Neil Olver June 17th, 2025

Fixing Education for the AI Age: Conrad Wolfram

Conrad Wolfram is the CEO and co-founder of Wolfram Research Europe and Strategic Director of Wolfram Research. He is a leading advocate for mathematics education reform and author of "The Math(s) Fix: An Education Blueprint for the AI Age". He recently gave a public lecture at LSE on this topic. The following is an edited version of an interview by Neil Olver in the Mathematics Department.

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1. Background and motivation

NO: How did you get interested in the topic of maths education?

CW: I've been quite interested in it for a long time, but a very specific point was the release of Wolfram Alpha in 2009. What happened was slightly bizarre, because we were all excited about the symbolic AI aspect – you could type in a question in English, and it would understand the question and produce some sort of computed answer, which seemed very exciting to us. But then we had people in schools saying, "Oh, my goodness! Should we now compute more or less? What should we do with this free service in terms of maths education? Because you can now compute an integral, so maybe we shouldn't be teaching what we've been teaching."

I was thinking: but this is nuts – Mathematica and other tools had been able to do these things for years. So, then I started looking into and thinking more deeply about what we have been doing in these curricula, when obviously computers have been massively moving forward in terms of what's done in the real world of mathematics.

That's what really got me going, and I ended up giving a TED talk the next year, and I started formulating my thoughts more seriously. The more I looked at it, at least in my view, the worse it got.

NO: What did you think about your experience learning mathematics in school?

CW: I was better at maths than I was at French, and so the fact that I scored fairly highly meant that I quite liked it, just like I liked physics because I was good at that. I would say it was a bit variable honestly. I liked the satisfaction of doing it, and I liked the abstraction in its own right.

Was it well taught? I was lucky because I had some very good teachers who were rather unusual, who were good mathematicians and didn't really follow the curriculum. If I'd been stuck at A-level math, I think I would have been okay, and I think the A-level and further maths A-level then were probably better than they are now.

NO: I had a somewhat similar experience. I was allowed to explore beyond the standard curriculum, which made a huge difference to my interest. And University?

CW: At Cambridge University I did natural sciences, and later switched to maths because physics was really a rote learning exercise. In the third year, I picked the applied side of mathematics, which was theoretical physics to a large extent. So having not had a great time doing physics, I had a better time doing maths. We were allowed to do computing projects and things like that even back then. It wasn't completely bereft of modern technology.

2. Maths education in school

***NO:** In the university environment, I think we're all very much on board with the idea that school-level maths seems to be too much emphasis on rote learning. We want people to be actually thinking mathematically. That's the type of training that we end up having to do – we have to sort of reprogram students from the idea that mathematics is following some very rigid process. I expect there would be less agreement that a computational lens is necessarily the solution. I'm interested in how you view your approach compared to previous approaches to making maths more conceptual.*

CW: I think there are a few things going on. One thing is that maths really wasn't that applicable to lots of things until computing. It's massively more applicable now. You might call it maths, you might call it computation in the outside world. But fundamentally the mathematical process has produced a fantastic range of answers way beyond the scope that it had before computers because you can deal with messy calculations.

So that has then driven people to think this mainstream subject was just a sort of esoteric thing that was sort of mind training to actually really needing it for people in the community. And I think they're right for the right subject.

So then you've got to backtrack a bit and figure out – Latin, which was forced on everyone in any intellectual school in England back in the fifties, and maths were the two bedrocks of intellectual endeavour. That was their role, and everybody accepted that even though people didn't speak Latin to each other, but somehow they thought that was the thing you needed to learn. Then it all fell to pieces in the sixties and seventies where it was like, do you really need a Latin A-level to go and apply to Oxford to read biology? Maybe it trains you in something, but is it really essential?

I think that we've now got a confusion between maths as a conceptual, abstract thinking thing where we're not that interested in the content, we're interested in the process by which people think – a bit like Latin was supposed to be – and maths as a pragmatic thing that you really do need as a practical matter in your everyday life. You could function at a level with essentially no maths above basic arithmetic 50 years ago. I just don't believe that's true going forward.

So what's happened is we've fallen between two stools in school. If you look at A-levels, further maths A-level, they're kind of a rite of passage for many people who couldn't give a toss about maths in its own right. I'm not sure they're fulfilling the needs of people who really are interested in maths in its own right. They're sort of neither.

So, I think what's gone wrong before is, firstly, most people you talk to as maths educators haven't thought about the change of the real-world subject. They just haven't thought about it. So therefore they're running to catch up with something that they've misunderstood, in my view.

Problem B is a lot of the change that ends up being promulgated is pedagogical change because it's so hard to change the subject. It's a very bizarre problem. Take religious studies – when I did divinity at school it was pretty tedious, learning bits out of the Bible. Now, my daughter did religious studies – it was very edgy. Different religions, comparing ethics, discussing the death penalty, things that I would certainly find pretty interesting. It had been allowed to change because nobody in a British context was that concerned about it as a mainstream thing. Maths is so central you can't change the subject because everything stops change. The ecosystem is completely locked.

If I can build a new company that gets you 1% more in your A-levels as they exist now, I can get lots of money to fund that. But if I want to do something which – what we're trying to do is say actually, the subject has gone off kilter a bit, or actually a lot in my view – we would like to have an alternative or something else. That's incredibly hard, mixed up with university admissions and teachers and schools and governments.

So I think what's failed in the past is not radical enough, not a complete clarity to understand what the main issue really is, which is the subject content in my view, and then far too gentle an approach to actually offering an alternative. But you can see why that's happened in the ecosystem in most countries.

Just to be clear, I'm absolutely not against there being a highly abstract Latin-like subject that people who are actually interested in can pursue. I don't think it's bad. I think it's good. I just don't think that forcing the majority of the population through that is at all the right thing. And it's not right for many other high-level courses at universities – engineering, biology. I think it's wrongly formulated for those too, for the most part.

NO: It sounds like what you're saying is the goals of mathematics for higher education in the mathematical subjects – math, physics, and so on – are maybe at this stage more different to the goals of mathematical literacy, as it were.

CW: Well, I think for literacy, everybody needs it to be practical, just at different levels. I suppose I would put subjects for their own interest – if I want to go study ancient Greek, it's a fine thing to study. I'm not against people trying to study ancient Greek if they find it interesting. But what I am against is saying if you don't get an A* in ancient Greek, you're not coming to read economics at the LSE, because there just doesn't seem enough connection between ancient Greek A-level and economics at LSE.

Now, the fact that you've got very good at ancient Greek might well mean that you are good at concentrating, and you can assimilate a lot of stuff, and there are a lot of side benefits. But it just isn't central, and I don't think you should be forced to do that. If you take maths A-level, I think there is a sort of rite of passage thing going on. It's a funny mixture because it's rather procedural, and in fact, you can get through a maths A-level with basically rote learning to a large extent.

So that neither services going to your maths course, for example, where you actually really want people to abstractly think about mathematics, nor does it serve anything much they're going to be doing applying it, nor do they know how to apply it, nor are they using the right algorithms even often. So it's kind of neither of those.

For example, I would like to see an alternative option – a kind of computer-based maths A-level which has at least the status of a traditional maths A-level, and is usable to admit people to many courses that would seem appropriate, which would be many of the quantitative courses that are not maths itself.

I think there's another thing going on here, which I think is often missed. A lot of pure mathematicians say to me, "Oh, but you're going to ruin the subject. You're going to pull everybody out." I disagree very strongly. I think we're losing, particularly from less intellectual backgrounds, a lot of people who are actually good computational thinkers, many of whom might get excited by the subject itself. But they ended up getting lost because they didn't know what they were doing. It was very procedural, it was rather boring, they had a rather bad maths teacher, whatever the problem was – it was not applicable to their life at that point, they didn't get interested in the application, and so they got completely lost. Now many students will just want it for its application, which is fine. But some of them will want to see what's under the hood – it's like some fraction of people who drive cars get interested in how they work.

We're losing this. So I actually think if we did what I'm talking about, we might well end up with more people wanting to go down a pure maths route than we do at the moment. For most people, if you want a mainstream subject, the thing has got to have some obvious applicability, and you've got to focus on that. And the more you do that earlier, I think the more people you'll get.

At the moment we've got mostly an abstract procedural thing, which, if you're lucky, you get a side problem that's applying it to some practical problem which is thought to be an extension. Maybe a simplistic application, because that's all you can do without the computer in many cases.

If you say, here are data from two websites, here are a million data points from two versions of a website, go figure out which is performing best – I mean, you don't get anything like that in the maths curriculum. And yet that would be a practical, everyday problem. It's quite hard – what do you mean by best? How are you going to analyse it? How are you even going to get the data in shape?

NO: We both had exposure to some more interesting mathematics when we were in school. Olympiad-style mathematics training was a huge influence on me and probably a big part of the reason I ended up doing mathematics. I feel like this approach has been very successful, but also elitist; it benefited students who already showed aptitude and interest. Is there any relevance of this type of mathematics in your view, in a more broad sense?

CW: It's complicated. The problem is that you need people to be able to think effectively. I've got a lot to say in terms of being explicit about outcomes we actually want, rather than "well, they solved this quadratic equation, and somehow that imbued some sort of thinking, but we're not going to explain what that is really."

I think it's just very muddled up at the moment. If you take very simple things, say the quadratic. What does that really mean? Well, at one level, you're trying to learn that there are processes in mathematics – there are things called equations that are pretty useful in solving a bunch of problems. And there is a whole bunch of techniques for what you do when you have this sort of opening abstraction of an equation to get to an answer, and they work rather well in many different cases. But then there's a sort of outer wrapper – well, why did you set the equation up to start with? And is the answer right? It's got two roots – what does that mean? All the roots came out complex – what does all of that mean? Does that relate to what you did?

So, there are many different pieces, some of which I think are highly relevant and people really need to know, some of which are, like the actual details of applying the quadratic formula, I think are mostly irrelevant. Is it a way to learn how to do algebra by hand? Maybe. Would I favour having far more complicated equations where you've got a huge experience of many different types of equations, where you understand where you might use equations altogether and where they tend to go wrong, and mistakes that get made using them? I would much prefer that. And I think then you could end up going into what is the computer doing actually to solve them.

The point is, the stuff outside now is interesting, complex, hard, and necessary – all the things you could want from a mainstream subject. So I don't know why we're not focusing on that first.

Just on the elitism aspect, because I know there was a thing with the Government recently about getting rid of funding for further maths: I wrote a blog post about it because I was fairly confused by the discussion. The idea that you should only be trying to get people in school from D grades to C

grades is nuts. We obviously need people who are going from A grades to A* grades, and there obviously needs to be help for people in schools that are not really equipped to do that, and that's money well spent.

Maths, computation, these things are important. So I'm very much for helping people who are already good do really well, and Britain has actually historically been quite good at that. I think probably better than mainland Europe, on the whole. But the argument gets all intertwined with further maths A-level specifically. I'm not sure that's doing what they want to do, and I'm not even sure that's doing that for the pure maths people, let alone for the other people.

NO: How do you see the hope of actually changing things? It's very difficult for something like mathematics – so many people need to be convinced. Are you optimistic that things can be changed?

CW: I think things will change, but they might change because there's an absolute crisis, or they might change because it's managed. It will change just like Latin got thrown out at some point because, in the end, it doesn't make sense. The thing as it's formulated at the moment is not going to work at some point. Somehow a crystal will grow somewhere, and people will come onto it. But the question is, can it be seeded, and where, and who can make the most benefit out of it?

The failure modes are pretty evident if you look for them. We've got a lot of people who are incredibly upset about maths. They can't do it. They're disadvantaged in all sorts of ways.

I actually think we've got societal problems that are emerging. If you look at most decisions now in society, they have some connection with a computational argument made for why the decision was made – data science, modelling. I don't think you had that 50 years ago. In the pandemic, it's like: here are some graphs, here are some models, and the models say you should wear a mask.

The problem we've got now is that most of the public is absolutely ill-equipped to be sceptical and intelligent about this. So, therefore, a decision is made, they don't really understand the decision. Then some expert stands up and talks some twaddle – some of the experts are good, some of them aren't good, but they have no way to tell between them because they're not educated in that. And so then the expert who gets on TV may be the one who talks twaddle. And then, basically, at some later point, it turns out to be wrong.

NO: Therefore maths is bad.

CW: Therefore maths is bad. Therefore we can't trust algorithms. It's garbage. So it's almost a pre-enlightenment era, it's sort of hocus pocus.

We've got a major problem with that. Obviously, what I advocate is, we want more decisions based on intelligent application of mathematics. But we've got to also be honest about its limits, and nobody has the nuance of that coming out of an A-level at school.

So I think we've got these pretty major problems to fix. And I think those are becoming more and more evident. Now, how does that end up forcing a change? Well, unfortunately, it's rather circuitous in most countries.

In principle, Britain has a structure that would allow change more readily than in many other countries. A-levels are not formulated by the government, they're formulated by exam boards. You can introduce a new A-level. But in practical terms, to do that, you've got to get enough people to agree – that they will admit people to university on it, that therefore there's an incentive for the exam boards to offer it, that the Government aren't going to block it, that parents and schools can be convinced to do it. So there's an awful lot of baggage.

In Britain, on the ground people are surprisingly innovative. I think this would actually not be a particularly hard argument to win on the ground. But then it gets stuck in the bureaucracy. So you find far less puritanical objection in Britain than in many other countries. But you find a sort of slight hopelessness – oh, well, nothing can really change, because everything's very complicated.

Another thing that comes up very often is the number of maths teachers. People may not like to hear this, but I have good news on this, which is AI – whether you're talking traditional maths or the kind of maths I'd like to see – I think AIs are doing already a pretty fantastic job of a lot of what a procedural maths teacher would be asked to do. So I think human teachers are very important, but I think the role can change. And I think you could get far further with fewer. So I actually think that's good – that's a very positive piece of news in actually delivering any of this stuff.

NO: Are there any schools that are really trying to bring in AI at this point, or is that still a few years in the future?

CW: You have to be careful when you're talking about AI to teach or AI to affect the subject because it's affecting the world. On the former, I think a lot of schools are experimenting. I think the stuff is fairly rudimentary, but honestly, I think there are a lot of teachers who are pretty hit and miss at diagnosing misunderstandings in students, even the procedural maths that's current.

Actually, I think that the chance of a decent AI – we're building tutoring systems for traditional maths as well as the maths I'd like, with a mixture of our deliberate computation and generative stuff – is surprisingly good. I think it'll do better at the sort of rudimentary everyday stuff than the average teacher might do. So I think that's really promising for levelling up. It is incentivised correctly because people will probably do better on their tests by learning it better. Hopefully, they'll get some other benefits as well. They'll be more confident, and it'll be evened out better between different schools.

I think that in terms of changing the subject, nothing yet because all the incentives are against you.

3. Maths in higher education

NO: Do you have any thoughts on AI in higher education specifically? We're dealing with AI in various ways, both in assessments, but also just in terms of how what we teach should change; I find this very challenging given the rapid pace of progress. How should the undergrad curriculum change, and how should our approach to teaching change?

CW: One big question concerns service courses; what is the core for people who are not studying maths per se? And also essentially every subject at university, certainly at a technical university, there's a computational version of the subject more or less. So the question is, how does that interweave with the core that's delivered?

I'm concerned the two get out of alignment pretty badly. A typical example – my daughter is just doing finals in biology in natural sciences. There is a biology maths for biologists in the first year, and it seems almost completely out of alignment with the whole of the rest of the biology course. The maths you need for biology is mostly quite modern computational biology – it's not going to be pre-computer, most of it. And yet what they were being taught was mostly sort of binomial distributions – which is fine, but it doesn't seem like your best foot forward on many of those things.

One of the things we've been trying to do is build problem sets that start with a fuzzy problem and end up requiring bits of maths to be determined. So you're covering all the maths that you need, but it starts from a context. I'm talking here mostly about the supply courses for all of the different undergraduate programmes.

I know somebody at UCL, a neuroscientist. She gets A*-maths people and presents them with a bunch of data from neuroscience experiments in their first term, and they have no idea what to do with it. Just none. Zero. So the question is, what is the right course to get them thinking along that track in a better way?

I think there's a central subject that we may be missing that people want to study in its own right in different places. That isn't quite traditional maths and isn't quite computer science, but is a foundational subject, and some of that may be what they need for servicing other subjects, and some of it may be actually learning that in its own right.

In terms of making use of AI, I think there are opportunities to run through more innovative questions, with more individual diagnosis. So, I think that might be a way to look at it – the AI as a tutor, as an on-demand tutor. Much more discussion together. I feel that there will be more opportunities to flip the classroom because you don't need to sit in a big lecture room going through problem sets in the same way. You can use those more as tutorial sessions, potentially to discuss how to apply the mathematics which is much harder in some ways.

4. Closing thoughts on AI

NO: A last, somewhat off-topic, question on AI outside of the context of teaching. As someone who does research, and views it as a primarily creative enterprise, I have been quite shocked at the rate of progress with AI. In January there was an announcement by OpenAI on one of their models achieving a score of 25% on the FrontierMath benchmark – this is not open, but the example questions seem very difficult to me. So this was a big shock. But then the model was released, and in fact, I still find very little use for LLMs in my research. How do you see AI progress in the next few years, in how it relates to research and other "deep thinking" tasks?

CW: I suppose my view on this is basically that this is the trouble with benchmarks. You can feed these things more and more, and they will be very good at the things they're fed, of course. At some level, they really don't understand what they're doing in my way of thinking. They operate with a different pattern of thinking.

I don't think they're going to manage to do the creativity. They produce new ways to look at things sometimes, but they don't produce the same kind of creativity that humans traditionally have. So they're very useful. If you feed enough curriculum information, if you feed them enough questions from A-levels or degrees or whatever to the thing, they do incredibly well at them.

But are they actually doing anything brand new? Obviously, they're putting together things that are different. But I think we've already seen, even in trying to do this tutoring thing and various other things with AI – I sort of call it deliberate algorithm as opposed to LLMs – I found that we've done a lot of work trying to put our sort of make those hybrid for solving various things, and that does still seem to have a lot of power to it in some cases.

It's very, very impressive to look at. It's somewhat less impressive on second and third viewing. I still think there's room for a lot of different approaches, and that LLMs aren't necessarily the approach to do everything.

NO: Probably another interesting few years ahead.

CW: Absolutely. The good news is, if one's in the maths business, one's not in coal mining. It's driving the world. We're in a computational era, whatever you want to call it.

About the author

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