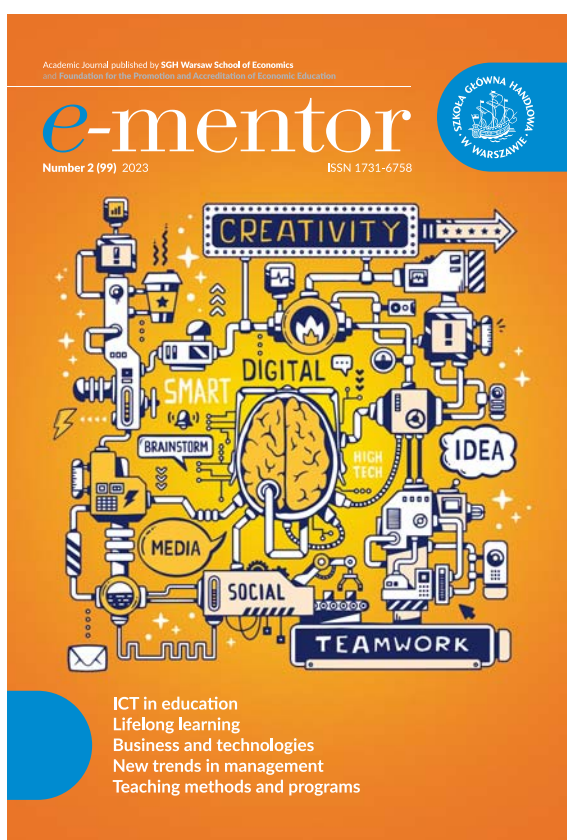


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Charles
Dziuban

Adaptive learning as a means of decreasing inequity and improving the quality of education

Professor Charles Dziuban from the University of Central Florida, US, shares his expertise in adaptive learning and describes the conditions of its adoption in conversation with Maria Zajac



Maria
Zajac

M. Z.: Thank you, Chuck, for agreeing to talk about adaptive learning (AL). Could we start by clarifying what this term refers to? I mean, is it more the technical term used by computer scientists or a pedagogical concept for educators?

Ch. D.: That is a good question. I think the best answer is both. It represents both worlds. Certainly, adaptive learning is not new. We have known about it for many, many decades. An original paper written by John Carroll called *A Model of School Learning*¹ talked about that. And in that Carroll at Harvard developed a model is built around the notion that if one holds the amount of time that student is able to spend devoted to learning a topic, then her knowledge acquisition will become variable. If learning is the constant, how long they will be engaged in the learning activity will be variable. And interestingly enough, that is not the way universities are set up. In the United States, we put students in semesters that are limited in time, 16 weeks. Students enter a course, all spend a fixed time, so naturally, what they learn in that period is individually different. It depends on their aptitude, ability, motivation, commitment, and willingness to work hard. All of that affects what they learn. So, they come out of the course at different stages of knowledge, which is usually reflected in a final examination. But Carroll said that an effective school learning model should be the amount of time spent devoted to learning, divided by the time needed. Some students simply need more time than others. Some subjects we learn rapidly, some we do not, and need more time to master a topic. So that is the educational definition of adaptive learning.

We have known about adaptive learning for years. Benjamin Bloom wrote the Six Sigma paper that said: individual mentors working with students constitute the best instructional model. However, it has been too complicated and cumbersome. Teachers have never been able to implement an adaptive learning model because it is too costly. Now with the new technology platforms, like *Realizeit* and other platforms, we can make it work.

But the other thing is that adaptive learning really has all of the characteristics of a complex system. It is not only adaptive but interactive, diverse, and interconnected. So, what it is emerges into something entirely different. It is more than in some of the parts, that is, in a sense, what adaptive learning has become, and it is still emerging. It is kind of existential at the moment and developing its effectiveness, its difficulty, and its disappointments. All of those things are coming into play with adaptive learning. There is always this initial enthusiasm as if it is going to solve every problem and it never does. Then there is disenchantment with it. And now, we are in a stage where we are looking at it: how does this integrate into the educational system? How can it change it? How can it impact it? And how can we continue to use this and develop its relationship to learning outcomes and teaching, which is a topic we will discuss later in this interview. In a sense, Maria, it has all the characteristics Susan Lee Star called the boundary object. It is something that holds a community of practice together. It is weak, but is able to hold the

¹ Carroll, J. B. (1963). *A Model of School Learning*. *Teachers College Record*, 64(8), 1–9. <https://doi.org/10.1177/016146816306400801>

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community gets together, but they disagree on what it is. But if we go back to the individual constituencies, let us say physics or rhetoric, or chemistry, or mathematics, they know exactly what it is. They know what it is in their scientific, in their specific disciplines. We just have not come to a general term that we can accept. That is very important. Critical thinking is the same thing. Everybody loves critical thinking, but we have difficulties when trying to define it.

M. Z.: You mentioned that the interest is growing in the USA. Do you have any idea how big the interest in adaptive learning has become among school or university leaders? Or is it restricted only to people who are passionate about the idea?

Ch. D.: Again, I think it is both. There are people who absolutely believe that this is the way we should go. But some people are very suspicious of it. Think about this, Maria. If what I just said is true about being in a semester for a fixed time and learning is variable. If you want learning to be a constant, it blows the semester up.

If you go to administrators and say you can no longer have semesters that does not play well, because universities are rigidly fixed in their organization. So, it has great implications. It has the potential to unbundle a university, which is a source of tension. We will see how that develops. I seriously doubt if we are going to dismantle universities. But it should be fun to watch.

M. Z.: And what about learning analytics (LA)? I know you are involved in this subject as well – is LA indispensable for adaptive learning? Or can they exist separately?

Ch. D.: I think they are, once again, bound together. My thinking is that when one looks at the broad construct of adaptive learning, somehow analytics is a subset of it because clearly involved in adaptive learning is this continual assessment of at what stage the student is in the adaptation, where they need to be, in a continuing recycling. So, it is a continuous analytic process that goes on within the context of adaptive learning. But in the broader context analytics is the predictive component for students. For instance, analytics and business: what will they buy? Analytics and literature: what will they read? That is what is involved in analytics and also in education. Adaptive learning is somewhat different because it involves learning as well. But I think this is really the three-body problem. You

know when Newton developed his principles of physics he did a marvelous job, and one of the things he showed was - when you had two bodies interacting with each other with their gravity, their trajectories are very predictable. When you add a third body, it is called the three-body problem, and it is unpredictable, and chaotic.

There is a great novel now, by Cixin Liu, a Chinese science fiction writer, called *The three-body problem*² about the land Trisolaris that had three suns which interact with each other, making their world chaotic.

And Newton is reported to have said to Haley, who introduced the notion of the three-body problem: you give me a headache. And I think what we have here is a three-body problem: analytics, adaptive learning and big data. And they all interact with each other, and it is creating kind of a chaotic problem. It causes friction in the educational system. Adaptive learning is about removing information friction. That is the problem students have. They have friction, getting information, getting knowledge. Universities often create friction for students. And so that three-body problem is something that we are facing, and that is what we are looking at in this notion of analytics, adaptive learning and big data. When we talked about the unbundled university, we created friction. What has happened to libraries? I do not know what is happening in Europe, but libraries have become unbundled here. Libraries are no more a place to which students have to come. They are outreach, they are electronic. They are platforms. We have in our library an automatic retrieval system where a student goes to an interface, asks for a book and a robot gets the book for them. They no longer wander the stacks, so things have become subsets of each other. I think we are smack dab in the middle of a three-body problem. That's where we are. Yes, I think it is chaos, in a good way.

M. Z.: Sounds interesting. I would tend to think that big data results from learning analytics. We analyze the learning process and get huge amount of data. Without learning analytics such data would not exist. In the educational context of course. So, I did not think that there are three different bodies.

Ch. D.: Yes, that is interesting. There is a great adage: data have no voice of their own, they never speak. And it is our job to responsibly select data, analyze it, and do the best we can with interpreting it. I have worked with big data my whole life. It is a mess. People want clear

² Cixin, L. (2016). *The three-body problem*. Macmillan (English Edition).

crisp data, but it never happens. Big data sets are excessively complex. I spend most of my time trying to clean up big data set and get the noise out of them because it causes friction. You have to separate the signal from the noise and that is very important. So, we have some responsibilities here. But big data has impacted what we have learned about traditional statistics. It has changed sampling, hypothesis testing and estimation to the machine learning, modeling and information technology. It has changed completely, for instance, what is the standard error meaning any longer – a statistical notion of a standard error when you have 10 million observations? It loses its meaning in the traditional context.

Why did we have statistics? Because we did not have the technology to deal with big data, but now we do have such technology. We have to integrate the two models in some way so they are all part of each other and interacting in a fascinating way.

M. Z.: Let us get back to adaptive learning. When we read the American papers about LA and AL, one gets the impression that it is mainly aimed at students being at “some sort of risk” – either because of being socially or economically disadvantaged or because of their professional duties, to mention the most common factors. Is that the correct assumption?

Ch. D.: I think it is context, Maria. What is the context you want to apply adaptive learning? In the United States of America, a tremendous inequity exists in our educational system. If you live in the United States in the lowest economic quartile, the chance of your going to and completing a college education is 12%. The odds against you are roughly 9 to 1. It is a horrible inequity. So yes. We want to apply adaptive learning in a context where we can level the playing field.

The other problem we have in the United States, which you do not have in Poland or generally in Europe, is accumulated college debt, which at the present time is 1.7 trillion dollars. If it were a GDP, a gross national product, it would be the ninth largest economy in the world, as published by the World Bank. That is the two-pronged problem we are facing. You do not face that in Poland because your higher education is free, but that creates other problems.

The context of adaptive learning so far has been trying to help students who are at risk, who are in poverty, but that is not the only application. We are back to the notion of: do you really need to spend four years in college? And the answer is no. You could ask me a question later on if students can accelerate through the university and I would say yes, of course they

can. Now in the United States, there are many adults who want to get an education. They absolutely cannot afford to give up their lives and jobs and go to university. So, they do it online in adaptive learning formats where they have time for their own pace. They can acquire an education and still maintain their lifestyle. That is another application of it. No, it is not just for people at risk, but at the moment in the United States that is one of our real hopes. Students who are at risk do not have a very good chance of getting an education. That is not acceptable. The inequity in the United States is currently not good and it is getting worse. Those who have money are acquiring more money. Poverty is getting worse in this country. That is where we are.

M. Z.: But on the other hand, at least as far as I know, in the United States, you can earn enough money for a good living not having a university degree. Is that true?

Ch. D.: Oh, absolutely. There is no question about it. We have several programs where we work with students, and they can get a skill-related job in any number of fields and earn a wonderful living. The Wall Street Journal just published the poll, and for the first time in recorded history, the majority of Americans think that getting a college education is not worth it. Almost 60% of the population believes that the cost and difficulty of getting a college education are inhibiting problems. It happened for the first time in our history, but things are changing very, very rapidly. Given Covid and all that we have had to deal with in our universities and our public school system it has shown that the young generation of students is much less enthusiastic about getting a college education. We have always believed in education, and we still believe it is the way to a successful life, the road out of poverty.

I do not know how it is in Europe or in Poland, but those attitudes are paramount in the United States.

M. Z.: Well, in Poland there are no fees for studying at public universities, so the financial factor does not exist. However, we are also noticing a significant shift in attitudes towards higher education. For many years, there was a widespread belief, supported by official propaganda, that obtaining a diploma guaranteed a job, and thus a good life. The demand for higher education was so great that numerous non-public universities were established, especially in the 1990s and at the beginning of this century. Young people took up studies in two or three different fields, sometimes even at other universities - they collected diplomas believing they would help them get a better

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job. However, employers quickly noticed that graduates lacked the necessary skills, and the situation turned upside down. When applying for a job, the essential requirement became practical skills and competencies preferably confirmed by experience already possessed, not certificates. So, students started working already while studying at the university. They do not want to “waste” time, I mean, to delay starting a professional career. Of course, this situation causes other significant problems, but that is another issue.

Ch. D.: Educational systems do have to adapt to the changing culture and what is happening in the world. And I think we are going to learn a great deal about what is involved in education. We will get to the role of teachers and what changes, but I think we are beginning to look at a global economy, a global educational system in the world. We are no longer nationalistic, although we have countries. The walls of the classroom are leaking, the classroom in an odd sense is disappearing.

I tell my faculty now, if you really think you teach a face-to-face course you do not. You do not even if you are in a classroom and close the door. Students talk to each other about you. They talk to the world about you. They are on social media talking about you, and I give my faculty examples. If you do not believe it, just go to YouTube and search drunk, terrible, stoned professor, search boring professor. There are hundreds of YouTube videos. The boundaries are gone. There are many people who can be perfectly productive, perfectly happy with their families and their lives without a university education.

M. Z.: And how do you think, at what stage of the adoption of AL we are now? In the US or globally.

Ch. D.: We are in the stage where we are over the initial euphoria. We have now abandoned the phase where we view adaptive learning as a universal solution. No, it creates as many problems as other technologies do, and we are at the stage now of careful, reflective looking at what it is, what it is not, what it can do for us, and what it cannot. How will it reduce the learning friction for students? How will it reduce the teaching friction for teachers, and what problems will it create? It is like anything else in a complex system. We really do not know how it is going to ripple through the system. Many of the outcomes will be counterintuitive, and there will be unanticipated side effects that we have to deal with and accommodate.

We are beginning to look seriously at what this can do for us and what it cannot. We need to take it seriously. But now, it is all of

us as responsible educators, to examine it carefully. Look at its good, at its bad, look at its ugly. And then make some conscious decisions about where we want to go. We cannot afford now to abandon it because it has great potential. But I think that is the stage we are in at the moment. We have been doing this for 4, 5, 6 years. It is like everything else. It is like the Gartner Hype Cycle. We are going to talk about ChatGPT later on - we are going to experience the same kind of phenomenon, that should not be abandoned because it has immense potential.

M. Z.: I asked this question because I remember, for instance, the research carried out by Peter Brusilovsky. I think about his papers published in the nineties last century or even earlier. So, it is more than 30 years now. I appreciate his work. But when I look at his papers and the research he presents there, I get the impression that there is no significant difference, in some sense, between those first works and where we are now. I remember the attempts of different LMS creators to individualize learning by giving the student the ability to create their own learning path. It has not changed much because, in my opinion, although I may be wrong, there are some systems which allow students to create their learning path but in many others the system decides instead of the students. In that sense, I do not see a big difference after 30 or 40 years, despite the instant development of technology. That is why I am just wondering if we, as scientists, researchers, and educators, have the chance to change it significantly in the nearest future.

Ch. D.: Well, Maria, there is an old adage, the more things change and more just stay the same. You know these ideas are not new. Very little is new. I think you raise a critical question: Are the students designing their own learning path? Or is the platform, technology, or pedagogical system designing their learning path? But that is a critical distinction. There is a huge difference between you doing it for students instead of them doing it for themselves. That is a critical issue. This is what we have encountered, and we encounter time and time again: I get the idea, but how do you put wheels on the idea? How do you make it operational? That is the problem. Well, there are platforms that do it, but it generates other problems, right?

M. Z.: I wonder, is it possible to use AL separately? I mean, without learning analytics and without a dedicated learning platform? In other words, can the teacher individually apply the idea of AL by adjusting the way (s)he teaches? Is it strictly combined with technology? Can we implement adaptive learning in f2f classes?

Well, you have partly answered that because you said that there are now no face-to-face classes, but is the learning platform indispensable for adaptive learning? What is necessary for me as a teacher to offer students adaptive learning?

Ch. D.: I am going back to the notion of friction. I think the critical question is how much friction a teacher can tolerate by doing this. Without some kind of technological support, there is a lot of friction and more than just a lot of work. If you consider even a small classroom with no technology, a teacher working at personalized learning for 30 individual students is overwhelmed. So, there must be a support mechanism for this to happen.

First, it depends on the teacher. And I think what it really involves is how much of the friction associated with adaptive learning can you remove to the point where there is a phase transition. A phase transition is when water turns to steam, or water turns to ice. What are the opportunity costs of doing adaptive learning within my instructional situation? If the costs are too great, I just cannot do it. But if the support mechanisms allow me to do it that I can go ahead. And I think that has to be almost an individual teacher's decision. Look at what is happening on the learning platforms like Blackboard, Canva, and others. They are working toward putting adaptive structures within their learning platforms. You do not have it in Moodle (I think), but Moodle is open source, so sooner or later, somebody will attempt to put adaptive learning structures within Moodle so that it will be available within the context of an LMS. Because, at least in my world, everybody uses LMS now.

M. Z.: What does adaptive learning mean to teachers? Provided we have access to the appropriate platform, does it still require a lot of effort and time from the teacher?

Ch. D.: No question about that. At the front end there is a tremendous amount of work in order to design a course that is adaptive. What is the old model of courses? You have your notes, you get in front of a class, and you lecture. That is the way we teach, we just talk. And now they want to interact with me, they want access to me. So it is an expanded role through my connectivity to students and in my interaction with them. You have to change your way of thinking about adaptivity and interaction, and learning. However, when you establish a classroom that is running adaptively, in some respects you can step back, but that is something where much of that activity is taken

over by students, who can teach themselves. They can interact with themselves. They can do many activities like that. I guess the answer to your question is yes and no – at the beginning, it is a lot of work we have to really think about. What is this thing that is called an adaptive classroom? And what does it mean for me? And what does it mean for them? It has to do with this notion of a psychological contract. What is it I want from them? What is that they want from me, and I have to negotiate that. So yes, it changes everything.

M. Z.: So, what could be the motivation to apply adaptive learning in that context? What is the way to convince teachers to get involved in it? You say them, well, in the further perspective, you will have less work, but you have to put in a tremendous amount of effort at the beginning. How will they react? Will they step into that?

Ch. D.: Maria, what are you and I? We are teachers. We are born teachers. That is all that I was ever born to do. And I want to be a good teacher. I am so happy when things go well, and I am crushed when they do not go well. And lots of times, they do not go well. There is virtually no one that I know, who as a teacher goes into a class and says, today, I am going to do a poor job. Everybody goes in and says: I am going to try to do a good job in my class. I think we are all committed to that. And I think the way to convince teachers is: you can be better at your craft. You can do well; here are some tools that will help you. There will be some costs involved, but you will feel better about your profession. You will feel better about what you do. I think that is the way I go about it. I do not think you should shame them. I do not think you should cajole them. And I do not think you should expect everyone to do it. We have some excellent lecturers; we leave them alone. Let them do it. They are wonderful. Why would you have them change? There are some terrible lecturers, and we say, why do not you try this adaptive stuff? Maybe it will help you. Maybe that is the way it will play out. I think you need to convince them: we can help you become a better teacher. We can help you feel better about your craft. That is the way how I always do it, and they respond positively. Not all of them, most of them.

M. Z.: Let us think now about the role of instructional designers in that concept. I have read the article³ about the Algebra course offered by UCF, which was described as adaptive – you and your colleagues have pointed out that more

³ Dziuban, C. D., Moskal, P. D., Johnson, C., & Evans, D. (2017). Adaptive learning: A tale of two contexts. *Current Issues in Emerging eLearning*, 7(1), 42–70. <https://scholarworks.umb.edu/ciee/vol17/iss1/4>

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advanced students can skip some pieces of information if they do not need them, while others make use of additional explanations. I am thinking about the instructional design concept of such a course. How to design those different ways of dealing with the course content and not to get lost?

Ch. D.: Yeah, it has tremendous implications for instruction designs, but is only one model. There are lots of models for learning as you know. For instance, deconstructionism, there are a lot of other ways.

M. Z.: Well, you can use this or this model, but anyway there must a general concept behind.

Ch. D.: I will give you our context on how we use it. Students here all have to take college algebra. In order to enter college algebra, you must pass an examination. If you do not pass the examination, you cannot register for college algebra. Instead, you must register for intermediate algebra, which is a non-credit-bearing course that reviews basic algebraic functions and concepts. It prepares students and once they pass intermediate algebra, they can then move on to college algebra and take the course which is required, credit-bearing. So now we have these two populations - those that can go into college algebra and those who cannot. The algebra instructor consolidated those two courses, put them together, designed in an adaptive learning platform *Realizeit* a continuous sequence of algebra skills that transverse intermediate algebra all the way to the advanced concepts in college algebra. This one unified thread of objectives and concepts, things to be learned, were sequenced. Then she integrated it into the adaptive learning platform with contexts for the word problems for the various disciplines, for business, rhetoric, English, education, medicine, engineering. Problems were all in the context of their individual disciplines because they come from all over the university. And then we started. So, what this allowed was those students that could go into college algebra went into college algebra and were evaluated by the platform. If someone understood the quadratic equation and passed an assessment, they did not need to review it. They could move on to the next one, the next one, and the next one. In the intermediate algebra course, as the student began to master these skills and demonstrate his or her mastery and did it rapidly at their own rate and pass an intermediate algebra course halfway through that "semester," they simply transferred to the adaptive college algebra course, and proceeded, at their own rate. And there is a large cohort of students who passed the intermediate algebra went to college

algebra halfway through and completed the college algebra on time. Some students who started in college algebra needed more time, so the instructor arranged with the registrar to give those students who did not complete the course in the adaptive learning platform in college algebra four more weeks, an additional month to complete the course. So, this is how it all works together. It is no longer the idea of a course starting and stopping, it is this continuous learning thread, and it works. It can work in any discipline, although it requires a lot of work. But that is the implication for instructional design sequencing the topics.

Now, what some platforms will do, if you give them your syllabus and your objectives, they will integrate it for you. They will sequence them, not perfectly, but it will give you a good start. That is the implication that it can be done in any course. But you understand we are back to the unbundling. It takes a very special teacher and a very special instructional designer to do that.

M. Z.: Should we, therefore, conclude that as long as the unbundling of the university really happens, the broad adoption of adaptive learning may not be possible? That the prerequisite for applying the adaptive solutions, the total change of our approach to education, which is actually needed is not possible unless the real unbundling happens. But I do not know if it ever happens, because, as we both as the teachers know, the universities keep very strong to their tradition, their structure. I think there is a strong resistance among their faculty toward such changes.

Ch. D.: The truth is that if you confine adaptive learning to these things called semesters, there is a limited number of things you can do. There is a restricted capability within these boundaries. But removing defining boundaries can be stressful. I am in favor, but we must be realistic about how many degrees of freedom we can tolerate. Look, most of our growth is online. If you are online, what do you need buildings for? But here we have, multiple billions of dollars invested in university infrastructure. What are you going to do? Come on, you are in Krakow, right? Are you going to not use the buildings of the Jagiellonian University anymore? No, that is not going to happen. Imagine, it is one of the oldest universities in the world, it has been one of the great universities for literally hundreds and hundreds of years. How much of that tradition can you unbundle? You know what I am saying...

Think about you, you were the editor of the journal for years, and the same things are happening in that area. It is all unbundling. It

is all happening virtually. In our early careers we wrote a manuscript and submitted it. Some of those journals still want their information hidden behind a paywall. How long is that going to last?

M. Z.: Let us finish with this last question. Last but not least – since November 2022, there has been a lot of noise around ChatGPT and its capabilities to replace humans in many educational tasks. In fact, we know that many other similar tools are already in use. How do you think – can ChatGPT and its counterparts support adaptive learning? Can we use those tools to better adjust the learning experience to students' needs and expectations? If yes, then how?

Ch. D.: First, GPT is not artificial intelligence. It is a Large Language Model (LLM). I asked GPT-4 if it was AI or LLM. Here is what he wrote to me:

As an AI language model I am designed to process and understand natural language, generate text, and perform various language-related tasks. However, while I can simulate human-like language abilities to a certain extent, I do not possess true artificial intelligence or consciousness. As a language model I rely on large amounts of pre-existing data and statistical algorithms to generate text that appears to be human-like. I do not have the ability to learn and adapt in a way that humans and true AI systems do. Therefore, it is more accurate to refer to me as a large language model rather than artificial intelligence. While I can perform many language-related tasks, I lack the broader range of cognitive abilities and decision-making capabilities that true AI systems possess.

That is what GPT-4 wrote to me when I asked if it was artificial intelligence, and it self-announced that it was not. However, it has tremendous potential. I ask it things like: can you relate Florida's theory of friction, the idea of complex system and Mandelbrot set to effective teaching and learning? And it gives me a spectacular answer. It gives an answer that

is a function of it scraping trillions of words from the internet. It is wonderful, stimulating and exactly correct. It does things that I possibly never could do. I just do not have the computer power to do those things. And at least gives me some idea, but it is not the be all, end all.

M. Z.: Well, that is interesting. However, should we look at the tools supported by Generative AI as the prospective game changers of education? In some sense, the situation with AI products resembles those with introducing laptops at schools, the internet at schools, the Wikipedia. There was a massive hype around that, many controversies and ... not much has changed in education so far. Do you think the same will happen now?

Ch. D.: Yes, it probably will. But on the other hand, as I mentioned, AI-based tools have tremendous potential. I can ask GPT to design a factor analysis course for me, and it does. It does a really good job, not perfect, but a good job in terms of doing, designing a whole course. So, can I use it for adaptive learning? There is no question about it. But if you ask, is there any artificial intelligence in these adaptive learning platforms, the answer is absolutely not. There is no AI. Those systems are rule-based and artificial intelligence can help to change that, but not yet. We are back to when we talked about big data. AI can assimilate and collect for you what it has found in many areas that we are just not capable of doing. It can put them together in a way that helps us think differently, which I like. But it does not generate anything new. It just takes things out there and recombines them in another way you may not have thought about.

M. Z.: Thank you so much for this fascinating conversation and your valuable insights. I strongly believe they will be helpful for those who are considering the adoption of adaptive learning. Thank you also for all those remarks and opinions you shared during our meeting and for your time. I really appreciate that.

WE RECOMMEND



BPM Symposium, October 23, 2023, Sopot, Poland

The BPM Symposium will be held for the third time in Tricity. The event will take place at Hotel Eureka in Sopot, organized by Gdansk University of Technology (Poland) and University of Gdansk (Poland), under the patronage of the Fahrenheit Universities. The symposium aims to bring together the academic community and practitioners engaged in BPM. Participation in the symposium is free of charge. See you in Sopot!

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