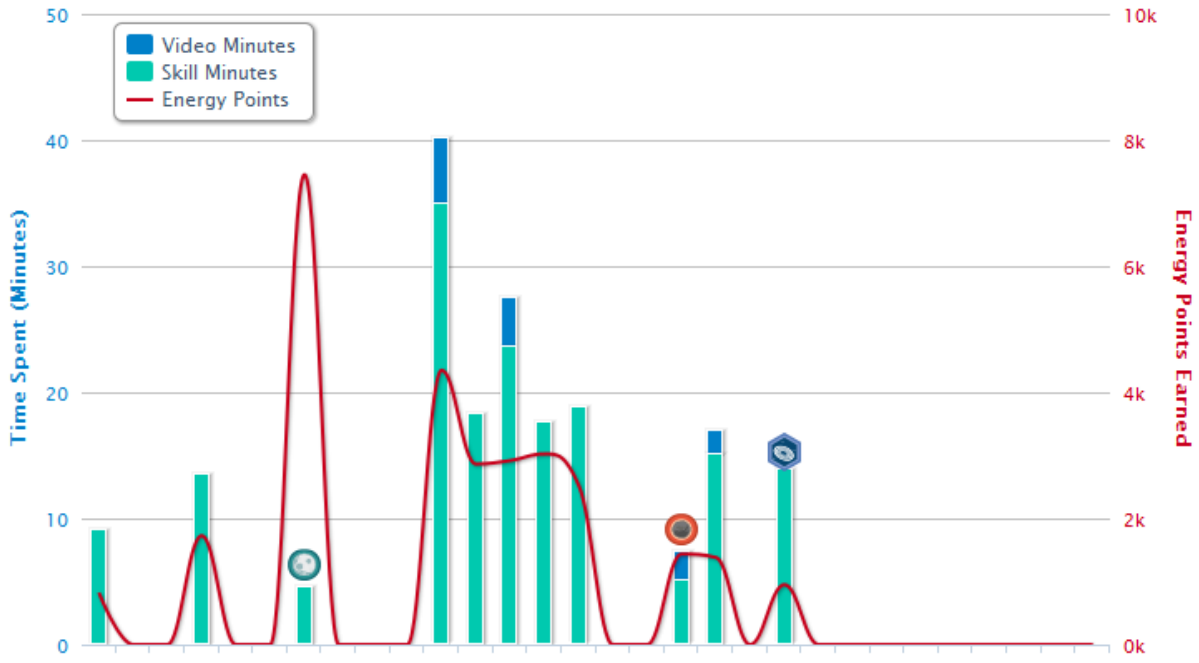

Figure 3: Sample of an individual student's 'Activity' graph on the Khan Academy.

Please note that hovering with the mouse over the above chart provides educators with very specific information about the skill that was being worked on, the exact amount of time spent on the task, as well supports accessed by the student while working on the skill.

The level of engagement for the control group will be determined through observations. An impartial observer (not the teacher) will use a checklist to monitor and track the level of student engagement on their independent assignment work each math period. This data will be used to estimate the students' time on task. The students' level of success will be determined by their scores on the daily assignments, formative assessments, as well as post-test scores. The students' assignment completion rate will also be tracked and averaged throughout the study.

Procedure

The study will take place in a grade five classroom in Rutland Elementary School, situated in Kelowna, B.C. (Central Okanagan, School District No. 23). The school contains approximately 435 students from Kindergarten through grade six. There will be 30 students in the classroom and all 30 students will be participants in the study (with parental consent). The class is taught by one teacher. The teacher utilizes a SMARTboard as a part of her instructional practice. There are three laptop computers available to the students at any time. A full set of 30 laptops can be signed out by the teacher. For the purposes of this study, the laptop carts will be assigned to the classroom for every math period. The school has consistent Wi-Fi internet access.

The teacher/researcher will administer and mark the DMA for both the pre and post-test. The teacher will deliver instruction to both the control and treatment group each math period. The teacher will facilitate the treatment group while they use the Khan Academy, and support the control group as they complete their paper based lesson work. An impartial observer will be used in the classroom to monitor the control group students' time on task during independent working

times. A checklist style tracking system will be used and the students' time on task will be averaged at the end of each lesson. Depending on the composition of the class (for example, if there are a number of students with behaviour concerns), there may be the need to have additional observers gathering data for the control group. The teacher/researcher will gather the data in regard to skill progress and time spent using the site each day from the Khan Academy for all students in the treatment group.

Research Design and Analysis

Due to the fact that the study population will be a pre-existing group of students, this study must be classified as quasi-experimental. Although other educators will benefit from the results of the study, it has been designed primarily to answer personal questions that I have as an educator in regard to how a web based tool such as the Khan Academy can aid me in reaching more, if not all, of my students making this endeavour one that could likely be slotted under action research. Details about the data that will be gathered and the analysis of the data can be viewed in Table 1 below.

Table 1: Plans for Data Collection and Analysis

Study Groups:	Data and Analysis of Information about Student Achievement	Data and Analysis of Information About Student Engagement
Control Group (Instruction and remedial support provided by the teacher)	1.) the students' baseline will be established using the DMA pre-test 2.) the students will receive regular instruction from the classroom teacher and will complete their daily lesson work seeking help from the teacher as needed. The daily lesson work will be marked and recorded by the teacher each day. Students at risk or struggling will be flagged for remedial intervention. 3.) periodic formative assessments will be administered and marked by the teacher to track student progress 4.) the students' assignment completion	1.) the students' time on task during independent lesson work will be observed by an impartial observer each math lesson using a check list. Each students' average amount of time on task will be calculated and recorded after each period 2.) the data gathered throughout the study will be analyzed at the study's conclusion in order to determine any trends or patterns in regard to the students' level of engagement over time

	rate will be determined at the end of the study (percentage of assignments completed and handed in) 5.) the students' progress will be assessed using the DMA post-test	
Treatment Group (Instruction and remedial support provided by both the teacher and through the use of the Khan Academy online learning resource)	1.) the students' baseline will be established using the DMA pre-test 2.) the students will receive regular instruction from the classroom teacher and will complete specific skill based assignments using the Khan Academy and the remedial supports built into the program. The Khan Academy skill work will be viewed and recorded by the teacher each day. Students at risk or struggling will be flagged by the program and will receive additional teacher support if necessary. 3.) periodic formative assessments will be administered and marked by the teacher to track student progress 4.) the percentage of unit skill work completed on the Khan Academy will be calculated at the end of the study 5.) the students' progress will be assessed using the DMA post-test	1.) the students' time spent on the Khan Academy program will be recorded each day for both time spent on the site at school and on their own time outside of the school day 2.) the data gathered throughout the study will be analyzed at the study's conclusion in order to determine any trends or patterns in regard to the students' level of engagement over time

Schedule of Activities

In Table 2 below, the timeline for major activities in the study has been provided.

Table 2: Schedule of Activities

Major Activities	Timeline
DMA pre-test (to be administered by the classroom teacher with all 30 participants)	Mid September, 2014
Initial meeting with parents to inform them of the study and to receive consent at parent-teacher conference time	Early October, 2014
Establish the control and treatment groups by random selection and inform parents of which group their child has been placed in	Mid October, 2014
Launch the multiplication and division unit and begin daily observations during math periods. Data will be collected for both groups on a daily basis	Late October, 2014
Carry out unit instruction and administer	Late October 2014- Early December 2014

formative assessments to monitor skill progress. Provide remedial support for both groups as needed.	
DMA post-test (to be administered by the classroom teacher with all 30 participants)	Early December 2014

Discussion

In most educational settings today, students are grouped into classes based on their age and not on their ability level. Because of this type of homogenous grouping, teachers are faced with the daunting task of teaching to multiple ability levels within the same classroom. Compounding the issue, are the budgetary constraints faced by many schools. Reduced funding often results in large classes and a reduced number of supports in place for both teachers and students. Although technology alone is not the answer to these hurdles that teachers face each day, technology coupled with sound pedagogy and instructional practice may certainly have a positive impact. The generation of students currently in our schools were born into a technologically rich society and are often referred to as digital natives. Technology is a part of their day to day lives and by including technology as a learning medium in our classrooms, we can potentially increase the level of engagement we see from students. Online learning resources such as the Khan Academy not only allow students to utilize technology for learning purposes, but they also allow students to take on a more active role in directing their own learning. The Khan Academy and other programs like it, offer students individualized instruction in a safe, structured and well thought out digital learning environment with built in scaffolding features and motivational elements. Based on the findings of other researchers, I would expect that the treatment group will experience more substantial academic growth overall than the control group will. Because this study plans to look at the Khan Academy as a supplement to and not a

replacement for the regular math program, the treatment participants will receive support from two sources; the classroom teacher and the Khan Academy program. The more capable students will not be asked to work at the pace of their lowest achieving classmates, which is often the case in many classrooms, and as a result of this, those students may be able to take their learning farther and do so more quickly than would be possible in a traditional whole class learning environment. Many elements of the proposed learning environment in this study allow for increased motivation and more learner success. Students are able to work at their own pace and receive immediate feedback about their progress. Students can review and revisit more challenging concepts as many times as they need to, or for those able to, they can move onto more advanced concepts when ready. Due to the affordances provided for learners in this blended face-to-face and online learning environment, it is likely that there will be an increase in at least student achievement, if not in their overall level of motivation as well.

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Appendix

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Sources of Figures:

Figure 1: Khan Academy Whole Class Student Progress Grid. Image retrieved from www.khanacademy.org from within my own personal teacher account

Figure 2: Khan Academy Whole Class Activity Graph. Image retrieved from www.khanacademy.org from within my own personal teacher account

Figure 3: Individual Student Activity Graph. Image retrieved from www.khanacademy.org from within my own personal teacher account

Instruments & Tools for Measurement:

Data collection for the treatment group will be taken from www.khanacademy.org

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