



**Interview with John Behrens  
Vice President, Product development, AI Products and Solutions, Pearson**

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**KENNEALLY:** Today in the United States, thousands of well-paying jobs go unfilled in science, technology, engineering, and mathematics. Educators are recognizing that a barrier to entry may be a basic STEM requirement, calculus. Nearly every STEM job requires at least one semester of the subject, but a third of calc students drop or fail the course. Now, an AI-powered tutor app from Pearson could help those students solve for success.

Welcome to Copyright Clearance Center's podcast series. I'm Christopher Kenneally for Beyond the Book. Aida Calculus uses multiple artificial intelligence algorithms to tutor students, teaching them how to solve problems and demonstrating why calculus is a useful tool outside the classroom. The algorithms can analyze students' homework, even reading handwritten solutions, and provide feedback in the forms of hints, extra practice problems, or videos showing how mathematical concepts apply in the real world.

John Behrens is vice president, product development, AI products and solutions at Pearson. He has published more than 50 scholarly works in the areas of AI and data science, learning science, and technology for learning and assessment. Before working in industry, John was a tenured professor of psychology in education at Arizona State University. He joins me now from his Mishawaka, Indiana, office. Welcome to Beyond the Book, John Behrens.

**BEHRENS:** Thanks, Chris. Thanks so much for having me.

**KENNEALLY:** I'm interested in learning about this subject and the ways that artificial intelligence and data science are being applied to help improve learning. How do you approach that?

**BEHRENS:** Well, we start with learning science, Chris. We want to understand what's best for the student, what the student needs, and how to adjust to students with different needs. We all have our own background and history, and we approach our problems with different strategies and things we like and things that work and don't work. So we start with understanding what those principles are.



And what happens in the physical world is humans make those decisions and they make adjustments to the learner and their background. What we're trying to do in our work is use the data that's generated through the learning process to help make those decisions more automatically and support the learner through that journey.

**KENNEALLY:** What's interesting to me is that it is, of course, relying on science and on what you understand about artificial intelligence, but your work at the university was in the area of psychology in education. So there's a psychological element here, an interesting combination of the scientific – the objective – and the subjective.

**BEHRENS:** Yeah, that's right. We always see this work as kind of an intersection of the learning sciences, of which psychology is one, the computing sciences, of which AI is one, and then the statistical sciences, which is related to how AI makes the inferences and links those different fields all together.

**KENNEALLY:** Can you give us an example of the way that this all works? A particular type of student approaches problems in a certain way. How does the algorithm work with them to improve the learning experience?

**BEHRENS:** Yeah, so in different kind of contexts, you might be more apt to need some conceptual understanding rather than computational understanding. For instance, in math, people often focus on kind of the doing the problem part of it. We think of that as the computational set of skills. But there's also conceptual understanding that helps you kind of bridge the different pieces of those computations, and sometimes students get that, and sometimes they don't. It might depend on the context they're working in. It might depend on the demands of the classroom. Might depend on demands outside.

And part of what we do is we watch through the data and through the interaction the student has with the app. We watch where their preferences go for different kinds of materials, different kinds of resources, and we map that back to our understanding about where you might need more conceptual help or where you might need more computational help, and we try to make sure that we have all the appropriate resources for you to align to get what you need in that context. So we serve them up as recommendations so that you both have your choice and have your control and have your power, but we're also bringing things up that we've learned through the data and the system has learned automatically through the data what is probably the thing that's going to be most helpful to you at that time.



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**KENNEALLY:** And for the student who is doing their homework, so to speak, with the help of Aida, what are the kinds of hints they get? Tell us about the ways that you can use the computer interface to really up the game here for students.

**BEHRENS:** Yeah, one of the pieces of Aida that we're very excited about – and there's a number of different pieces. We have an area of Aida where you can explore the relationships of different calculus concepts visually, and we call that the explore area. We also have a set of videos that I mentioned before that are highly conceptual, and you can bring those to bear to enrich in your understanding of the larger context.

We also have a set of very specific tools that help you with the computation that you might be working on in that context. There are hints, as you mentioned, built right in. The way that works is the student takes a picture of the homework problem that they were computing – all the different work just kind of lined out by hand – you take a picture, and then it gets converted through OCR and AI algorithms into the actual math that you can see on the computer. Then the system not only looks at your final answer, which is important and has been what people have focused on historically, but it also looks at each of the steps that you took along the way and tries to understand the process that you were going through and for that process, which steps you might have gotten right, which steps you might have gotten wrong, and in what ways.

And rather than just solve the whole problem for you, which might be kind of convenient, but might not drive your learning in the same way, it'll take each of the steps and do what a human tutor would do, which is say rather than here's how you do it, give you a hint – have you thought about doing this? Have you thought about this approach? So that it can not just get you through the problem faster, but get you thinking in the right direction. And you have the opportunity to edit your answer either through a keyboard or through the optical character recognition, and then the cycle repeats until you're through the entire problem.

So a set of hints that are direct verbal kind of cues for you to think a little bit more in an appropriate direction, but also aligns you – gives you recommendations about specific videos that might help you either with the direct computation or your conceptual understanding of what you're trying to do in that context.

**KENNEALLY:** Well, we know that calculus is not the easiest subject, and as you've reported, over a third of calculus students drop or fail the course, so they're feeling a sense of frustration. Does the digital learning product help them overcome that sense of frustration? Because as I understand it, this is something that is



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personalized. It can be used anywhere, any time. So if a student is not happy in the classroom and maybe is looking for a way to learn without becoming embarrassed, they can go to the computer for this kind of feedback and perhaps feel a little bit better about themselves and their progress.

BEHRENS: Yeah, absolutely. So, Chris, this is a mobile app. It runs on the iPhone. It's not something that works in a web browser, because it requires the direct access to the camera. And it also because of that is an anytime, anywhere device for supporting your learning and the kinds of extra help that you want from a tutor. So that can happen either through the videos if you're just wondering about – something happened in the class, but I'm not sure I really got it. Well, there are very high-quality videos that have a lot of humor, a lot of illustration that really connect the ideas that are going on in the mathematics learning with the ideas you already have from your life about how the world works and the shapes of things that you might see in calculus, but maybe you didn't connect what's going on in your world and the math world or the larger world.

For instance, one of the videos explains the idea of limits by talking about how gravity increases toward infinity as you get closer to a black hole. So there's great, fun animation about falling into the black hole, but it's all done in a way that's mathematically appropriate and ties that experience we have about what's happening in our world of news and the social world to the mathematical thinking we're doing.

This is an important concept from learning science – that we learn new things by relating them to things that we already have. So great fun. Focus on computation when needed, but also a fun, enjoyable way to think about the larger concepts that help you tie everything together, as well.

KENNEALLY: John, thanks for correcting me with regard to the app. So I guess the next time I'm walking through a university library and I see all those students on their phones, some of them could be doing calculus. Is that what you're telling me?

BEHRENS: Absolutely. An important part of the approach is meeting students where they are and in the space that they want to work. That's part of why the optical character recognition and people being able to take pictures of their work is important, because people think generally right now in calculus with students in college – they think with a pen and paper, and they make their mistakes and their ins and their outs and the memory and the expression – all that happens on the paper. So when it's time to help them with a problem, it's great if we can meet



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them where they are in that kind of expressiveness without having them learn a new interface or a new way to express themselves in the computer.

KENNEALLY: And I suppose another important point is the result, and I understand that something like nine out of 10 students have been asking for faster ways to get results on their testing performance. This is one way to really give them a real-time read.

BEHRENS: Absolutely. Absolutely. This is the key area that's a bottleneck in many university contexts and many learning contexts around the world, is how do we increase the amount of feedback the student has so that when they go into the midterm or the final, they've had lots of opportunities to get the feedback they need to evolve their performance and learn what they want to learn at the rate they want to learn it. So feedback has been a bottleneck in educational systems, and we've made a lot of progress, but we think that Aida Calculus and AI from the ground up in this mobile app really blows the top off what's been done historically and is really ushering in a new era of meeting the student where they are, using the forms of expression that are most natural to them, and giving them lots of feedback.

The other thing, Chris, that's related to this idea is most work in educational technology centers around, I give you a problem, and then I expect you to answer that problem. But here, we reverse that around. You bring the problem to Aida. It's the problem you're working on, not the problem I assigned you. And we help you where you're at with the problem you're trying to understand. That allows us to help people in lots of different contexts.

KENNEALLY: Well, you have helped us today understand the new Aida Calculus app from Pearson. We've been speaking with John Behrens, vice president, product development, AI products and solutions at Pearson. John, thanks so much for joining me today on Beyond the Book.

BEHRENS: Chris, thanks so much. It was a pleasure.

KENNEALLY: Beyond the Book is produced by Copyright Clearance Center. Our co-producer and recording engineer is Jeremy Brieske of Burst Marketing. Subscribe to the program wherever you go for podcasts and follow us on Twitter and Facebook. The complete Beyond the Book podcast archive is available at [beyondthebook.com](http://beyondthebook.com). I'm Christopher Kenneally. Thanks for listening and join us again soon on CCC's Beyond the Book.

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