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## The Creation of a Video Review Guide for the Free-Response Section of the Advanced Placement Calculus Exam

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# THE CREATION OF A VIDEO REVIEW GUIDE FOR THE FREE-RESPONSE SECTION OF THE ADVANCED PLACEMENT CALCULUS EXAM

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LEE HONORS COLLEGE THESIS

WESTERN MICHIGAN UNIVERSITY

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THESIS COMMITTEE:

DR. KELLY SCHULTZ, ACADEMICALLY TALENTED YOUTH PROGRAM

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## **Abstract**

*The Creation of a Video Review Guide for the Free-Response Section of the Advanced Placement Calculus Exam* follows the creation of a resource to help students prepare for the College Board's Advanced Placement Calculus Exam. This project originated out of the authors personal experiences in preparing for this exam. The goal of the project was to create an accessible resource that reviews content, provides insights into the Advanced Placement exam, and creates successful habits in student responses. This paper, chronologically, details the development of the resource and a reflection on the final product and future uses.

## **Origins and Reasoning**

*The Creation of a Video Review Guide for the Free-Response Section of the Advanced Placement Calculus Exam* began to develop as I looked for a useful and productive project to serve as my Lee Honors College thesis. As a secondary education mathematics student, I was looking to complete a project that involved both my mathematical and educational areas of studies. As I began to search for a potential projects, I also began to reflect on my prior experiences as a student. I began to consider times when I felt that I did not have enough resources to be successful. As I did this, one particular occasion came to mind; my preparations for the Advanced Placement (AP) Calculus Exam.

I completed my high school's AP Calculus course in my final semester of high school, in the spring of 2012. It was widely known in this course that very few students pass the AP exam with a score that would receive credit at a college or university. At most institutions the minimum score to receive credit is a 3 on the College Board's 5 point scale. (College Board is the creator and governing organization of the Advanced Placement courses and exams.) The semester I took AP Calculus, my school decided that they need to do something different to better prepare students for the AP exam. The school's short term solution was to provide a private after school tutor for students who wished to receive additional help. This tutor was a local university student who had studied Calculus extensively. It is also worth noting the students who used the tutoring were required to pay the cost of the tutor. This tutor was very helpful to the student who used the resource. In fact, to the best of my knowledge, only students who used this resource received scores to receive credit.

As I reflected back on this experience, I began to think of why only a few students, around eight, took advantage of this resource. I quickly landed on the fact that the student had to cover the cost of this tutor. My family was fortunately in a position that this was not an issue. However, I am sure that many students were unable to take advantage of this resource due to its cost. And, thus, I found my thesis project.

I began to formulate the idea of creating a resource for students that would be available to most students and more importantly would be free. I wanted to create a resource for others that encompassed what this tutor was able to do for me. Perhaps one of the single most helpful things the tutor was able to do was to introduce us to the Free Response portion of the exam. I then began to refine this idea and move forward with its creation.

### **Goal**

As I began to proceed with this project I wanted to create a goal for the project. I developed the following goal:

*Through this project, I want to create an accessible resource that reviews content, provides insights into the AP exam, and creates successful habits in student responses.*

As I created this goal I focused on four main points: Accessibility, Review, Insights and Habits. Accessibility focused on the fact that I wanted anyone to be able to use it. I did not want there to be any cost or restrictions to who could use this resource. The other three factors referred mostly to the content I wanted to cover in this resource. Review was meant to ensure that students are familiar with topics that frequently appear on the AP exam. This also implies the fact that students have previously seen this material. Insights were meant to be trends that I found in how the College Board asked questions on the AP exam. For example, if topics were

often presented in a similar manner year after year. Finally, habits refer to facts that students should keep in mind about how they present their work and their answers. This goal is for these facts to become habits before they take the exam.

### **Development and Methods**

Once a solid idea and goal was formed, I needed to research how I could present this resource. I needed to address both how I make the resource available and what would be in the resource itself. First, I wanted to know how I would present this resource. This was important because the method of the presentation may impact what would or would not be included as far as content. I began with the idea that I wanted to be able to spread the resource quickly and with no cost. I immediately settled on the idea of videos. These videos could be uploaded to YouTube and be accessed from around the world for no charge. With videos as my medium, I began to look into how to create a high quality video.

### **Technological Needs**

As I began to do simple internet searches, I was frequently seeing the idea of a “Khan” style video. These are videos based on the very popular site of Khan Academy. This site uses an iconic style that is instantly recognizable to any individual who has seen one of the site’s videos. I, myself, had used this site through my mathematics career and I decided on this format for my videos. As I continued my informal research, I knew that I was in need of four key components: a graphics tablet, drawing software, an audio recording device and screen capturing software.

The graphics tablet is a way to get my own handwriting across to the viewer. This essentially works as a secondary way to control the cursor and create text for the viewer to see. These graphics tablets come in many brands, sizes and with many features. I looked through

numerous reviews and critiques and landed on the Wacom brand tablets. These were a high quality line of tablets of good price that offered many models to fit many needs. After another round of reading review after review, I settled on the Intuos Creative Pen Tablet. This allowed me to have the features that I anticipated needing without many additional unneeded features.

With the tablet selected, I needed a software program that would allow me to draw on the screen with the tablet. I began to look into things that the Khan Academy uses to create their videos. The drawing software they use was a free software known as SmoothDraw. Since the software was free and very user friendly, I opted to use the same software for my own videos.

The audio recorders were more difficult. I found very little in suggestions for this piece. I found that Khan Academy used a nice recording studio with professional recording equipment. This was far beyond my needs. I began to look at simple recording devices on online shopping sites and decided on a CS95 USB communication headset. This was a simple style recorder that would adequately suit my needs.

The final piece of the puzzle I needed was a way to record the work I was creating on my screen. This is done through a screen capturing software. This is just like a screenshot but it's a video instead of a picture. I again looked into what Khan Academy used. I found that they use a \$200 program known as Camtasia. Once again this was far beyond my budget. Although, in looking into this software, I discovered a free version of the software, known as CamStudio that allowed me to do a few key things. Most importantly I could select the file type and record a region or portion of my screen. With my recording needs met, I was ready to begin finding the content of these videos.

## Determining Content

As I began to look into the content to include, I remembered back to the tutor's ability to introduce and familiarize the students with the Free Response section of the AP exam. I knew that this was where I wanted to focus, but I still needed a more narrow scope. As I began to search for information on the exam and for this section specifically, I more or less stumbled across an archive of previous FRQ sections of past exams. Included with this archive was a document that broke down each exam question and part into both its major concepts and specific knowledge topics. This quickly became a very important document. This allowed me to pin down the topics that the College Board addresses most in this section of the exam. This was precisely the narrowing focus I needed. When I first accessed the document, it was only current up to 2010's exam. I then decided to take the 2011, 2012, and 2013 exams and complete the exams in order to classify them and add them into the document. As I completed these questions, I was also brushing up on my own Calculus skills as it had been nearly two years since I had had a Calculus course.

With these tests completed, I was now ready to narrow down the content. As I looked at the three tests I had completed, I noticed that several topics appeared on all three tests or prominently on two of them. Since it is reasonable to assume that the focus of the exam has changed since the classification document began in 1969, I decided to use the last three years to determine the focus of my videos and then use the classification document as supporting evidence for my choices. Table 1 is a summary of the recent exams on which each topic appears. It also includes how many exams prior to 2010 on which each topic appeared.

Table 1<sup>1</sup>

Major Topic	Problem Topic	2011-2013 Questions	Appearances on AP Exam from 1969-2010
Particle Motion		2011 #1, 2012 #6, 2013#2	50
	Direction	2011 #1d, 2012 #6a, 2013#2c	
	Speed/Velocity	2011 #1a, 2013#2a	
	Position/Speed/ Acceleration	2012 # 6 c and d	
Model of a Function		2011 #2, 2012 #1, 2013 #3	
	Average using Various Methods	2011 #2b, 2012 #1c 2013 #3c	20
	Total Change	2011 #2c, 2012 #1b	77
	Rate at a Given Point	2011 #2a, 2012 #1a, 2013 #3a	61
Differential Equations		2011 #5, 2012 #5, 2013 #3	
	Solve using Initial Conditions	2011 #5c, 2012 #5c, 2013 #3b	103
	Tangent Line	2011 #5a, 2013 #a	61
	Find Second derivative	2011 #5b, 2012 #5b,	36
Regions Formed by Two Functions		2011 #3, 2012 # 2, 2013 #5	
	Find Area of Region	2011 #3b, 2012 # 2a, 2013 #5a	61
	Volume by Rotation	2011 #3c, 2013 #5b	48
	Region as Base of a Solid	2012 # 2b, 2013 #5c	15

<sup>1</sup> Note: The classification document uses each part of a question as a separate entry. Thus it is possible that a single topic appears four or more times on a single exam but likely occur in one single question.

With topics chosen, I began to develop the content to appear in each video. I chose to use a recent problem from a real exam in each video. This not only helped me to address appropriate content, it also exposes the viewer to the format and wording of the AP exam. With the content and technological needs met, I began to create the videos.

Once I finished creating and editing the videos, I uploaded the videos to a private YouTube playlist. Using a specified link, I distributed the videos to several teachers around the Kalamazoo area. I received critical feedback on errors and general comments on my videos. I was able to address some of these with annotations on YouTube. However, at the current time, I have not released the videos from their private settings. I will discuss the reasoning for this below.

### **Evaluation**

In the end, I am very pleased with the resource I created. Through the review of current teachers, I have discovered a few things about the process, the use of videos in classrooms, and myself along the way. One aspect of this entire process that I discussed at length with my committee was the idea of a perfect video or in a broader education context, the perfect lesson. As I have discovered, it is nearly impossible to teach an entire lesson without error. In fact, it is unreasonable to expect to. For example, the best sports figures in the world fail at times. Although their errors may be small and infrequent, they still exist. The same holds for teaching. Teaching is a performance art form that changes every time it is performed. Thus each time a lesson is taught it is like teaching a new lesson. This again shows how perfection is nearly impossible and hardly the goal of most teachers. In the context of my videos, this means that they are bound to have errors. Although some can be corrected, errors are a fantastic learning

experience for students. I will discuss this more later. As I look at my “final” product, I still honestly believe that with errors and all, these videos are a helpful resource for both students and teachers alike.

### **Reflection and Future Plans**

As I look back on this entire project from my small idea to the final project, I cannot help but be proud. I am extremely grateful to have had the opportunity to create a resource that could be used for years to come. I think that I have a great set of videos that I can use not only in my classroom but to show prospective employers. I am not sure that I directly addressed my goal for the project however, indirectly I think they are still useful in completing this goal. In my own classroom I think I would present them in a unique way. As I discussed above the videos have errors. I would allow the students to watch the original draft of the videos. I would have them follow along and catch any mistakes that I make in the video. This is a well researched pedagogical activity to have students evaluate and correct completed exercises. This allows students to reason with arguments and justify their own responses and corrections. It also serves as a very good review for students.

As I complete this project, I must answer the all important question of “next time”. If I were given the opportunity, I do not think I would use videos again. I think I would steer more towards a website. This would allow me to correct errors and create a better resource for students. As I discussed above, I think the errors are useful. However, if students use this resource outside of a classroom, they may identify the errors or simply accept them as truths. This scares me that my resource could in fact be used inappropriately and hurt students. This is in fact the reason, I have yet to make my videos public. I need to grapple more with the idea of

presenting a resource riddled with errors for the public. This is a conflict I will reflect on for years to come.

### **Helpful Resources**

#### College Board Websites:

- General Advanced Placement Information
  - <http://apcentral.collegeboard.com/home>
- AP Calculus Course and Exam information
  - [http://apcentral.collegeboard.com/apc/public/courses/teachers\\_corner/2178.html](http://apcentral.collegeboard.com/apc/public/courses/teachers_corner/2178.html)
- Free Response Exam Bank
  - [http://apcentral.collegeboard.com/apc/members/exam/exam\\_information/1997.html](http://apcentral.collegeboard.com/apc/members/exam/exam_information/1997.html)
- Classification Document (Referred to on website as Index)
  - <http://apcentral.collegeboard.com/apc/public/homepage/35399.html>

#### Khan Academy:

- <https://www.khanacademy.org/>