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## Accidental World Teacher

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# Accidental World Teacher

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## Synopsis

When the College Algebra and Calculus I video courses I created were posted on my university's YouTube channel in 2009, I suddenly began to receive dozens of heartfelt emails from students around the world thanking me. Here I tell the story of the creation of those videos and sample the effect they seem to have had over the last decade, as I accidentally became a teacher available to the entire planet.

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**Keywords:** video, YouTube, college algebra, calculus, education.

## 1. Prologue - Voices

... Your skills and knowledge are very, very much appreciated. Words do not describe what it means to returning adult students like myself who suffer from attention deficit or are on time restrictions due to work and this economy...

(Edward, 29 May 2009)

I am Pandiyan from India, born to farmer family and for me economically not viable to undertake schooling through English medium and higher education as well. But I had a rigid thought to get into Engineering...

While I am taking Engineering Math it was very much hard for me to cope up with the concepts. More over even if I approach the faculties I am hopeless. I came to know about your lectures

through my friends... to acknowledge for your service this is feeling from my soul.

(Pandiyan, 6 August 2010)

I am a stay at home mom of 2 children... You are changing so many peoples' lives...

(Nirusha, 16 September 2010)

...most of all thank you for remembering what it is not to understand.

(Gerri, 10 February 2011)

I have discovered an insatiable interest and desire for mathematics...

(Curtis, 19 March 2011)

...had your lectures been available at the time, they would have probably changed the direction of my career. United Kingdom

(Mirjan, 15 July 2011)

...I am an airline captain from Argentina and I wanted to take a moment to send you this email ... a small note from this part of planet Earth so that you know your excellent work made it all the way down here, was received with gratitude, and keeps serving its purpose every day.

(Ignacio, 5 July 2012)

Unfortunately, most videos there [on YouTube] show only "how", but not "why". And then I found your lectures...

(Anna, 6 July 2012)

While in college in '98, I lost my parents and left school without my degree... Your course is allowing me the opportunity to reignite my mind...

(Dean, 23 September 2012)

... please do something for the poor s.ckers (like me) all around the globe and put your a\$\$ on video yet again before you die. Thank you :)

(Johnny, 3 March 2013)

Had I encountered a teacher of your caliber I may have gone on to a Mathematics major in college...

(Jim, 9 October 2013)

Because of you I am not afraid to take mathematics any more...

(Daniel, 30 December 2013)

... allowed me to stop questioning my own intelligence...

(Sabrina, 23 October 2014)

... you're a rockstar to many people out there.

(Jeremy, 26 March 2015)

I retired from the Fire Department in my city after 29 1/2 years. I decided to start a new career in education... These videos helped me to reach my goal. I passed my state mathematics content exam, and have accepted a position in the math department in my local school district... Thanks!!!!!!

(Willis, 10 August 2016)

I have loved mathematics all my life; however struggled with it all my life. I feel like I have been reborn...

(Branden, 15 April 2017)



## 2. Unexpected

Teachers rarely hear back from their students after classes end. This is natural and expected—a handful of comments immediately after the course, maybe a response if you request from them letters of recommendation for some award in later years. Mostly, however, nothing. The river of students' lives flows away as it should. So, when unexpected praise does come, we are pleased.

Since 2009, more than a decade now, I have received over 250 personal email messages about my YouTube College Algebra and Calculus I course videos from respondents in at least forty-eight countries around the world. This doesn't include subsequent email exchanges I had with many of them, answering mathematical questions or other inquiries. 250 doesn't seem like many. But, since my contact information is not on the videos, all these correspondents had to seek out my email address in order to send me these personal messages. After spending hours and hours online “with me” as my virtual student, they felt emboldened to share their stories and their thanks. Like many of them, I was a first generation college student. Hearing how my video effort has been appreciated in detail, not only in their hours of viewing time, but by their taking of hundreds of pages of careful notes, heartens me. I continue to be moved and humbled by their revelations.

These videos were intended for a local use: Missouri rural high school students or students at my university in need of additional help. How they suddenly acquired a global audience is decidedly not my achievement alone, but the result of the shared dedication of several parties.

First, the University of Missouri – Kansas City (UMKC) Center for Academic Development (CAD) initiated and implemented both video series. Deanna Martin of the CAD, and 1973 founder at UMKC of the International Supplemental Instruction program, approached me in 1997 to record a set of College Algebra videos for the Video-based Supplemental Instruction (VSI) program, to add to their existing collection of videos for World History, Chemistry, and Physics. My qualifications were a Master's degree in Mathematics, having taught university mathematics for about seventeen years, and having won two years earlier a Dean's Award for Outstanding Teaching. I was hired and would complete these videos by July 1998. Likewise, six years later the CAD approached and hired me in early 2004, after I had earned my Ph.D. in Mathematics, to create a similar collection of Calculus I videos by the end

of summer 2005. Note that for both video series the word “Supplemental” in the phrase “Video-based Supplemental Instruction” is a misnomer. The College Algebra and Calculus I videos in fact form complete lecture courses and are not just collections of supplementary reviews. Note too that the VSI program pioneered the “stop tape” pedagogical feature of the videos (described below). Finally, when UMKC opened a YouTube channel in 2009 and looked around campus for video content to post, the CAD agreed to allow all these videos to be posted, and so deserves the credit for making them freely available to the world.

Second, the organization of the mathematical content in the videos for both courses was based on the textbooks I chose to use. Although I freely added or revised sections and removed all references to a particular text, those authors get the credit for the breadth of coverage and in what order the algebra and calculus topics unfolded.

Otherwise indeed, the teaching performance choices on the videos are mine.

### **3. College Algebra onto Video**

From November 1997 to July 1998, in the UMKC campus video studio I spent about eighty-five hours recording an entire university College Algebra course for the VSI program. These recordings gelled after my many edits to about forty-three hours of video.

The VSI program provided students in rural Missouri high schools the opportunity to take UMKC courses for college credit when their school had no faculty qualified to be certified as dual-credit instructors for the UMKC High School College Partnership program. Schools used the videos for lectures and used tests written and graded at UMKC, while day-to-day problem solving and homework was taught by their local high school teachers using a VSI-designed handbook. In addition, some VSI courses were offered at UMKC to fulfill a remedial role. I was the UMKC “instructor of record” assigning VSI College Algebra grades for all those rural students each academic year from 1999 to 2015.

When I began this College Algebra project, my first thought was to learn from existing mathematics video series, such as those provided by textbook companies. But most series were review or summary videos, not true lecture courses. I disliked them and was not impressed with the apparent pedagogy.

The video instructors were either sloppy in presentation (poor notational choices, randomly leaving out equals signs, performing algebraic steps magically, and the like), or exhibited “canned” completed problems to discuss, rather than conveying the process of solution and the reasoning that led to it. It is as much the important patterns of thought (How do I start? What do I do next?) and habits of presentation (Be organized. Use standard notation, etc.) that students should learn from us, as it is the content of College Algebra. The skills of algebra must be demonstrated as a living process if the ideas underlying them are to be made clear. I saw none of this on those video series.

I chose my style on the videos to maximize the effect of watching mathematics appear in real time on the screen with concurrent verbal commentary, just as might happen in the classroom. When I teach in front of a chalkboard or whiteboard, I have both gesture and movement across the front of the room available to me to draw together the fore and aft of visually-presented arguments, all of which the students can see simultaneously. On video, since the screen is so small, this past-and-present simultaneity is lost. So, I organized the material into small coherent chunks, save for a couple of theoretical discussions that really could not be trimmed, to capture as much as I could of the board experience given the strictures of the medium.

I avoided dead silence as the “moving hand writes” across the page, by talking my way through the work, and projected as much energy as I could while seated, seen mostly in the lower right corner of the screen, and while lecturing to a black void with no students present for feedback. Humor even reared its head from time to time. Of course, over the many hours of recording my verbal “patter” may occasionally have degenerated into babbling. I chose to keep the notation, topic headings, and the like as generic as possible, so as not to be tied to a particular text. To lower expenses, camera work was kept to a minimum. I constructed all the PowerPoint slides, including whimsical lecture titles such as: “Basics: Remembrance of Things Past” (my nod to Marcel Proust), “The Language of Mathematics” (my quick explanation of a persistent underlying mystery to students), “The Powers That Be: Exponents” (a little word play), and “The X-Y Files: The Proof is in Here” (riffing off a popular television series).

In the editing process, with help from the studio technician, I looked to find and have repaired all minor errors, both vocal and visual. Some were difficult to fix without re-recording a long but otherwise correct segment.

I must admit that as a man who likes to repeatedly revise his written work, the impossibility of “tweaking” parts of recordings without having to re-do an entire patch was frustrating, though I came to accept it as another inevitable compromise of the video medium. There were also errors that we did not correct, but which I self-corrected on the videos soon after they occurred, as I might catch myself in a class.

As mentioned, in the VSI setting these videos are played to students during a class period by a high school mathematics teacher who then has them discuss what they’ve seen and taken notes upon and work many problems as indicated in the handbook. I am video-present as lecturer, but as is the nature of a video course, I am absent in problem-solving sessions where much of the real learning takes place. So, I included on the videos a selection of examples, some easy, some hard, some optional, to at least lay the groundwork for learning to solve problems in the course. After a lecture segment, I will start a problem, then pause while the “stop tape” sign pops up with its characteristic loud attention-demanding whistle, at which moment the instructor halts the video playback. In the break, students work on the problem themselves. When the instructor re-starts the video, for students to compare with their work I demonstrate one possible solution hoping for the same “Aha!” moment I might elicit were I there in person. A diligent student can find in these stop-tape completions enough useful advice to successfully begin to master problem-solving skills.

The choice of algebra topics covered was a blend of those in the text I chose to base the videos upon (in which a graphing approach was emphasized), what UMKC actually covered in such a course (using a different text), and what I thought essential from my own years of teaching. The reference text was *College Algebra Enhanced with Graphing Utilities*, by Sullivan & Sullivan, 1st Edition, 1996, Prentice Hall. I avoided tricks or algorithms of limited long-term use. Enrichment topics appear only in the final X-Y Files video, where an instructor may choose to use them or not. Overall, I recorded more material than instructors may need to present, so that some choice is left to them, which I hoped would increase the flexibility of the course as well as the shelf-life of the videos.

Figure 1 from the videos is an image of function notation  $f(\square)$ , in extreme (!) close-up. Figure 2 presents a function  $g$  drawn as a machine, taking input values  $t$  and producing output values  $g(t)$ .

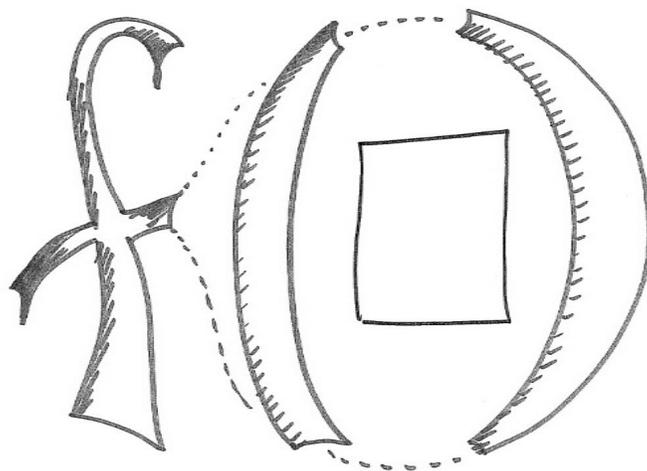


Figure 1: Sketch by the author, 1998.

ex:

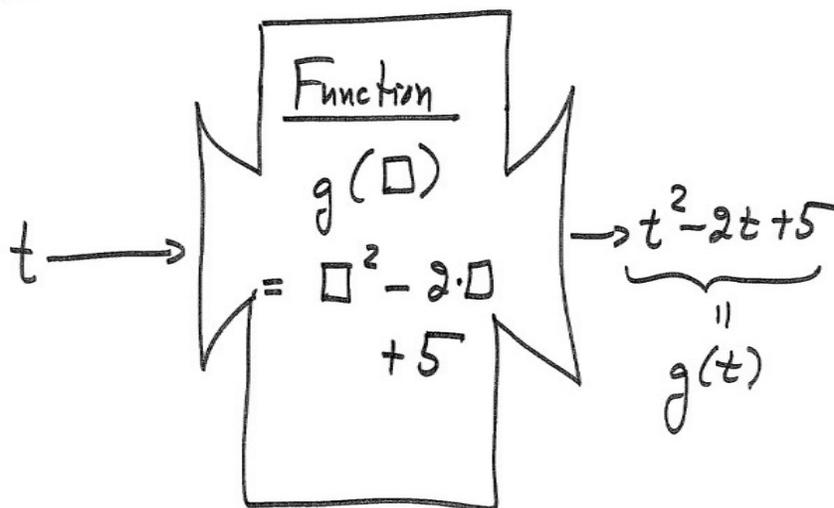


Figure 2: Sketch by the author, 1998.

Figure 3 shows how to find what domain values  $x$  cause range values  $f(x)$  to be nonnegative.

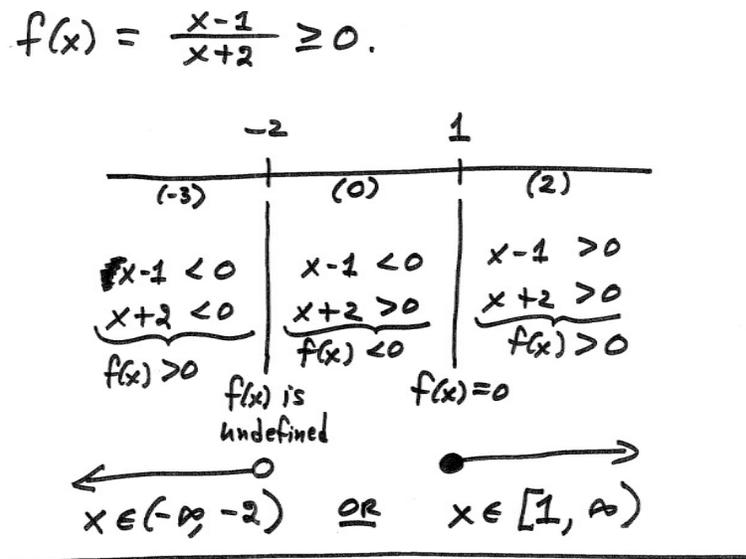


Figure 3: Sketch by the author, 1998.

I live at the tip of Cape Cod MA and the nearest college is 2 hours away. Again, thanks from me and all the others lucky enough to view your lessons.

(Lois, 12 September 2011)

Thanks to your lectures I have been getting A's all semester long. Not only have you helped me to have a solid understanding of all of the course material, but you have also helped me to develop an appreciation for math that I'd never had before. Thank you so much.

(Thomas, Lexington, KY, 28 November 2014)

#### 4. The Joy of Technical Details

How we crafted the videos drew email questions to me.

My name is Asger. I am a graduate student at Aarhus Engineering College in Denmark, and for some time I have had the ambition to create educational videos instructing undergraduate students in various engineering-related subjects as well as mathematics... Then I had the great pleasure of stumbling on a video of yours, where you demonstrate the irrationality of the square root of two. [From the X-Y Files video.]

In this video you use a camera that films vertically down, whilst you write on a simple piece of paper, as one might write on blackboard (or whiteboard even). This technology is precisely what I have been looking for!...

Does that piece of equipment have a name? Might one purchase such a piece of equipment from a reputable vendor? Or must one fashion it oneself from a camera and a tripod of some sort?...

Best Regards,

(Asger, B.Eng, Aarhus, Denmark, 28 March 2016)

... you are our online video HERO!!! How do you record yourself in front of your calculations? Are you using ELMO? or a regular video camera? Are you using a green screen to record yourself? How do you assemble your presentation? We are dying to use this in our online teaching. Can we do this in Camtasia? Inquiring minds want to know! Thank you so much. Hope you are well.

(Michaelann, MA.Ed, CMA (AAMA), Instructor, Medical Assisting, 24 February 2017)



We recorded the videos in a studio on campus with two cameras.

One camera was directly in front of me as I sat at a desk. Behind me was a “blue” screen on the wall so that my PowerPoint slides could be superimposed electronically as background when I introduced sections and titles. On a monitor placed nearby I could see what was appearing and used a keyboard to move through the slides myself. It was important to me that I controlled everything affecting the pace of the lecture. The other use of this front camera once I began the lectures, was to place a reduced image of me writing in the

lower right corner of the screen, because everyone agreed it would engage viewers. That image would fade out when I started to write over myself.

A second camera was attached to a pipe vertically above me, focused down on the page. This was the most important camera placement, it seemed to me, to preserve the intimacy I tried to capture. My intent was that viewers should feel as though they were peering over my shoulder.

I used pads of matte light-tan or gray paper, which I had made up at an office supply store. I wanted sheets thick enough to absorb the pen's ink and be easy to tear off the pad. I used standard dry-erase or overhead transparency marker pens. What you don't see on the videos is that I had another blank pad out of view nearby, as well as lots of other pens so I would never run out, because stopping and starting again disturbs the flow of the lecture.

Most importantly, I had already thought through and written up the lectures beforehand, exactly as they appear when I write them on the video. These previously-written and carefully drawn sheets lay just above the pad on the desk, also out of sight of the cameras. Since I was just copying my own work, I was left free to concentrate on what I was saying as I wrote, reducing enormously the number of verbal errors.

## **Two Reviews**

I think each (video) showed that a great deal of thought and preparation had gone on before filming. The placement of the material on the writing tablet, the associated discussion, and the examples chosen to make particular points were thoroughly thought through. [R]... has a strong voice with enough variation and tonal accents to make his discussions easy to listen to for students (versus a monotone type voice). He is careful in his use of mathematical language, and he usually makes an important comment at just those places where students have difficulties or are likely to miss important conceptual ideas. His writing is very clear and easy to read. His sketches of graphs are well done, and he has tried whenever possible to introduce visuals into the lectures. I also thought his numerous historical references were very interesting. [R] pays attention to details and rarely misspeaks -- quite an accomplishment when one realizes this project involves 40 some hours of tape...

Watching this gave me a real sense of the advantage of having a qualified mathematician teaching college algebra. His cheerful demeanor and sense of humor should help him to bridge the gap created by the medium... students will relate well to some of his common expressions such as calling a fact “handy” or saying that some result or simplification “makes us happy.” It is easy to see how he has earned a reputation as an effective teacher.

Joe Yanik & Elizabeth Yanik, Professors of Mathematics,  
Emporia State University, Emporia, Kansas, Summer 1999

...the video tapes are excellent... [R]... is an outstanding lecturer and is exceptionally well-organized...

There are several specific things that I like about this course which should be mentioned. The first point that I would like to make is that the graphing calculator is used in appropriate places and in appropriate ways. It is not a crutch, but rather an instrument to enhance the learning process. In particular,... at several places, some ways of getting around certain limitations of graphing calculators are carefully spelled out.

A second point that I would like to make is the use of the “stop tape” feature. This is clearly a good idea. In particular, at a number of places the students are given a problem and then they are to work on the problem during a stop tape segment. After the stop tape segment, one way of doing the problem is then shown on the tape. This cannot help but get the students involved and more interested.

A third point that I would like to make is that the historical references made during the tape are quite informative and I am sure that many students will be “turned on” by the knowledge that mathematics has a history and was done by people. Too often mathematics, especially college algebra, is presented as though it is material that fell out of the sky...

...this is an excellent course and I am impressed with the work that has gone into its creation.

John Beem, Professor of Mathematics,  
University of Missouri, Columbia, Missouri, Summer 1999

## 5. Calculus I onto Video

After 2004 discussions, in 2005 through August, I likewise recorded with the UMKC Interactive Video Network an entire Calculus I course on about twenty-nine hours of video for the “VSI Calculus Project,” recipient of a grant from the Chancellor’s Fund for Innovation. In the Final Report, Glen Jacobs, Director of the UMKC Center for Academic Development, wrote:

Our partnership in this project with Dr. [D] from the Department of Mathematics and Statistics has been very rewarding. As he has demonstrated in past projects working with us, Dr. [D] is a true professional who wants every student to meet high standards in math.

The reference text was “*Calculus (Early Transcendentals version)*,” 8th Edition, by Anton, Bivens, and Davis, 2005, Wiley.

In Figure 4 from the videos we illustrate what it means to say a function “grows without bound” up or down as its domain value  $x$  approaches the number zero from either side.

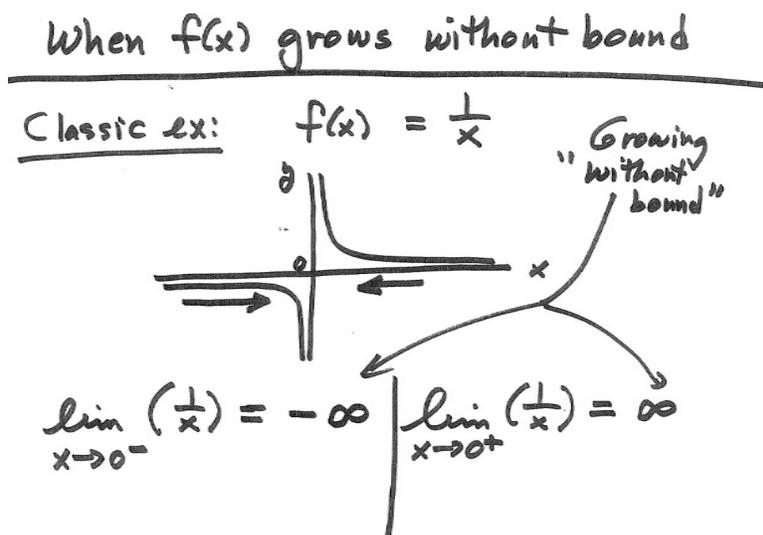


Figure 4: Sketch by the author, 2005.

In Figure 5 we demonstrate how differential calculus enables us to find where the graphs of functions have peaks (local maxima) and valleys (local minima).

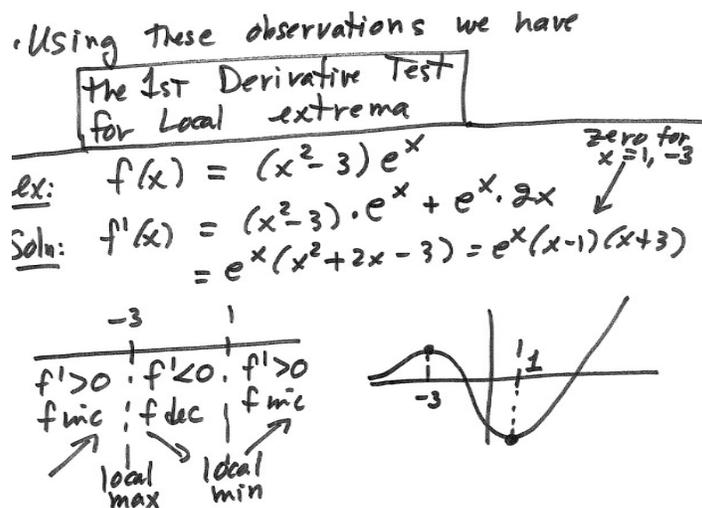


Figure 5: Sketch by the author, 2005.

Figure 6 shows how integral calculus enables us to find the area between two curves.

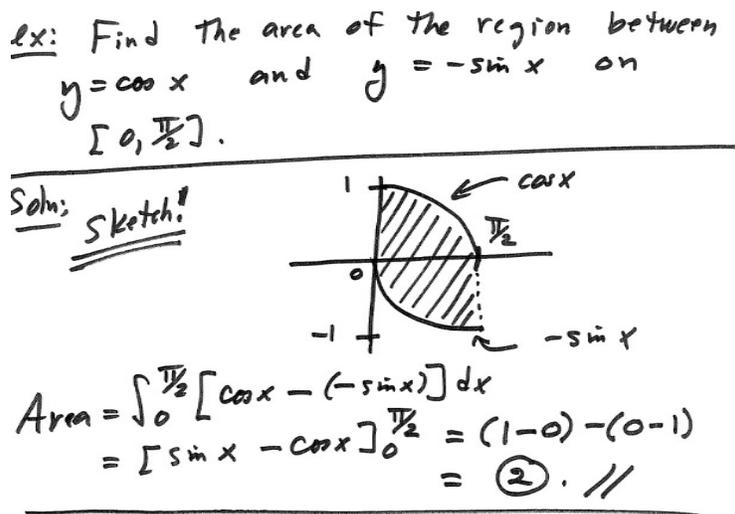


Figure 6: Sketch by the author, 2005.



Visualization, visualization, visualization--that is the key, in my humble opinion, to truly understanding calculus--and you provide that handsomely.

Thank you. Math nerd in Portland, Oregon,

(Nick, 1 August 2010)

Your video lectures have made me love calculus which I previously feared. (Honestly, I am not kissing your arse... )... Your style of teaching has “infected me” and I want to be just like you (I know it sounds cheesy but that’s an honest truth).

(Zrrobhertts, London, England, 8 and 16 August 2010)



## 6. More Joy of Technical Details

At each recording, a so-called *window burn* video tape was created and handed to me as I left. This was an entire day’s session, often up to three hours, with an embedded time code running across (*burned onto*) the bottom of the screen when played. A VCR and monitor had been installed in my department office. There I would spend hours reviewing the tape second by second to pinpoint for the technician where sections should begin and end, and precisely locate errors to be corrected later, either by him (deleting the audio of my incorrect verbal remark, obscuring something I incorrectly wrote, and so on), by me recording a voiceover, or in the worst case re-recording a segment at our next session. I sent him my notes within a week. A few typical or amusing examples of audio or video fixes were:

I mistakenly say “One over  $x - 2$ ” instead of “One over  $x + 2$ .”  
Delete the audio of  $x - 2$ .

I fail to write the word “exist” after I write “one-sided limits.”  
Please add that word.

Delete the audio “uh”.

My stomach growls loudly.

Stop at the end of this bullet point, just after I draw my two little lines //, and before I begin to babble.

I gurgle.

I suppress a burp.

Is my whistle on the word “quickly” a problem?



Figure 7: The author recording Calculus 2005. Photo by Sonny Painter, UMKC.

## 7. Posted on YouTube

Four years later in May 2009, UMKC posted both video courses on its YouTube Channel. Our Information Services Associate Director, Vishal Kurup, wrote in January 2016:

[R]’s videos on UMKC’s YouTube channel, something I worked with him on importing, have drawn rave reviews and shine a positive light on both UMKC and the University of Missouri as a whole.

[Course - College Algebra with Professor Richard Delaware - YouTube](#)

[Course - Calculus I with Professor Richard Delaware - YouTube](#)

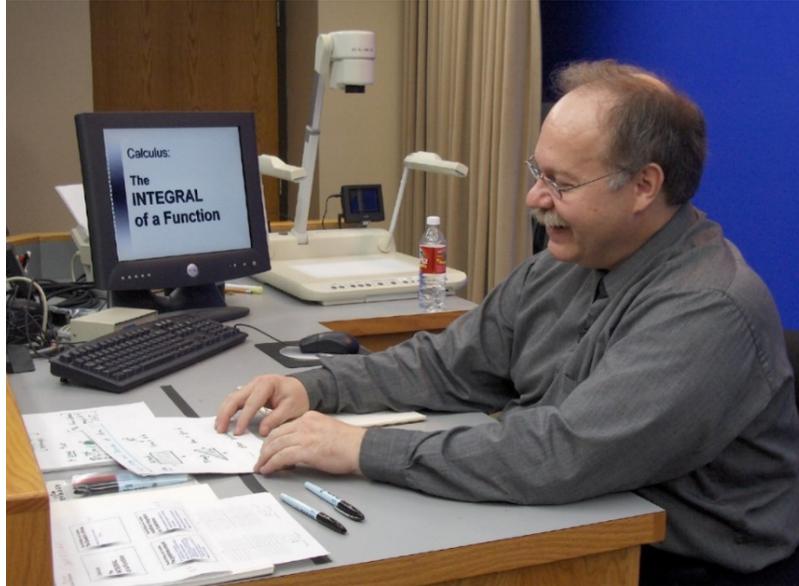


Figure 8: The author recording Calculus, 2005. Photo by Sonny Painter, UMKC.

Each video series has now been viewed hundreds of thousands of times - the first Calculus I video, “Functions: A Review of Precalculus,” in fact over one million times. It is clear that UMKC has had a sizable impact on the world through these videos. I’m proud to have been a part of that.



I just wanted to thank you for being my teacher without realizing it, and for putting those free videos out there for people like me... You are my hero!

Sincerely,

(Felicite, 27 July 2013)

Sir, by your diligent work and efforts someone in India got immensely benefited, which can never be paid off... thanks,

(Amit, 23 March 2014)

Well you were never officially “my” professor, but I feel like you were!

Thanks professor and hope you are well.

(Steve, 5 June 2018)

Thank you again for your excellent lectures. . . I love math now thanks to you. . . you are in my prayers always with as much gratitude as I hold for professors I have studied with “in the flesh”.

(Mary, 26 July 2019)



Not so many emails arrive these days, just a trickle. Yet the accidental world teacher in me smiles at each one.

## 8. Pandemic Voices

This is a fan letter. I am half way through your video on Algebra. I think you are the best teacher ever. On behalf of the millions of people on YouTube who have watched your video, thank you.

I am a freshman at UW-Madison. I am also from China. . . your lectures enlightened me. As if I have been under the water for years and breathe fresh air for the first time. I love math now.

I wish you well during this pandemic, and continue to enlighten students around the world.

(Siwei, 13 September 2020)

My name is David I'm a student from Medellin, Colombia, and I'm on university studying engineering (Universidad Pontificia Bolibariana). In high school I did not have math teacher for the last 2 years, so university has been pretty rough, but thanks to your course of calculus I was able to understand the concepts in a way I did not know was possible. I just want to say thank you

for your work. It has helped me a lot like no other teacher I have met.

(David, 24 September 2020)



## 9. Emails from around the world

The following is a list of Countries/Nations from which I have been emailed directly.

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Afghanistan	Morocco
Angola	New Zealand
Argentina	Nigeria
Australia	Norway
Boznia and Herzegovina	Oman
Brazil	Pakistan
Canada and Quebec	Palestine (West Bank)
China	Philippines
Colombia	Romania
Denmark	Saudi Arabia
Ecuador	Seminole Tribe of Florida
England/United Kingdom	Seychelles
Ethiopia	Singapore
France	Somalia
Germany	South Africa
Greece	Spain
Guyana	Sri Lanka
Hungary	Sweden
Iceland	Switzerland
India	Taiwan
Iraq	Thailand
Ireland	Turkey
Israel	United States of America and Puerto Rico
Jamaica	Zambia

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**10. Epilogue – World Voices**

I'm 19 years old and I study at the university of mathematics of Uberlândia (in Brazil).

(Fábio, 14 November 2009)

I'm a student at Politehnica University of Bucharest, Romania.

With respect,

(Iulia, 6 September 2010)

I am an international student from Bosnia and Herzegovina.

Kind Regards from

(Amela, 12 April 2011)

With thanks from Iceland,

(Ómar, 19 April 2011)

Regards, Soca, Angola, Africa

(Soca, 25 September 2011)

I would like to introduce you and your videos to Taiwanese and Chinese. Have a great day,

(Suei, 2 August 2012)

You might have heard about Somali, and that is where I'm coming from, but now I'm living in South Africa and willing to study Industrial Engineering.

Thank you.

(Ahmad, 13 October 2012)

Al Salam alaikum (peace upon you).

My name is Adel, i am from Palestine - west bank,

(Adel, 15 November 2012)

My name is Ali. I am a senior and study at the American University of Afghanistan in Kabul. Regards,

(Ali, 11 February 2013)

Kind regards, Switzerland

(Ilian, 2 March 2013)

My name is Sikiru from Nigeria in west african region.

(Sikiru, 12 August 2013)

My name is Esat. I'm a student of Economics at Middle East Technical University (METU) in Turkey.

(Esat, 14 September 2013)

I am a math professor in Ecuador. Take care!

(Omar, 8 October 2013)

Greetings from Puerto Rico!

(Julian, 3 January 2015)

I am a math instructor. I teach college algebra, and calculus courses at University of Hargeisa, Somaliland. Thank you.

(Ahmed, 17 January 2015)

This is Mukuka from Zambia in Africa. Warm regards,

(Mukuka, 4 October 2016)

Sir I'm student of mathematics from Pakistan.

(Zahid, 31 January 2017)

This is Viraj from Mumbai, India pursuing Bachelors Degree in Electronics. Thanks Alot sir!!!

(Viraj, 24 March 2017)

... a great legacy to future students. A life well lived. Spain

(Ignacio, 11 June 2017)

You truly inspire me to continue on my way to hopefully someday achieve a Ph.D. in physics. I hope this gets to you. Thank you, from Denmark.

(Simon, 3 August 2017)



**Acknowledgments.** I thank my intrepid and long-suffering first readers, Cindy Thompson and Rachel Homard.