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Graphic Math: A Collection of Interviews With Creators of Mathematically Themed Graphic Novels

Audrey A. Nasar, Department of Science and Mathematics, The Fashion Institute of Technology, USA, Audrey_Nasar@fitnyc.edu

This article presents interviews with five noteworthy creators of mathematically themed graphic novels in effort to provide insight into how they developed their storylines and visuals to incorporate mathematical concepts. The creators interviewed include Larry Gonick of the educational graphic series *The Cartoon Guide to* (Gonick and Smith, 1993; Gonick and Huffman, 2008; Gonick, 2012; Gonick, 2015), Robert Lewis and Jennifer Granville of *Prime Suspects: The Anatomy of Integers and Permutations* (Granville and Granville, 2019), Apostolos Doxiadis of *Logicomix: An Epic Search for Truth* (Doxiadis et al., 2009), and Gene Luen Yang of *Secret Coders* (Yang and Holmes, 2015). Two of the interviewees created graphic novels for scholastic purposes and were therefore guided by pedagogy, while the others let the story be their guide. Despite these differences, the combination of interviews offers advice and suggestions for writers, illustrators, and educators interested in creating or using mathematical graphic content. The interviews took place between the 5th of June and 31st of December, 2020.

Graphic novels are increasingly being used for scholastic purposes across the curriculum as supplements or replacements for traditional textbooks (Syma and Weiner, 2013; Brozo, et al., 2014; Maughan, 2016). In particular, there are a number of graphic novels that explore mathematical concepts in algebra, calculus, statistics, and even graduate level studies (Gonick and Smith, 1993; Doxiadis, et al. 2009; Gonick, 2012; Gonick, 2015; Gossett, 2018; Granville and Granville, 2019). This article documents interviews with five noteworthy creators of mathematically themed graphic novels in effort to provide insight into how they developed their storylines and visuals to incorporate mathematical concepts. The interviews were the result of a combination of email exchanges, phone calls, and video calls, all of which took place between the 5th of June and 31st of December, 2020, and written consent was obtained from all the interviewees for the purpose of this article.

The Interviews

Part I: This part contains general interview questions and answers that were posed to all of the interviewees.

What is your process of developing the storyline and visuals to incorporate mathematical topics?

Larry Gonick (LG): It can be complicated, but the pedagogical structure always comes first. All these books have a tremendous amount of careful organization behind them. Then comes the writing. Then comes the revision. And only then does a cartoon structure begin to appear.

In a collaboration like *The Cartoon Guide to Statistics* (Gonick and Smith, 1993), some of the cartoons come ready-made from the mind of the collaborator. Sherlock Holmes shooting arrows at a target, the polling for Senator Astute, and the brass tack factory (for illustrating sampling) were Woollcott Smith's ideas. Using a swami who sits on tacks to do the sampling was mine, as was the insurance agent and the use of reptilian car names.

I've often used two main characters to carry the narrative. This started with *The Cartoon Guide to Physics* (2008), where my coauthor Art Huffman introduced two observers, Lucy and Ringo, because he wanted originally to do a relativity book, where observers matter! I simply adapted them to beginning physics and found that playing them off each other worked well.

In *The Cartoon Guide to Calculus* (2012), the two characters probably have their basis in the dynamics of an epsilon-delta proof. A math teacher told me that he describes an e-d proof as a challenge game. You challenge me with a tiny epsilon, and I satisfy you with a suitable delta.

In *The Cartoon Guide to Algebra* (2015), I had another consideration. It's a very abstract subject, mainly concerned with symbol manipulation, so I had the idea of trying to make readers feel as if they were inside the equations somehow. This accounts for the frequent use of small characters carrying numbers and parentheses around, including on the book cover. I was also very concerned to make Algebra as concrete as possible, with as much exposition as possible devoted to everyday things. Rates, for instance, are explained in terms of eating. Who can't relate to that? And there's a ton of stuff about money.

Frankly, I don't think I did nearly enough of that in *The Cartoon Guide to Calculus*. For a couple of reasons, the calculus book is too dominated by formulas. One is that I strove for some rigor, trying to make e-d proofs more understandable. Another is that I gave proper space to the transcendental functions, which ate REAMS of pages. What got left behind was a more concrete sense of what smooth curves are, what tangents are about, more intuitive stuff like that.

Apostolos Doxiadis (AD): From my point of view there were no pedagogical decisions, there were communicative decisions. What makes communication more effective? I found it appealing as a scriptwriter of the comic book that many of the ideas were naturally visual. Geometry is visual, Euclid is visual, Hilbert's Hotel, I mean it's incredible – it's a hotel. I didn't force them. I followed the flow of the ideas and when the ideas naturally became visual, I visualized. I didn't try to visualize to make something easier or harder or sexier or easier to consume. If there was visual potential in something, I used a visual language. Since my aim was not pedagogical, I didn't have to think would this be better conveyed if it were visual or not. Frege's axioms were highly non-visual and I didn't try to visualize his ideas. I emphasized his obsession and the character structure that goes around the ideas. For example, if you have a rigid axiomatic system it goes with a rigid and paranoid personality, like Frege.

Jennifer Granville (JG): It wasn't so much a process of developing a story to incorporate mathematical ideas – the story WAS the mathematical ideas! I had no role in pedagogical decisions. And, in fact, this wasn't ever conceived as a pedagogical *tool* – it was conceived as a way to communicate advanced conceptual mathematical ideas – and if some learning took place as a result of reading the book, then that was a bonus.

Andrew Granville, my brother, would explain something to me, like permutations, cycles, even prime numbers. Then I would come up with a concrete idea that could illustrate it in some way. His initial concept was to visualize integers and permutations as two dead bodies that were in fact twins. He asked me to bring that concept to life by developing it into a story and screenplay. I was very reluctant, but it was quite fun and then we got into it. Basically, he'd explain some math to me and I'd try out ideas for dramatizing the math. Which is a methodology I think could be used in teaching.

For example, in the scene about logarithms (see **Figure 1**), I used actual logs to display the math, which I felt was a nice visual thing. For permutations we used dancers (see **Figure 2**). The process of developing the visuals is the same as when writing a screenplay. If you have two people in a scene professing love for each other, you wouldn't just have them sitting there saying 'I love you'. You have to find a way for them to express that emotion visually and without necessarily saying those words. So, if you think about the storytelling in that way – that we want to 'show' the readers what a prime number is, rather than 'tell' them – then that is the approach we took right the way through the creative process.

Robert Lewis (RL): Whenever possible, I aspired to find compositional equivalents to the mathematical concepts being explored, so as to not have to rely primarily on blackboards, screens, and the like to merely cram figures into boxes and balloons (see **Figure 3**). Panel arrangements, grouping of characters, patterns and etchings into architecture, fractal patterns on clothing items and within decor were conceived to complete the mathematical explorations, if for no other reason than thematic resonance and to function as in-jokes or Easter eggs for those in the know.

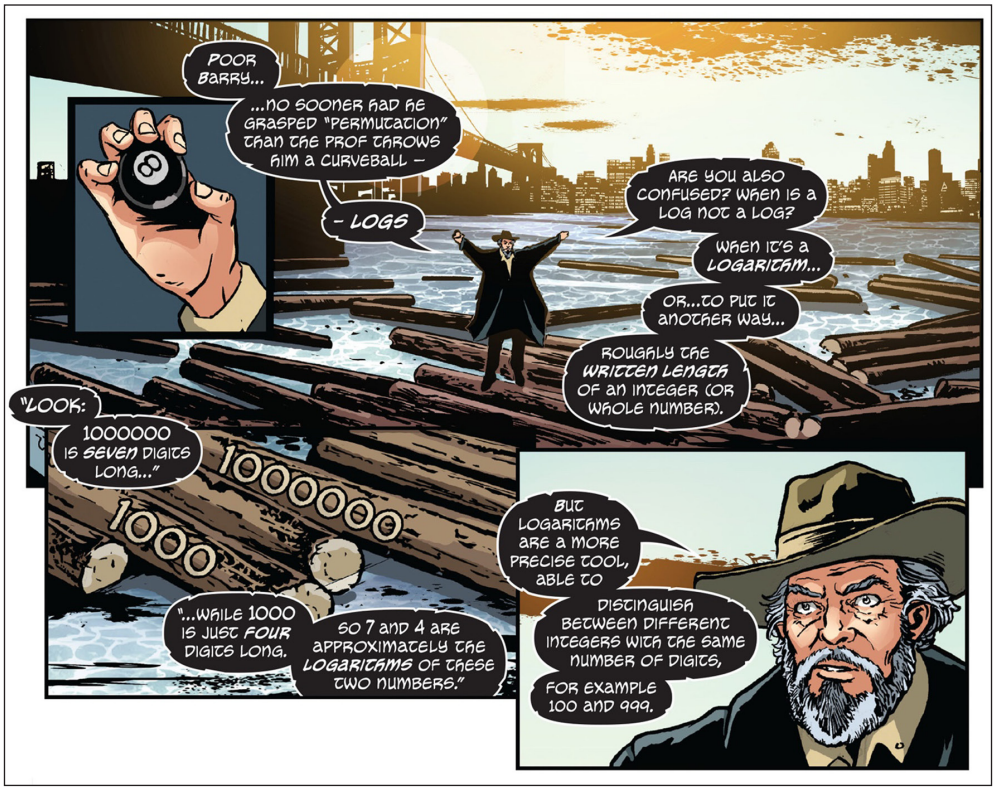

Figure 1: Page from Granville and Granville (2019) *Prime Suspects* (Princeton, Princeton University Press). © Robert Lewis.

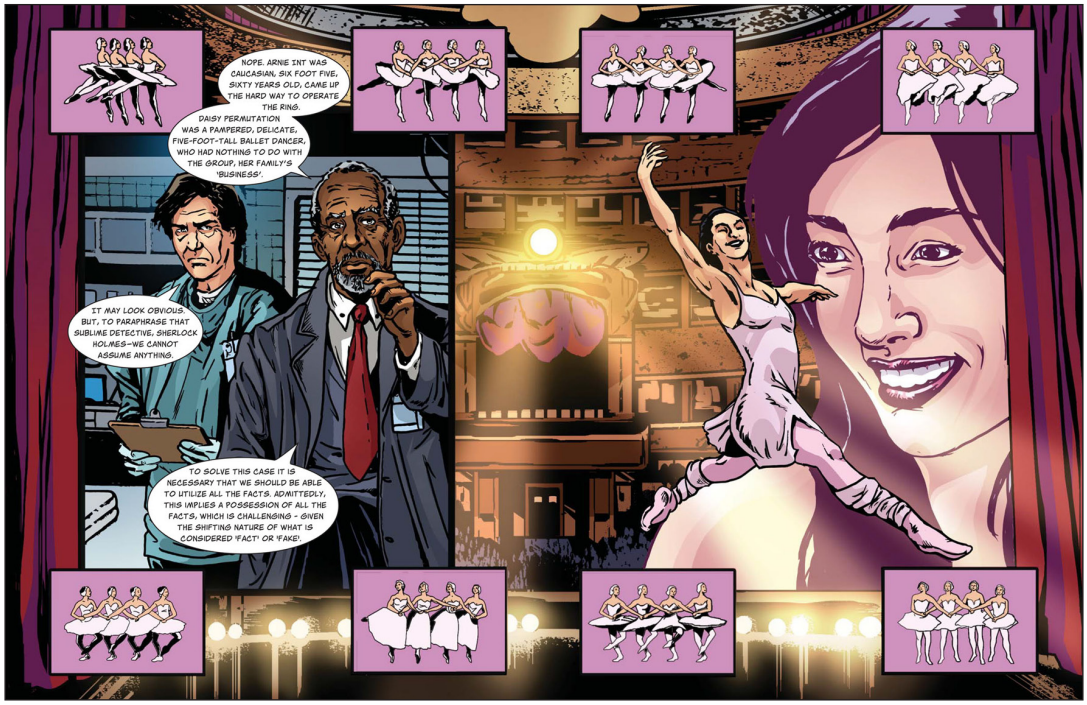

Figure 2: Page from Granville and Granville (2019) *Prime Suspects* (Princeton, Princeton University Press). © Robert Lewis.

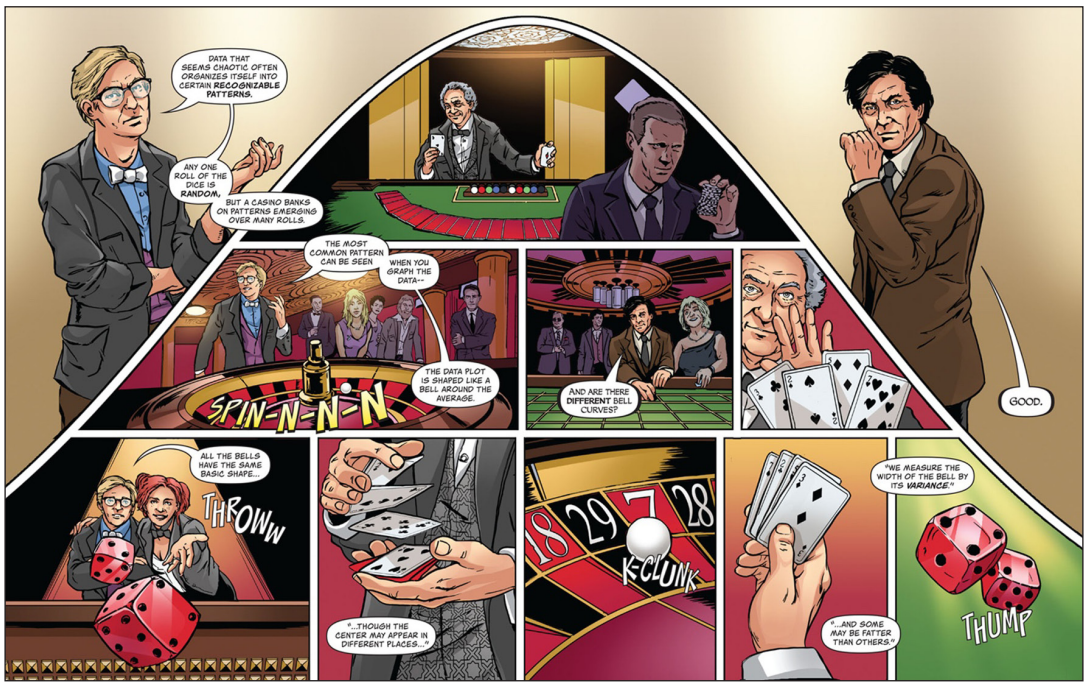

Figure 3: Page from Granville and Granville (2019) *Prime Suspects* (Princeton, Princeton University Press). © Robert Lewis.

As well, I conducted research into examples of mathematical thinking in other comics and graphic novels. I was surprised to learn the golden ratio has been employed—sometimes unconsciously—by a great many esteemed artists, in terms of external (the page) and internal (the elements within the panels) compositional structure.

Gene Luen Yang (GY): With *Secret Coders*, I thought hard about which topics to cover and how to cover them. I looked at the curriculum I used in my classroom and chose the topics that I thought were best suited for comics. I tried to scaffold the topics. I did a lot of this by instinct. When I began *Secret Coders*, I'd been teaching various levels of Computer Science for over ten years. I knew that some lessons required a lot of drawing on the whiteboard, and other lessons didn't. I pulled heavily from those visual lessons.

Who is the intended audience for your book(s)? Would you recommend that this book be used in the classroom? In what way?

LG: The books are certainly intended for students: middle and high schoolers for Algebra, upper high school or college for Calculus, any age up to grad school for Statistics.

AD: No, I wasn't planning for this to be used in the classroom. The moment the project takes on for me, I forget the audience. There was no intended audience. Believe in the work we'll see who reads it. I think I cannot work any other way. You do it for its own sake. Alecos Papadatos, the illustrator, was very worried that no one was going to read it when he would tell them about the subject!

I did have the experience with *Uncle Petros and Goldbach's Conjecture* (2010) that it was often referred to by teachers and professors and that it was used and discussed in an educational setting so I wasn't surprised when that happened with *Logicomix*.

JG: Anyone with an interest in math and graphic novels are the audience for the book. Math geeks, math enthusiasts, and comic aficionados. I can't speak to using the book as a mathematical aid in the classroom – but I do think it is useful in illustrating and demonstrating how close science is to art and art to science, and how creativity is present and important in science and not exclusive to 'artists'. I have used it in lectures as to how an idea, however tenuous, can be developed and mined to go off in so many interesting and unexpected directions – possibly resulting in discoveries that would never have happened had one not allowed the imagination to run riot.

We never envisaged our audience as students in an academic environment – what we were doing was bringing something to life in a different way and having fun and we hoped our readers – whoever they were – would have fun.

GY: I saw *Prime Baby* (2010) as entertainment. I wasn't really trying to teach math with that book. *Secret Coders*, on the other hand, is explicitly educational. I began that project because I wanted to combine education with entertainment. I wanted to teach computer science concepts by telling a story.

How did you arrive at the illustration style and design of the panels? Were there specific cartoonist that inspired you?

LG: I have a pen style and a brush style. My pen style is inspired by Rius and others, including the great Malaysian cartoonist Lat. My brush style comes from Walt Kelly's *Pogo*. I'm more comfortable drawing with a brush. It gives me more control over the line, and filling in shadows comes more naturally with the brush.

RL: The aesthetics of directors like Stanley Kubrick, Brian De Palma, Alfred Hitchcock and David Cronenberg were as important to me as the comic book art of Neal Adams, Gene Colan, Bernie Wrightston, and Howard Chaykin, whose styles I shamelessly imitated.

Andrew and Jenny provided me with photo reference whenever they had an idea for a character or location, or when the script dictated a very specific likeness (the book's many mathematician cameos, friends, relatives, and celebrity in-jokes). The lead characters evolved over many sketches.

How do you see the role of comics/graphic novels that teach mathematics changing in the future?

LG: One thing that writing history has taught me: never predict the future!!!

AD: The appealing thing is it can make math much less scary, it can lessen the fear. On the other hand, there are many ideas in mathematics that are very intuitive and have very much to do with perception and visual understanding and I think it can help you understand those ideas and develop an opinion of them before you get to the formalism, through the visual language. The visual ideas can appeal to the emotions.

GY: I think we'll see wider and wider acceptance of comics and graphic novels in the American classroom. As an educator and a cartoonist, I'm looking forward to it.

What advice do you have for a new author setting out to make an educational cartoon/graphic novel?

LG: Hmm... I guess the main thing is don't take on too much. The hardest thing about the medium is keeping it open and inviting, and that means not too many words on each page. You would be amazed at how much winnowing down has to happen before a story

can become a page of pedagogical comics. On the other hand, it is ESSENTIAL that the writing be uninterrupted enough to make coherent points. I've seen examples where individual sentences are broken into fragments, each fragment being given its own drawing, and I don't think this works very well. The artist has to respect the fact that it's a cognitive challenge for a reader to shift back and forth between words and pictures.

AD: For an author, try to understand the language very well. Don't consider it axiomatic that if you can write a story you can write a comic book. I've looked at some educational comics, or comic books that were aimed to educate and their problem usually is that they don't know the language. They think that if they do it in pictures it's funnier but it can be deadly dull. From people who come from writing or education and do graphic novels the usual mistake it they haven't make themselves familiar with the language. They have to really understand the language and this is the hardest part. If I hadn't made films before, I don't know how easy it would have been for me. Both Alecos and I had experience making films. We spoke in terms of long shots, tracking shots, voiceovers. We used film language in a different form.

JG: Make sure you have a great relationship with your artist and that you lay out clear, realistic goals and deadlines for yourself and your team. Fit the style and content of your novel to your budget (both time budget and financial budget). Be clear about the mechanics of finishing a graphic novel. i.e. understand the processes such as lettering, colouring, inking etc. Also, think about how you are going to market it.

RL: The usual clichés: read Scott McCloud's *Understanding Comics* (1994), Eisner's *Comics and Sequential Art* (2008). Try to read comics in languages you don't understand and see how much of the story you can follow based on the drawings alone.

There's a great collection *99 Ways To Tell A Story* (2005) by Matt Madden. Watch a lot of silent films. While too-often dismissed as crude, hammy, and quaint, those created by best directors of the era were masters of staging sequences that could be perceived only visually or with minimalist musical accompaniment. Title cards were in the service of the images, as opposed to the inverse, which too-often in comics has the art being in the service of the dialogue balloons and narrative captions.

GY: Think through your classroom teaching. Figure out what lessons might best be adapted to comics. Lessons that require visuals and lessons that walk students through a series of steps are strong contenders. Take a look at Scott McCloud's work, too. He puts himself in his books to create a connection with his reader. I think it's a great technique.

Part II: This part contains specific interview questions and answers that were catered to each interviewee.

Larry Gonick

What inspired you to use the comic book format as an educational tool?

I started cartooning "seriously" in late 1970 or '71, when a friend showed me the non-fiction comics of the great Mexican cartoonist known as Rius. Rius pioneered the use of a highly flexible format to convey information with humor and graphics; traditional looking cartoons inhabited a non-traditional page; the characters made commentary on events described in the text. I borrowed his approach wholesale, although I wanted to give the drawings a more American look.

Within a fairly short time, I found that these explanatory comics lent themselves very well to historical subjects. For 16 months starting in April, 1975, I did a cartoon history of colonial Massachusetts and the American Revolution as a color feature in the Sunday comics section of the Boston Globe. In 1978, I started working on *The Cartoon History of the Universe* (1978) as a series of black-and-white 48-pagers for Rip Off Press, one of the pillars of underground comics publishing.

Around 1980 I first applied the technique to a scientific subject, genetics. Part of my motivation was commercial—popular science books were booming—and part was a desire to expand my repertoire, not to mention learning some more science myself. It just so happened that molecular biology is a subject made for comics. I still believe that simple, cartoony, sequential graphics convey the elements of genetics better than all the illustration techniques that had been used up to that point.

Although I initially conceived of it as a popular science book, *The Cartoon Guide to Genetics* (Gonick and Wheelis, 1983) found a market outside "trade" publishing (i.e., bookstores and the general public) in schools, both secondary and college. This perennial market made it possible to extend the Cartoon Guide series to many other subjects.

What advantages do you feel the comic book format has over traditional textbooks?

Advantages are legion. The book weighs less. Its appearance is inviting rather than repellant. Comics use story-telling techniques, which are more accessible than plain exposition. Comics use characters; textbooks don't. Comics bring to life phenomena like attraction and repulsion, excitation and inertia. And humor, if properly deployed, reinforces learning in several different ways.

Can you talk more about your process and pedagogical decisions?

As far as I can tell, every curriculum developer in every subject acts as if students have no other subjects to learn, so curriculum development becomes an exercise in piling on. There are always more considerations, more goals, more expectations. (This is also a good way of keeping a roomful of developers happy; everyone's ideas get to go in!)

My approach is in some ways the reverse. I always have to pare down. The comic medium, to be effective, has to be elegant and concise (even if the drawings look like crap sometimes). It's all about making clear connections, transparent transitions, etc. Comics is a medium of essences.

I'm not saying this is ideal. It's just what happens in comics, at least when I make them. And it's quite true that something important may be lost in the process. Modern science/math curriculum developers all stress that subjects should not be presented simply as given, but that readers should also acquire some sense of the process of creation and exploration, an understanding of how we come to know these things, a glimpse of the lab or a mathematician's creative thinking. Educators want to stimulate problem-solving skills as well as (or, in my opinion, sometimes at the expense of) memorization. I have almost never had room for this. In some ways, my non-traditional presentation is also old-fashioned.

As it happens, I believe in memorization. Unfortunately, that discussion is too long for now.

Apostolos Doxiadis

What was your inspiration for writing a graphic novel that tackles complex mathematical topics? Did you write the graphic novel to teach math, or to tell a story that happens to be mathematical?

The second, definitely. I have no particular affection for popularization. I like to talk about ideas. I describe it as a graphic novel of ideas, and the ideas happen to be mathematical. I faced that previously in my novel *Uncle Petros and Goldbach's Conjecture* which was about a mathematician. Readers will either hate or half hate mathematics, so how do you make mathematics appealing, not in order to sell but to make your hero appealing? The only way is the make the reader understand why its appealing to the hero, through empathy with the hero's emotions. Everyone understands when a man loves a woman, or a man, or social justice, but to make the reader understand the hero's love for mathematics, how do you make them understand that a theorem can be just as appealing as a poem or a symphony?

What was the impetus for choosing the graphic novel format for Logicomix? I noticed that for your other book Uncle Petros and Goldbach's Conjecture you did not choose the graphic novel format.

I was a writer of novels. *Logicomix* became a graphic novel because of chance and necessity. I was old friend from Alecos and he was working in animation and he asked me if I had a graphic novel idea and I said I had a story that I did not want to write as a novel on the foundations of logic and we started talking more about it, almost as a joke at first, and then once we had time we gave it a try. If anyone had told us it would have taken five years, I'm not sure if I would have done it.

Are you interested in publishing more graphic novels on mathematics?

No. I don't have an interest in publishing any more graphic novels. If I ever do again, I would do it a totally differently way. The way I did it with Alecos, we would go chapter by chapter. He would finish each chapter to almost the final stage of illustration and then he would receive the next one which I was writing in the meantime. This kept me occupied for years. If I ever do another, I would finish the script and then hand it off. The agony of creative work is recognized enough as it is. The agony of finishing something and then having to wait years before you can see it was too much for me. It was a profound experience in very many ways, but perhaps that's also why I don't feel like I need to repeat it.

Jennifer Granville

Can you describe your experience as a non-mathematician writing a story about advanced mathematics? What challenges did you face? How did you overcome these challenges?

If I hadn't been working with my brother Andrew it would have been impossible. I didn't feel as though it was 'about' mathematics, but about the world we had set up... he has a knack of explaining and illustrating mathematical ideas and concepts using ordinary language.

I was able to get my head around high mathematical concepts and then transfer them into something I understood.

What kind of research went into this preparing the story to become a graphic novel?

We read a variety of graphic novels, particularly ones based on detective/mystery/thrillers and any based on scientific ideas. I am a screenwriter and filmmaker so have a knowledge of story boards, which have some similarities to the comic book medium, and films were also very important to me as a reference and baseline for working with the artist.

If you were to start the project over today, how would you do things differently?

I probably wouldn't have done it. I don't mean that in a negative sense. And I value and am grateful for the experience for so many reasons as well as creating the book itself. But it was an extraordinary amount of work. We were working across two continents and three cities, we all (Andrew, Robert the artist and myself) had very demanding 'day' jobs, and we were doing something with no precedent and for which, in Andrew's and my case, we were complete novices. Starting over, I would want to be able to work with my collaborators full time on full pay for a year. As it was, the book took 10 years to finish and that was way too long.

Robert Lewis

Are there any educational comic authors that you admire? In what ways do you feel that they are successful?

The aforementioned *Logicomix*. During the production of the book, a graphic biography of Richard Feynman (Ottaviani and Myrick, 2013) was published, which incorporated mathematical imagery into the otherwise straightforward biographical account in interesting ways. Joe Kubert, who had drawn mainstream titles for most of his career, indulged in more personal works like *Fax From Sarajevo* (1998), about his family's involvement in the war in Bosnia, and the Holocaust account *Yossel* (2003) in his senior years. Eisner's scholarly studies on the medium, of course.

If you were to start the project over today, how would you do things differently?

Moving forward, I would likely incorporate more digital tools, esp. for architecture and to plot scene choreography because they afford so much more speed than tradition hand-drawing, and, of course, the modern miracle of the undo function when one makes an error. There is always hangs the nagging curiosity to combine more styles and break out of traditional forms, but that is perhaps best left for self-created work, as collaborative efforts often demand a degree of consistency. And I really would trust my instincts more, because often my first drafts and initial impressions/doodles generated the best avenues to pursue, and this epic undertaking was no exception.

Competing Interests

The author has no competing interests to declare.

Author Information

Larry Gonick responded to interview questions via email on June 5, 2020 and gave written consent via email for the interview to be published on October 7, 2020. Jennifer Granville responded to interview questions via email as well as via a video call with the author on June 25, 2020. Granville gave written consent via email for both interviews to be published on October 19, 2020. Robert Lewis responded to interview questions via email on June 22, 2020 and gave written consent via email for the interview to be published on October 5, 2020. Apostolos Doxiadis interviewed with the author via a phone call on July 3, 2020. Doxiadis gave written consent via email for the interview to be published on October 5, 2020. Gene Luen Yang responded to the interview questions via email on August 3, 2020 and gave written consent via email for the interview to be published on December 31, 2020. Every effort was made to obtain written permissions to reproduce relevant figures from all interviewees. The figures in this article have been included with the written permission of Robert Lewis, and reproduced here under educational fair use/dealing for the purpose and criticism and review and full attribution and copyright information has been provided in the captions.

References

Brozo, W. G., Moorman, G., & **Meyer, C.** (2014) *Wham! Teaching with Graphic Novels Across the Curriculum*. Teachers College Press.

Doxiadis, A., Papadimitriou, C. H., Papadatos, A., and **di Donna, A.** (2009) *Logicomix: An Epic Search for Truth*. 2009. New York, Bloomsbury.

Doxiadis, A. (2010) *Uncle Petros and Goldbach's Conjecture: A Novel of Mathematical Obsession*. New York, Bloomsbury.

Eisner, W. (2008) *Comics and Sequential Art: Principles and Practices from the Legendary Cartoonist*. New York, W.W. Norton.

Gonick, L. (1978) *The Cartoon History of the Universe*. San Francisco, Rip off Press.

Gonick, L. (2012) *The Cartoon Guide to Calculus*. New York, William Morrow.

Gonick, L. (2015) *The Cartoon Guide to Algebra*. New York, William Morrow.

Gonick, L. and **Huffman, A.** (2008) *The Cartoon Guide to Physics*. New York, Collins Reference.

Gonick, L. and **Smith, W.** (1993) *The Cartoon Guide to Statistics*. New York, HarperPerennial.

Gonick, L. and **Wheelis, M.** (1983) *The Cartoon Guide to Genetics*. New York, Barnes & Noble.

Gossett, E. (2018) *Discrete Math: The Graphic Novel*. Iowa, Kendall Hunt.

Granville, A. and **Granville, J.** (2019) *Prime Suspects: The Anatomy of Integers and Permutations*. Princeton, Princeton University Press. DOI: https://doi.org/10.1515/9780691188737

Kubert, J. (1998) *Fax from Sarajevo*. Oregon, Dark Horse Books.

Kubert, J. (2003) *Yossel: April 19, 1943, A Story of the Warsaw Ghetto Uprising*. New York, Simon & Shuster.

Madden, M. (2005) *99 Ways to Tell a Story: Exercises in Style*. New York, Chamberlain Bros.

Maughan, S. (2016) *Graphic Novels Go Back to School: How Graphic Novels are Finding Footing in Classrooms and School Libraries*. Publishers Weekly (Online). Available at: https://www.publishersweekly.com/pw/by-topic/industry-news/libraries/article/71237-graphic-novels-go-back-to-school.html (accessed 15 January 2018).

McCloud, S. (1994) *Understanding Comics: The Invisible Art*. New York, HarperPerennial.

Ottaviani, J. and **Myrick, L.** (2013) *Feynman*. New York, First Second.

Syma, C. K. and **Weiner, R. G.** (eds.) (2013) *Graphic Novels and Comics in the Classroom: Essays on the Educational Power of Sequential Art*. North Carolina, McFarland.

Yang, G.L. (2010) *Prime Baby*. New York, First Second.

Yang, G.L. and **Holmes, M.** (2015) *Secret Coders*. New York, First Second.