

Q: Welcome everyone to Inspired by Math. In this podcast series I interview people who are inspired by math and who are inspired by others. I'm really excited this morning to be having a phone conversation with Lou DiGioia. He is the executive director of the MATHCOUNTS organization, the largest non-profit organization dedicated to extra curricular middle school mathematics. So, Lou, welcome to Inspired by Math.

L: Thank you, thank you for having me.

Q: Yeah, yeah. So, I have always loved math and I have dabbled a bit myself in math competitions when I was in high school, I did what was then called an AMA exam.

L: Yeah.

Q: I figured it's changed names now, but you know. I guess I'm showing my age here, but this was in the late 70's.

L: Okay.

Q: And my nieces have done some MATHCOUNTS. I've never done MATHCOUNTS, but they have done some MATHCOUNTS competitions. So I'm excited to- for myself personally learn more about the MATHCOUNTS organization and also for all of the students and the parents who are here and general math lovers to learn more about MATHCOUNTS. So, let me read a little bit of your bio and-

L: Sure!

Q: Okay, here we go. So, as executive director of MATHCOUNTS, Lou DiGioia leads the largest non-profit organization dedicated to extra curricular middle school mathematics. As a former mathlete, DiGioia is the first executive director to have participated in the MATHCOUNTS competition series as a student. During his tenure, he led the creation of the National Math Club, which builds student enthusiasm for math by providing schools with free resources to hold after school math clubs and the math video challenge and online competition it has teams create innovative teaching videos based on MATHCOUNTS problems. In 2013, he orchestrated the organization's successful Guinness World Record attempt of the fastest time to create the first 25 rows in Pascal's triangle in human formation. DiGioia holds a BA from a Georgetown University and an MBA from George Mason University. So, once again, welcome.

A: Thank you.

Q: Okay, so let's jump into some questions here. So, as people who have listened to others of my podcast series, you probably know that I'm much more interested in the people than the math. I mean, I absolutely love math, but I'm very interested to know how it is that people get excited about math, and maybe hopefully we can bottle that and spread some enthusiasm, and to some extent, I'm sure you probably think the same way, and MATHCOUNTS has done a lot of that, bottling and distribution of enthusiasm. So, what's your personal story, do you have a story about sometime in your life where you remember falling in love with math?

A: Absolutely. And it was at MATHCOUNTS when I was in eight grade, and that's what's so exciting about the fact that I currently work at MATHCOUNTS. And I vividly remember in eight grade going to my first MATHCOUNTS practice, Mrs. Jacobs, my coach, and I was always good at math, but like a lot of students, I don't know that I was really excited about it. I didn't really see the fun behind it, I didn't look forward to doing math homework, and it just wasn't cool, exciting for me.

I went to MATHCOUNTS because Mrs. Jacobs asked me to go, she was our math teacher, got to the first practice, and she showed us the problem, which was unlike any of the problems that we typically see. They were multi- they were trick questions, but they were just, they were not your typical math worksheet, where here's ten problems using the exact same concept over and over again, this overkill. They were creative, and to solve them, you needed to think outside a box a little. And I remember, I remember one of the problems on the very first math camp practice. And it was, she told us to solve the problem, showed us a story about Gauss. The mathematician was challenged by one of his, I think it was first or second grade teacher, because Gauss was always piping up in math class, and you know, finishing the problem off so quickly that the other students were getting annoyed, so the math teacher gave Gauss a problem, and said, "I want you to add all the numbers between one to a hundred", thinking it would take him a long time to do this, and by the time the teacher turned around and went back to the desk, Gauss had the answer, and Mrs. Jacobs told us that story, and challenged us to do it.

We couldn't, no one could match his time, we couldn't do it that quickly. And then she explained to us that it wasn't a matter of just saying $1+2+3+4$, she showed us the pattern - $1+100=101$, $2+99=101$ and if you keep doing that you have fifty times 101 and that's how you solve the problem so quickly. It blew my mind. That was so cool to me that you were, to

look at a creative way to solve a problem, it wasn't, here's not only the problem, but here's how you're told to solve it. You have to do $1+2$, it didn't matter. The way that he solved the problem didn't matter. He had a creative solution to solve it, that's what mattered, and getting the right answer in a creative way was more helpful in MATHCOUNTS than doing it in a prescribed fashion, so that's what really excited me about math.

Q: That is a great story, and is a great example also because MATHCOUNTS is a middle school program, right? It targets middle school students.

A: That's right.

Q: And the beautiful thing about the example you gave, and I have a similar experience, when I learned also how Gauss I was able to add the numbers from one to a hundred so quickly. The beautiful thing is, for me, and I get that from you and from people who really enjoy math, math is about pattern matching, it's about seeing relationships between things, it's not about doing boring arithmetic, and it's a great example of, if you tell a kid to add up the numbers from one to a hundred, and they just go $1+2+3$, and it's going to take them a while, and they're not going to get anything out of it. Whereas, if they can visualize it, or sometimes think of it as it's almost like you have a square and you cut it in half along the diagonal, it's not exactly that, but a triangle that you get with $1+2+3$ and so on is close to what you get if you made a square of a 100 by 100 dots, or a 10 by 10 dots, or a 100 by 100 if it's one to a 100, yeah.

The other thing I wanted to say, and we'll talk about this in a little bit is that this counting problem was actually very useful to me when I read about your human creation of Pascal's triangle, that you had, I think it that was 325 people and going, "Huh, where did that number come from?" And then when I saw 25 rows, it's like 'a-ha', okay, so it's like 'hey, it's the same counting problem'. So let me ask you now about your organization. MATHCOUNTS. I'll give a little plug for what MATHCOUNTS is, and tell us a little bit about its history.

A: Absolutely. Well, we like to say, MATHCOUNTS is, what we do is we help kids who love math and we help kids that fear math. And the way that we do that is, we have fun and challenging math programs for middle school students.

From a historical perspective, we were founded 31 years ago, and we started off with the MATHCOUNTS competition series, that was our first program. It's what we're actually known for, it is a nation-wide math contest, strictly for middle school students, we are only for 6th, 7th and 8th grade students, and what's great about the MATHCOUNTS competitions, even for my perception is that it is a nation-wide program and it's a tiered competition, there are four different levels. So we have students compete at a school level, the winners there advance to the chapter level, the winners at chapter level advance to the state level and the top four students of every state win an all expenses paid trip to the national competition, wherever that's held, until we determine the national champion every year.

So, it's a great program, it's unique because there are other math competitions out there, and they're all great, I would encourage people to do as many as they can if they are excited by math competitions, but what I think is unique about the MATHCOUNTS competition series is that we have in person events everywhere. So, you have an event in the school, the winners there move on to the Chapter Competition. We have a very strong volunteer network that puts on 550 chapter competitions throughout the country during the month of February.

So, no matter where you are, there is a MATHCOUNTS chapter competition near you, and what's special about that is if you're excited about math, they get to meet students from other schools that are also excited about math, and that's a huge takeaway from our program. We hear this all the time, I have students in programs come up to me, and say, the best part of MATHCOUNTS, yeah, the education is great and the problems are great, but just getting to meet other kids, finding out that I'm not the only one that loves math as much as I do. In my school, I'm the only one who's excited about it, but when I got to the chapter competition, I met all these kids nearby who go to other school, who have that same passion, and that was really life changing for me. So, I think it's a huge benefit that the students get to progress. So the students who won the chapter and went on to the state, again, in person events and then to bring everybody together for the national competition is just amazing. There's just no other event that will have the top 224 middle school mathletes in the country together in one place, it's just awesome. And I'm lucky that I get to be there every year.

Q: Yeah, that's... Go ahead.

A: So, that's the competition history, that's where we started and we, over the years realized that we needed to develop programs to reach students that weren't interested in competition. So that's how seven years ago we decided to launch the National Math Club, which is a program that allows any organization, any school, if you want to hold math club, you tell us, you sign up and we give you the resources and structure you need to hold math club. Because we see the tremendous value in getting kids together to have fun with math in an extra curricular setting. We also know that that's a time intensive process to create activity, to find incentives to get the kids to participate, so we have the ability to take care of all that, we provide the activity, we provide the incentives to get them into the room, and the hopefully the club leader can create that fun environment for the students to have fun doing math.

And provide more opportunities for students to get involved, and really, a lot of them get involved without the need for a teacher or a club leader, which is why we created the math video challenge. And that's an online program, so we're taking advantage of the ability to reach even more students through technology. They take a problem and create a teaching video about the problem, put it online, and then these videos are voted on by the public and the videos with the most votes advance in the contest. So it's a great program getting kids excited about math in different ways. So that's MATHCOUNTS, that's what we do.

Q: Very cool, very cool. So, tell us a bit about the history. So, whose idea was it, when was MATHCOUNTS created, whose idea was it, was the inspiration?

A: Absolutely. So in the early 1980's, the National Society of Professional Engineers was very concerned about the crisis in middle school math education, the gathering storm, the issues that were being identified about US math enthusiasm and achievement levels for students at the middle school level. And they clearly had a vested interest in making sure that we have a population that is high functioning in math, because if we don't have people who can do math then they can't become engineers one day. So they saw a national problem with math at the middle school level. That was the target at the time, it's inflexion point where the US scores seemed to come from other countries at that age range.

So they had a math competition that was done at a state level at that time, that one state

had adopted and take on and had grown and was a successful program, and they said "Let's do this on a national level. We have members in all 50 states, how do we bring the competition model throughout the country?" So, they realized that they needed some partners to help with this, they contacted the National Council of Teachers of Mathematics, so they were another founder, to help with the content creation side of the equation, and they also contacted CNA insurance, a close partner of theirs, and they helped on the financial side, to provide funding to get help this program going. So you have this great synergy between NSPE and its volunteers, the content, the financial backing, and they teamed together to create MATHCOUNTS, and really, at that time it was just the MATHCOUNTS competition series, that's what they were setting out to do. And they started that, and within two years they were in all 50 states, and the program just really took off, and yeah, it's been a success story ever since.

Q: Great story, thank you. So now back to asking you about you. So, you earned a BA from Georgetown, what was your BA in?

A: American Government.

Q: Okay.

A: Not math at all.

Q: Well, you have me curious.

A: I'll tell you what, so you know, I love math and ever since eight grade I was inspired by it, but you know, what MATHCOUNTS taught me in eight grade was more than just these techniques. These problem solving techniques can be applied not only to math problems, it's that they can be applied to any part of your life. If you're good at solving problems, if you have a good toolkit for how do you approach the problem, you can take that, and use that in your English class or social studies class, or really any discipline you want, it's going to make you better at it.

So, later on, in my high school career, I thought that government was where I wanted to go, and that's what I wanted to focus my life, and I decided to go to Georgetown, majored in American Government, and I was on tab there, and I worked for a non-profit called Presidential Classroom, a great organization that was helping kids become more civic-minded. And after several years of working for an organization like that, I realized that I really loved the non-profit management side of things, but the government isn't where my real passion was and that was when I found out that MATHCOUNTS was hiring.

Q: Okay, so there are some other things that you mentioned, or that I read from your bio. There is the National Math Club and the Math Video Challenge, so tell our listeners about those two.

A: Okay, absolutely. So, we have these new programs, the National Math Club and the Math Video Challenge, they were designed to reach students that we didn't think were going to be entering the competition series. We wanted to go beyond- We wanted to provide opportunities to students that were not here competition head-to-head events. I am a strong believer in competitions, of those experiences, as someone who benefited from that competition myself, but I also recognize, and MATHCOUNTS as an organization recognizes that there's a lot of different students out there, and some students are not going to be interested in a math competition. So, we have these programs-

The National Math Club is a program where we just want kids to have fun with math. We don't have that competitive element to it. In fact, we don't have any head-to-head competitive element yet. There are still opportunities for students to win prizes in the National Math Club, and that's one of the things that's great about it, the school signs up, or an outside organization that is not entirely school-based, so you can do the National Math Club if you are a math student, if you're the tutoring center, if you are the neighborhood math tutor, and you had students come into your house once a week to do math activities, you can become a part of the National Math Club, as long as you have middle school students that you're working with in person, you can sign up to take part in this.

And the benefit of signing up besides getting all these great resources, activity ideas, some giveaway and what we call Math Club in a box, not only do you receive that, but the

students have the opportunity to advance in the club. There is a silver level of the National Math Club, where, if you have a certain level of participation of the course of the year, your club leader can certify that and the club becomes a silver level club and when that happens, the club receives a trophy, they also enter into drawings for \$250 gift card that the club leader, or the club can use to whatever they like to support their efforts. And we've heard lots of great stories about people using those gift cards for parties for the club, calculators, t-shirts, you name it, people have used the money for. So it's a great way to financially support the efforts of those clubs.

And then, beyond silver level, we have a gold level. And what the gold level is, if you have the students that are working together, we have what's called the Gold Level Project. And it's in our club, we want these students working together. And we want them to see the fun in doing math in a collaborative fashion. Math is not- A lot of people think math is sitting at the desk and just crunching numbers, but a lot of times, especially when you get it to your career you have to work on the team and solve problems together. And we've seen a lot of value there. And that's a major component, of I suppose, all of our MATHCOUNTS programs, the Competition Series and the Math Video Challenge as well.

So with the National Math Club we have the gold level project. This year's project was a math scavenger hunt, where students were given about two dozen math vocabulary terms they had to find examples of those terms in their community or in their school and create a project around that, whether that was a presentation, a book a sketch, whatever they wanted to do, we wanted them to be creative, and then they sent those to MATHCOUNTS office, and we checked those out, and in the school the turned in a successful gold level project became a gold level club.

And if you become a gold level club, not only do you get trophies, you get a banner for your gym or your basement, wherever you want to hang it up. You also get entered in the drawings for the \$500 gift card, and the grand prize for the gold club, we pick one gold club at random and four students and the club leader or a team win an all expenses paid trip to the MATHCOUNTS national competition so they can see that in person. And this year, the even was held at the Walt Disney World Swan and Dolphin Resort, so it's a very cool location, and it's a very cool thing to be able to give the students an opportunity to make it to Disneyworld because they're doing math club, so we're really, really excited about that.

Q: That is very cool, I didn't know, I didn't know a tenth of this was going on with MATHCOUNTS, I just assumed it was this annual competition where super bright students got together and solved really hard problems, so there's a lot more going on.

A: Oh, yeah, absolutely, absolutely. And you asked me about the Math Video Challenge, to give you a little more detail in how that program works. So, as I briefly mentioned before, student create- They pick a MATHCOUNTS problem, and they create a video where their team teaches the problem, but not only teaches the problem, we really want them to also show the real world application of the math. So we don't want it just to be a student standing at the blackboard 'here's how I solved the problem' and that's it, we want them to show a real world example of how, whether it's the specific example in the problem might play out, or to use a more generic example of the math concept in the problem could be used in the real world setting.

And we've seen some incredible examples of this, last year's winner was a video where students, it was a coordinate geometry problem, and the students, the premise of the video was that an exchange student was lost in Los Angeles. And they were trying to figure out how far has he walked over the course of the day, and they used a coordinate geometry problem to figure that out. So it was a very creative way to demonstrate how you'd use coordinate geometry in a real world application.

So after the students create these videos, they upload them to the MATHCOUNTS website and people will want to vote for them, and we, based on those votes, the top 100 videos are selected. Those 100 videos then go to the MATHCOUNTS judges' panel, where those videos are evaluated on content, on their creativity, their communication. And from those 100 videos that advanced, 20 semi-finalists are selected and the four finalist videos are selected. Then, the student teams that created those finalist videos, they receive an all expenses paid trip to the National Competition as well, so not only do they get to see the national competition, but those four teams present their videos to the 224 mathletes competing in the national competition. And those students, those 224 champion mathletes, they're the ones that select the ultimate winner in the Math Video Challenge. So we're really excited about that, we have students determining who they pick in the top 100, and then you have these great students picking the winner, so it really is a student driven contest,

and we're really excited about that.

Q: Yeah, I mean, I'm excited just listening to it, I mean, this really is amazing, I'm looking forward to lots of people listening to this podcast, because I really, I bet that if I had interviewed a bunch of people, 'what do you know about MATHCOUNTS?', that they don't much of the huge amount of stuff that your organization is doing. I mean, I hope I'm wrong, to be honest, but-

A: You know, if that's the challenge that we're dealing with, it's a good thing. Well, it's not good that people don't know about it, it's good that we're evolving. I'm excited that people know about MATHCOUNTS, and I'm excited that people know the MATHCOUNTS competition, and they know it and they love it, and that's what we're most closely associated with. But, you know, that program has been around for 31 years, it's logical that it would have more awareness than the two newer programs. But any opportunity we have to use the National Competition to raise the profile of these other programs, that's great for us, and that's what we want to do, because our mission is to help all middle school students. It's not just to reach middle school students that like math competitions. So, in order for us to achieve that mission, we have to do these other programs, and we're excited about it. We've seen a lot of interest in it, and we're getting more students than we ever could through competition alone.

Q: Yeah, that's, yeah. That is phenomenal and talking about interesting things that your organization is doing, I was really excited when I read about this Guinness World Record thing, I didn't- So, are you, I mean, have other people tried this, or are you the Guinness World Record holder because nobody else had thought that they could actually pull this off?

A: So, the answer to that is, no one had tried this before, however, it's not as easy as it sounds, because we found out that the way Guinness operates is when you go to them with an idea for having a record, it's not a matter of just because no one else has done it you've done it, therefore you're a Guinness World Record holder. They evaluate the idea, whether it's something that can be certified as a world record, and then they will determine a bar that you have to beat in order for them to certify a new world record. So, in our case, the bar that was set was, we had to create this in ten minutes or less. So, even if- Even though no one had done it before, if we had done it in eleven minutes, it would not have counted as

Guinness World Record, we had to do it in ten minutes-

Q: Yeah, yeah, yeah, I'm not at all meaning to imply that it was not a remarkable feat, I was interested to know- And I wanted to know more about how you did this, maybe you could give us the inside scoop on the making of-

A: Sure, sure.

Q: Go ahead.

A: Yeah, this was the- The idea was, this happened at our national competition, which Raytheon is our title sponsor for the national competition, and they're an outstanding partner with MATHCOUNTS, they really are supportive of what we do, and have really worked with us to raise the profile of the event. So, when we were brainstorming prior to the last year's national competition, an idea came up, what about doing a Guinness World Record attempt at the national competition. So, we, frankly, have never thought of that before, and if it wasn't for Raytheon, maybe we never would have, so I give them the total credit for having this creative way to bring some attention to these brilliant math students who were attending the national competition.

So, we thought about, what would make sense, what type of world record could we do, using all of these smart kids, that are together in one place. And what we wanted to do was come up with a record that had all of them working together. So, we thought, one avenue we could go was to see which kid maybe to recite the most digits of Pi, or something along those lines. But, we didn't want to go down the individual route. We have our national champion, that certainly is an individual contest, so what could we do to bring everyone together. And Pascal's triangle came up, and as soon as that came up, we just knew, that was just really going to be awesome if we could pull it off.

And so, we started thinking about, how do we do this, and what was trickier was that the students who were participating in this, we would not have them together until the day before the actual attempt. So, we couldn't practice this a bunch of times, and the other trick

was, to do this attempt, people were not allowed to know what number they were going to be in the triangle ahead of time. So, the way, the digits worked, everyone was given an envelope that was sealed, and the Guinness World Record keeper would yell 'go', and everyone would rip open their envelope to determine what number they were. At that point, all 325 people had to assemble in the right order. So, it's-

Q: Let me ask you an algorithmic question, because I'm putting on a computer scientist algorithm hat. So, if I got a number 73, what does that mean when you're doing 25 rows of Pascal's triangle?

A: Right, so we had to think about that, what would that mean. Because we knew the kids were brilliant kids, but we didn't expect them to memorize the first 25 rows of the triangle, so that when they did see, they'd say "Oh, clearly, I'm in row eight, position five". I mean, that would not be fair to do that, to expect that of anyone. So, what we did, we thought about it for a while, we knew that the students would have a basic understanding of the triangle, the outside rows are just ones, that the second row increases just 2, 3, 4, 5, 6, 7, 8, 9, all the way down to 24. So we knew that we had, we knew there was a basic understanding of the triangle. The other thing that we knew they'd have a grasp of is that the middle portion of the triangle, the bottom middle, I guess you could say the bottom triangle inside the bigger triangle would have really large numbers, that's where the biggest numbers are, because, the biggest number in the first 25 rows of Pascal's triangle is over two million. So, they do go up very quickly in the middle. So, the approach that we used was, we had students, everyone opened their envelopes, we'd have the students with the lower numbers, with ones, with single digit numbers, to immediately get to their position. We were counting on them to know that if you had a one, that you'd have to go somewhere on the outside of the triangle, or if you had a two, there were only two places you could end up, and you'd be at the top of the triangle.

Q: So, let me ask you something about this. So, people's positions are not always fixed, so you could have two people sort of wrestling, trying to figure out "I'm a one, I could be anywhere along the edge of the triangle".

A: Absolutely. That's what the kids were doing. So basically explaining to people that this is a team effort, and if there were two people vying for the one, everybody had one spot

somewhere, so and in this case, I think there were, I think we had 51 ones in the triangle, is that right? I don't remember, it was a while ago. But, so there's a lot of people that are going to have the same number - we just told them, it's in their interest not to argue over a spot, just take another one, because you know that you're going to be somewhere on the top of the triangle

Q: Right, and the triangle is symmetric, so there's going to be a duplicate, I mean, you've got some odd numbers, but certainly for the even rows, no, yeah, you're going to have symmetry, in the odd rows you're going to have only one person in the middle, but in the even rows, you have like 1, 3, 3, 1-

A: Exactly.

Q: So two people with the 3-

Q: So, here's how we tackled that. There is one more piece I should mention about the constraints of the attempt. You were not allowed to, people were not allowed to communicate with those 325 doing the attempt. The only people who were allowed to talk and communicate with each other during this event were the people inside of the triangle, 325 people. So, this would have been a lot easier if we could have had an outside director for giving help on this. Instead we had MATHCOUNTS staff members take part in the attempt. So we helped in that process.

So, what we did was, the first step was getting all the ones and all the low single digits into the triangle, to let them figure it out. We also had people over a certain threshold, I think it was over a thousand, if your number was over a thousand, you went to a certain part of the room, and there were some volunteers who helped arrange them into a big chunk of the of the bottom triangle. The rest of the individuals that were left over, those few were told to pair up because most of them, to get in line numerically. So, if you had a partner, which, like you said, most of them did, just make sure you were standing next to your partner. So, once we had this mass- It started off as a big mass of people, which very quickly turned into the outside of the triangle, then we had a big line of students in numerical order, from I think it was 25 all the way through to a thousand, and then we had another big group, from a

thousand, up to a million in a back.

The people who were in an order from 25 to thousand, they were directed to specific spots in the triangle by MATHCOUNTS staff and we had some other great volunteers that helped us out, we had folks from the the Art of Problem Solving, another great math resource, they participated in this event as well to help get our students lined up. So, we had to memorize portions of the triangle. So, you had these volunteers that knew exactly, to a point where does 73 go, we knew that. So, as we saw these people in a line with their partners, we were working in tandem, so each staff member had a volunteer that they were paired with, you were given a number, to grab them and split off and align symmetrically and it was a great way to do this quickly, because even though you have your portion of the triangle memorized, it was great to have a partner on the opposite side of the triangle also placing that same number, and it was a great way to confirm that you were on the right spot. And then, once everyone was placed, in the big triangle on top, we had that bottom chunk of the triangle, basically just march forward and completed it looked very cool when it was done. And that's how we did it. And when it was all set and done, we did it in six minutes as 14 seconds.

Q: Wow. I was going to ask you how- That's impressive. Right. So they took a stab at saying ten minutes or less, but you demonstrated, you almost didn't need those last four minutes.

A: Well, like I said, we didn't get a chance to practice this with everyone until we got them on site the day before. Now, we had our concept for how we wanted to approach this, we knew that the students would understand the basic instructions, but there was certainly a big question mark whether we could get it done in ten minutes. And the first time we practiced it, we also knew that we had to experience the day before, but they were there for the MATHCOUNTS competition, they were not there to set a Guinness World Record. And we didn't want to spent hours drilling on this because these kids were there, they wanted to win their competition, we didn't want to take away their practice time. So we only gave ourselves three tries the night before to practice this. And there's a lot to it, you can't just drill over and over again, because every time you do this, you need another set of sealed envelopes, so it's a lot of paper, a lot of envelopes, every time we wanted to practice. So it was a major effort.

So the first time we did it came nowhere close to ten minutes, I think we were around 19 minutes the first time we tried this.

Q: Wow.

A: Yeah, it was very scary because we knew that we only had three tries and the Guinness judge came the next day, and that was it. So, we were a little nervous about it, but it was one of those things where we knew it would be a steep learning curve, that the minute we did it the first time, the students picked up a lot, that yes, it wasn't wise to fight over the spot- Using the students to help build the triangle, because it obviously builds upon itself. So if you made a mistake at the top, it was creating the ripple effect, and that's what we saw the first time we did it. So, the students, because they're brilliant, realized that instead of just sitting in their spot, they were actively involved in looking around at the spots near them and figuring out which numbers needed to be where, so even though we had MATHCOUNTS staff and volunteers initially telling the people where to go, the students were actively involved, they knew what number needed to go where, just get on the position, not on their memorization. So it was really cool to see that. And they took off on that based on that after the first try and we went from 19 minutes on the first try, I think we got to 12, the second try, and made it the third try, but just barely. So the next day when we got to the attempt and did it in 6 minutes, it was awesome, we didn't think we were going to come anywhere close to that number.

Q: Now, you realize that once I publish this conversation, you're giving good information to your competitors who are going to analyze this algorithm and figure out how to do this more efficiently, you know that?

A: Oh, absolutely, that would be cool. And they can see the whole thing, there's no secret to it. If you were to watch, we have the video online, so you can see the entire six and half a minutes on our YouTube channel and see how it was done. But, no, I think that's what's cool about it, if people want to break that six minutes score, that's cool, because that means that maybe someday we'll try to break whatever record it's set for then. No, I think it's cool, And we- actually, in our club activity- So when you sign up, like I mentioned for the National Math Club, we provide a book that has activity ideas. And we had so much fun doing this

Pascal's triangle that we thought that this was something that teachers could try, or club leaders could try with their math clubs. So, we actually, in this activity guide this year explain how we did it, and gave instructions on how clubs could do their own human Pascal triangle. So we think this is great. And if this is something folks would do all the time, that would be awesome.

Q: Yeah, that is a really brilliant idea, and I just have a couple of thoughts about this. One is, the wonderful thing about Pascal's triangle is, everybody just needs to look at the two people in front of them, and if their number is the sum of those two, right, there is a precursor thing going on here, if everybody gets that, then you know that you got it right. If somebody adds up the two numbers in front of them, and it's not their number, then they're in trouble.

A: That's right.

Q: And the other thing is- So who decided that you weren't going to give the kids just a pair of numbers, in other words a binomial coefficient, that would make the thing very boring, I guess. Because essentially then you're telling people if you're 7,3 and a binomial coefficients, you go to row seven, position three, that's pretty dull.

A: Yeah, you know, they were pretty strict about how we did it. We had to give the kids numbers, the numbers had to be regular numbers printed on a piece of paper, there were no clues, no hints that could be given on the pages, so they were really, you know, Guinness to their credit were very efficient in making sure that there was some problem solving and deduction and that people were looking at the numbers, and numbers only, and then basing their position on the triangle, based on the number.

Q: Yeah, that's quite remarkable. So, along those lines, are you planning to do this again, have you debriefed among all the staff and students and have figured out how you could do this even faster, better algorithms?

A: Yeah, but that's the beauty of MATHCOUNTS that it changes every year. So, if we did it

again at this year's national competition, certainly, a portion of the students who competed as 7th graders, would be back for 8th grade, but for a good number of the people would be the first time. If we had several more tries with the same group, we definitely could have gotten the time down much lower. We will not be doing it again this year as we're holding it down in Orlando, and our time schedule is much tighter. But with Orlando, we know that we're right next to the theme parks, and we want to maximize the amount of time that these great students came to have down at Disneyworld.

So when we're not hurt by time-constraints, but in the future I definitely think this was such a great way to raise awareness of the program, give attention to kids doing some amazing things with mathematics, to give them the attention. So, I think, we would love to do some Guinness Record attempt. Maybe it's the human Pascal's triangle or maybe it's something else we haven't thought of yet.

Q: Yeah, as I'm listening to you, I'm wracking my brain thinking, could you do something with fractals, could you do Surpinsky's triangle or something. Yeah, some fractal thing could be really interesting if it could be turned into a human activity. But I will let you brilliant guys spin your gears and come up with the next contest and make it a secret. Obviously you don't want to give it away until you've done it.

A: Yeah, right. Yeah, coming up with the ideas, that really was a hard part. And I'll say this too, one of the hardest challenges for this was the placement, to getting people to stand in the right spot. So, the more complex your geometrical figure that you're trying to get the people to assemble into, the harder the attempt is going to be. For us, we actually taped a big triangle, Pascal's triangle on the floor of the hotel ballroom in order to do this, otherwise, just getting people to stand in the right spot is really hard. If you're not standing precisely in the spot that you need to be, if you're off, then it's still back to "well, who am I supposed to be adding with to form the next number, if it's this person?" And that really made it difficult. So we really had to be precise to allow people do the error checking by adding the correct numbers. That's a challenge you have to take into account with very complex geometrical figures that you might be on the future.

Q: Right, yeah, okay, good point. I'm also thinking back to the triangle thing. So, are there any shortcuts? I mean, it's been a long time since I've thought about Pascal's triangle, but I

know there are things like, it's not a coincidence that you have rows with all multiples of five in them, except for the ones on the end, that you have 1, 5, 10, 10, 5, 1. So you've got primes and multiples of primes and interesting properties, right, in elements of the triangle.

A: Right. So here's the shortcut that we used that we thought was a more effective way to do it. Instead of building the triangle row by row, because the number, every row starts by one, and by the middle of the row it gets, the numbers can get very large, so by the 25th row, it got over two million. So, knowing that, one way to approach this would be to build it row by row, but that makes it a little more of a challenge, because you can't have people line up. When you're trying to place people quickly, people will not know inherently once they do their number what row they're in.

So, the approach we took was have everybody line up in a numerical order. And by doing it in that approach, we built the triangle not row by row, but going down the triangle's diagonal. So, you would build, it would start off going down the row, but eventually what would happen is, you go down, maybe, to the seventh row, and you'd be in the second spot in the seventh row, and then the next person in the numerical order would have to be that in the third row. So, you had- The way we approached it, we had staff members in charge of diagonal, not rows across the triangle. That way when people were coming up numerically, we knew that, there was only three or four different places where they could go, once they came up in the order, and it was easy for us to point them to a right spot at that point in time.

Q: Yep. I'm very impressed, and I'm excited that we've got to spend more than half of the interview it seems talking about Pascal's triangle. I think it's a very inspiring example. I think it's a showcase example of taking a bunch of kids and some adult helpers and solving a very interesting algorithmic problem. I absolutely tickled for you guys that you got the Guinness World Record for that. They said, okay, ten minutes, and you did in six and change, and you have brilliant kids, and you figured out some clever heuristics for optimizing the problem, and I'm sure that people will come along and try to break your record, because, why not? And they'll learn something, and you'll come up with something else. Let me ask you, since we're winding down here, I've got two more questions that I want to ask you.

A: Sure.

Q: One is, is there some interesting new project that your organization is working on? We've talked a lot, beyond this triangle, we've talked about the video challenge, the National Math Club, the competitions, what can you share with us about what other stuff you're thinking of?

A: Absolutely. I'll tell you, we've just launched a new fundraiser. It's called Solve-a-Thon and this is something that we'd love people to take advantage of. From our perspective, the reason for creation Solve-A-Thon was we knew that there's a lot of coaches and club leaders who do great things for their math teams and math clubs. But, they don't have the financial resources to put into it. When you're in the math club, it's going to be a lot more fun for the kids if there's some snacks for them when they show up. Or, if, when they go to competition, they all have a matching t-shirt. So we know that right now, a lot of coaches and club leaders are putting their own money into these programs, it's something they love and it's something they do, so we were thinking if there's anything we can do to help them, anything that we can do to help them get funding to support their math activities. So, there's lots of fundraisers out there, from selling things like candy bars or cookies or wrapping paper to the pledge race fundraisers, where for every lap you do around a school track you get a track, or whatever it is.

So, we thought is there a way to come up with a math based fundraiser. And the proceeds would go back to the teachers putting these math clubs. So we created Solve-A-Thon. And the way that works is, school that wants to participate, or club, it doesn't have to be a school, if you have a math club in an organization, you can utilize it as well. You sign up for Solve-A-Thon, you have your students get pledges for the number of problems they're going to attempt in the contest, it doesn't matter how many they get right, it's just how many they try to solve. And based on their pledges, the school determines when they're going to do the problems, they solve their problems, and then based on how much money the students raised, the students won prizes, the school, or the teacher receives 60% of all the money that's raised from the fundraiser, which is more than you get from almost any, I don't know if any other school project gives that much back to the school or the club, and the rest of the money is used just to offset expenses, and then whatever's left over it's supporting the Chapter Coordinators, so our competitions, we support our coordinators, and also putting on those local events. So, 100% of any donations to Solve-A-Thon goes to

supporting math club or math activities. And any program, any school running, any club leader, any math club, you can use it to raise money for your activities, so we hope more people try it.

Q: That's, yeah, you guys are coming up with some remarkably innovative things, and I will post links to all of these things when I see there is a page mathcounts.org programs, Solve-A-Thon, I will put a link to that on the notes for this particular episode. But yeah, I'm as excited as you, and I think some of your enthusiasm has rubbed off on me, I'm sure will rub off on a bunch of our listeners.

So, let me ask you the very last question, this is a question I ask just about everyone. It's a broader question, and I've been accused of asking the question that's too broad, and people want to make it more specific, and I just smile and say, "This is broad question, answer it however you'd like to answer it". And the question is: what advice would you give to a parent whose child was struggling with math?

A: Wow, that is a great question, and one that we get posed a lot at MATHCOUNTS. So, I think there's a lot of ways to answer that, I'm not going to get into a specific curriculum, because there's some people who might say "Oh, you should try approach and that approach." There are certainly cases to be made for how you approach the actual teaching of the math, but I'm going to take a different approach: it's all about attitude. And I think attitude is very, very important. So, if you a child struggling with math, you want to be supportive, I think the worst thing that the parent can do or the mentor can do, "It's okay to be bad at math, I stink at math, I hate math and I did fine in life, so don't worry about it." I think that is the worst thing you can do, because if you put in their heads that it's okay to be bad at math, than what incentive to they have to want to get better at it? I think you have to keep working on it. And there's a lot of approaches, and I think problem solving is something that everyone uses.

So, I totally disagree with a notion that you can get by in life being bad at math or not know math. It's totally, to me, that's ridiculous. Because no matter what profession you're in, you're going to be solving problems. Or, even in your day-to-day life you're going to be solving some sort of problem, where you get information, and you have to use your skills to figure out the best way to solve this issue. And I think it's important that we instill in children

that recognition of the value of math. So, I would say to parents to keep working at it, try different approaches to get students the help that they can need, but please don't set the bad example of saying "It's okay, I hate this too", because that is a recipe for disaster like that.

Q: That is a great answer, I love your passion behind that answer and behind everything that you have said, and I love what your organization is doing, and I don't know if it's a coincidence or not, but I keep chuckling at the thought that there's a word 'count' in MATHCOUNTS, and obviously there's a double meaning, right? That math has something to do with counting and also that MATHCOUNTS, it matters.

A: Yes.

Q: But also, that in middle school, counting is something that is so accessible to middle school students, yet, as I'm sure you know real well, counting becomes common rhetoric, which is a remarkably deep and exciting and beautiful subject. I mean, Pascal's triangle has so much depth to it for something that is so simple that middle school students are not going to have any trouble understanding. At least, how you construct it. You can take any middle school student, and you show them how you add two numbers, and you get the number below, and they will get it. Yet, it's a beautiful showcase example, of how something as simple as the Pascal's triangle becomes this Guinness World Record that we've been talking with so much fun about, and how people can go into deep math and find patterns and find prime numbers in it and all kinds of common rhetoric identities. It's remarkable to me that the word 'count' is part of MATHCOUNTS, because common rhetoric just go so deep and forever.

A: Yeah. I mean, it was certainly no accident when they named the organization, and that's why it's in all caps, the founders wanted to draw attention to the fact that math mattered and math counts. And it does, and like you said, we hope that we inspire kids to see the beauty behind that and the different approaches that we have, we know that some do, and hopefully we'll get to a point where all of them do. And that's our mission.

Q: Yeah, and, yeah, it is also. Also, as I was poking around the web to see what your

organization was up to, I found some YouTube videos, I think there's 70 or 80 of them in your YouTube channel, and in particular I loved one, there was a young fellow, I don't know if he was a teenager, maybe in his early twenties. He was wearing a sweatshirt with a hood, and he was doing a combinatorics problem that also tied into Pascal's triangle and it was basically counting the number of partitions of a particular number, allowing duplicates and not allowing duplicates.

A: Right. So that, who you're talking about, that's actually Richard Ruszyck, he's the founder of The Art of Problem Solving, and he was actually a part of the successful Guinness Record attempt, and what he does, we have a great relationship, MATHCOUNTS and The Art of Problem Solving, they have a great website with resources for students who are advanced in math and are looking for a greater challenge, so it's a great resource for folks there to check out, but what he does is every month, he creates a video called the MATHCOUNTS Mini, where he takes one of the MATHCOUNTS problems, and like I mentioned, these are non-routine, these are challenging problems, he explains how you'd teach it and how you'd go about solving it. So, we have several years' worth of minis where you can download the problem and see how he would teach it. And it's helpful for students, but it's also helpful for competition coaches, looking to see how you train your team. This was a great resource for a lot of coaches and how they prepare for their MATHCOUNTS practices. So, it's a great resource, and we're going to keep doing this.

Q: Yeah, and Richard was great. I mean, I know the name, he and I have never talked or met, and I know his organization, and I have been thinking over the years that it would be great to get to know him, so I think I will drop him a line and see if he would talk about what he's up to with his gifted kids that he works with in the Art of Problem Solving.

A: Absolutely. I'd be happy to make the introduction. Because he's a great guy, and if you think I'm passionate about this stuff, wait till you talk to Richard, he's just as infectious in his love of math and working with kids. It's a great program, and we're happy to work with him

Q: Yeah, that is great. So, those are all the questions that I have. Do you have any closing thoughts, anything that you want to share, and I will provide lots of links and your picture and your bio with the article on the blog, so people will, I'll spread the word as much as I can, but any closing thoughts from you?

A: No, thank you for doing what you're doing. This is what we're trying to accomplish. We talk about our vision, MATHCOUNTS' vision for the world, it's the one where everyone sees the value of math in their lives, and I think, there's an attitude problem in our society. People think it's okay to be bad at math, and it's marginalized, and I think anyone who's passionate about it like you are, and has a podcast, has a website that get's other people's side of that is fantastic. So it's a battle that we're all in together here, trying to get math where it needs to be. So, thank you for what you're doing, I was so excited to learn about what you're doing, and I wish you the best with moving forward.

Q: Great, great. Very good. Thank you much. So, there you have it, Lou DiGioia, Inspired by Math.