



A conversation with Prof. Sheizaf Rafaeli

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Chatbots and artificial intelligence are already changing the world of learning, education and teaching, says Prof. Sheizaf Rafaeli, a senior research associate at the Samuel Neaman Institute at the Technion, and head of the Internet Research Center at Haifa University. “Today the rules are being created by machine learning, and this is without human intervention. Those who wish to be frightened can write apocalyptic SciFi literature, and those who wish to be Luddites may do so.”

How can we use chatbots for education, and how will they change the classroom, teachers, and the relationship between them and the students?



“First of all, it’s not in the future – it’s in the present. You’re certainly going to mention Jill Watson, and the experiment at Georgia Tech (in which a teaching assistant who assisted students online was in fact a female chatbot – IK). Let’s realize that this is not the future. Second, let’s recognize that chatbots are not something that stands alone – they are part of a much broader fabric of artificial intelligence (AI) technologies. And, in the context of teaching and education, they are part of a broader view of AI technologies that are reshaping the processes of teaching, learning, education, and the other things that we try to do in the institutions that we are talking about. What grabs the headlines, and justifiably, is those places that are trying to replace people in a crude way – they set up a system that does what was previously done by teaching assistants. There are things that are a little less sensational in the short term such as systems that assign grades. If I would have told you 50 years ago that your grade would be given by a computer, it’s likely that you would have gone white with fright. When we started using Excel spreadsheets, those who saw it for the first time thought it strange which today is obvious. But if those Excel spreadsheets were not only to add up and divide to obtain an average, but would also make all sorts of rules – e.g., to give an allowance to someone who was on maternity leave, or to give a greater weighting to certain subjects and examinations, that’s where AI begins to come in, or at least some system of thinking, not just calculation.

Is it the system that allocates these criteria, or is it that people tell the system, “Please give a weighted average”?



“That’s exactly what we are moving toward. Once, if there was some conditional statement, an if-then statement, then someone will have written it, not the machine. But today the rules are being created by machine learning without human intervention. And it’s not just machine learning – a growing share is taking place ‘unsupervised,’ that is, machine learning that takes place without us even knowing what rules are being applied. Every day, there are things that were once absolutely human, and today are being done by machines. Those who wish to be frightened can write apocalyptic SciFi literature, and those who wish to be Luddites, opponents of innovation, may do so; this may often be justified. It’s not that there won’t be changes – everything changes. All of learning is changing, all of measurement is changing, and everything that we are learning is being overturned in front of our very eyes. The ‘who is learning?’ is changing at an almost indescribable pace. ‘Wait on, that’s not the kind of classrooms that we are accustomed to!’, it’s not the same age groupings, it’s not the same gender distribution, and it’s not based on who has or doesn’t have a degree.”

That means that people can get into all sorts of applications and websites, and decide what they are learning – they don’t have to pass a selection committee, they don’t have to pay too much (or at all), and they don’t need anyone’s permission.

“Your description seems a shade too utopian. Today people can’t continue to work if they don’t make up material that didn’t exist when they were studying.”



“The world that we’re talking about is not the world in which we grew up. And the world that we see around us today is not what will be in another 10 years. The story of lifelong learning, for better or for worse, is redesigning learning systems. The concept of a ‘degree’ is losing its original form, but it is not certain that there is another form that it can take on – it is possible that there will no longer be a need for a full-blown degree, and that it will be replaced by mini-degrees.

“Given all that as a background, the technology of teaching and learning is changing, the technology of assessment is changing, the technology of organizing and retrieving knowledge is changing, the technology of helping is changing in various contexts, the technology of identifying obstacles that the learner encounters – if I need to learn how to do long division, how to multiply one matrix by another, the important names in the French revolution – the answer to those questions was once, ‘So go and learn, and stop complaining.’ Now it’s, “You have learning difficulties in mathematics, someone else prefers formal learning, and a third person would learn better in another language.’ All of these distinctions can also be fed into the loop of learning and teaching, and this is indeed what’s happening. With the entry of smart systems into teaching and learning, I see how they are slowly doing it better and better. We are still really at the dawn of this day, we’re still just beginning to build.

“With chatbots, the big story is not that there is an R2D2 that you can talk to, but what goes into the R2D2, what things he looks at, to what extent he can do what the legendary teacher could do, what we all yearn for. Is he really able to sense the learner?



to find the right balance between excitement and boredom? to organize the material so that what should be learned is internalized and what doesn't need to be learned? He will at least know where to find, and that time isn't spent unnecessarily on dry repetition. The specific issue of being able to talk with a machine, an Eliza-like experience, may be interesting in and of itself, but only in the short term. Chatbots will operate as part of a much broader development called AI in education. In what way will it be intelligent? It will know all those things that are needed to know for learning, teaching and education. The average teacher is, by definition, a lot less good than the good teacher – I don't mean to insult teachers, that's simply the fact. And we want to get to the best, not to the average. In regular systems, including systems for teacher management, we assess teachers in comparison with the average. I have been teaching for 40 years now, and for all of that time I have been getting reports on the quality of my teaching that compare me with the average. One of the major contributions of the entry of AI is to say, 'I'm sorry, the threshold for comparison is not the average – let's compare with the best.' And that's what AI has to address. It has to address the learner and plan learning; to look at the learning environment, the other learners, the assessment tasks and feedback and reporting and so on, that's what a good teacher can do, and in general even they do it less than optimally.

“What makes the headlines about this chatbot technology is this sense of ‘Wow, I just spoke to a lump of metal, and it answered me.’ It's nice, but the novelty will soon wear off. We'll get used to it. Alexa, Google Assistant, Cortana and so on – that's not the breakthrough. Also, the NLP that's behind them hasn't yet been



solved, but that's not the big thing. The big thing is that when I say to it, 'Teach me' – it will really teach me. Today I can say, 'Get me the BBC news.' Tomorrow I'll say, 'Teach me,' and it will be able to look me in the eyes and see where I'm perplexed – what I didn't understand. Here I have dyslexia, and there I suffer from dyscalculia, and in a 3rd place I have problems hearing, and in a 4th place I am simply being lazy. The fact that it will be able to make those distinctions, that today even average teachers aren't able to make. Chatbots will be successful, not just by virtue of the chat, but because they will really be able to do this intelligent work.”

Just as we speak of individualized medicine, so there will be individualized learning.

“Partly individual, partly group. To imbue a group with a spirit of research and discovery, that's also part of a teacher's skill. As is the ability to give the same lesson that you have given 700 times before, but to update it so that it touches on current events and is relevant – that's not just adapting it individually, but also temporally, or to things that are happening all around. In the short term – 1 to 2 years – chatbots have some clear hurdles to overcome: they are not perfect, they get confused by difficult accents, they are available more in English than in Hebrew, they are not connected to all the databases – but they are already doing some very nice things. Anyone who has played with Siri or Alexa, with Google Assistant or Cortana, or with the robot that the Hilton chain has installed as a replacement for the concierge, can already perceive the fascinating opportunities. Before I get up in the morning, I say good morning to Google



Assistant, and it tells me what the weather will be, what I should wear, and what's written in my diary for the day, and it reads me the news, and that's great, because by the time I have brushed my teeth, I have already done what would otherwise have taken me a good deal of time to do.”

How can chatbots help teachers improve themselves as teachers?

“First we have to understand what teachers have to do, we have to clarify for ourselves whether a teacher is a source of authority or a channel that leads to the source of authority. In the business world, talk of changes in technology comes under the heading of a transition from pipeline to platform – that is, a shift from a serial concept of transportation, from raw materials, through processes and on to sale at the wholesale and retail level, that is, the pipeline concept of production and industry, to the world of the platform, in which the major challenge is to construct tools that allow someone to get to something. For ex. Airbnb, which allows you to find rooms where you are traveling, or Uber which makes sure you have transportation. It's not the taxi company that ensures you have a taxi, but the platform that ensures that taxis that want you, and you who wants a taxi, will meet. The question is whether the teacher is pipeline or platform. I think that much of teacher training still conceives of the teacher as a pipeline. When you come out of teachers' college, you have to be familiar with lesson plans, syllabi, and all of the information needed to complete subject X; or, in the context of learning and education, to know that you have to develop a student to be calm, friendly, to have certain values, to



show loyalty to a flag or anthem. Whatever the pedagogic task placed on the teacher's shoulders, the teacher is the pipeline through which this task is transmitted. In a newer world, the teacher is less a pipeline and much more something else – a platform, in the sense that the world of knowledge is no longer stored in the specific textbooks that have to be purchased at the beginning of the school year, and it is no longer defined in some Ministry of Education circular; rather, it is a world in which knowledge is at our fingertips, in the phone in each child's pocket, and often the child has a device that is much more up to date than the teacher.

“Initially, the chatbot may threaten to replace the teacher (it won't do so, but it may threaten to do so), or take his place. When the teacher is not available, or is busy with another student, it will assist by assigning exercises and practice questions. The early use of devices in the learning environment was CBT (computer based training) or CAI (computer assisted instruction), to use the computer to give the exercises, to practice what you've learned, to check your answers. That's the most primitive use. The idea of AI is to do intelligent things, both on the level of testing and on the level of providing feedback. It's no longer, 'Correct, $2+2=4$ ', or 'No, when you combine sodium and chlorine you don't get an acid, you get a salt' – but much more in-depth assessment – 'Why didn't you understand? Why are you not learning? What can be done to make this material more appetizing, more attractive?'

“I think that the next stage is that of presenting the content material. We already have it in Wikipedia, in Q&A sites such as



stackexchange and stack overflow, on YouTube, on TED or in thousands of courses in Coursera. The material is already there, the task of the person designing the learning process is to make it possible to draw from this material. The good teacher of today, will know how to find the appropriate TED lecture, or a virtual museum tour, or an experimental trial. But the internet is not just a slightly larger collection of pedagogic offerings – it's a whole new world in terms of volume. Libraries, too, have shrunk to a relatively uninteresting shadow of what they once were, compared with what can be extracted from the cornucopia that exists online. And this is something that AI can mine intelligently, both in terms of finding the materials and in terms of adapting them and making them accessible to teachers. Today we are running MOOC (massive open online courses) on EdX and it is already being translated simultaneously into 3 languages. I worked hard on this, and while I was sweating over getting this MOOC to be in English, Hebrew and Arabic, Google comes out with this new device that you stick in your ear, and it translates into and from I don't know how many languages. That's a leap forward. Today, if there's a good lecture being given at the Sorbonne, then it's something that I should be giving my students, and not be stuck with the same syllabus that I have been teaching for 20 years now. To do it well, both to survey what's available and to construct the funnel that will channel in all of this abundance. To bother me and my students with only the best, and not the rest. To provide feedback to those who have read the material, as well as dealing with learning statistics – measuring what students have done and are doing, seeing that little Mikey is dreaming in the back row, while Rachel is excelling in the front, and in this context individualizing



education. To provide feedback on the classroom level as a whole, and at more inclusive levels – the cohort, the school, the whole institution. These are things whose value we are beginning to learn. The reason that we have not understood them up till now is not that we are stupid or blind, but that we have not had the tools to be able to do so, and today we do. Let me come back to my own recent experience – I am teaching a MOOC on EdX, this semester I have just over 600 students. When I taught classes with hundreds of students in university, it was a bit idiotic – I would come into a large auditorium and speak, and in the back the guys would come in, go out, sometimes listen, sometimes not, I have no idea what was happening. But even now, before AI, I know for each student which video clip he has watched, and which ones he has watched through to the end. The data matrices are enormous. Not only on the assessment side, but more importantly, so that I should be a somewhat less poor teacher.”

You mean, if at a certain point in the lesson 50% of the students have withdrawal – what have I done wrong, what can I do better?

“Correct. Both for those who remained and for those who withdrawal – if there could be a machine whose task is to monitor, to draw conclusions and do things, and to chat about it – that would be possible. Today I can make myself available in my office, but with 600 students in the course, it is very discriminatory to be able to talk to 4 or 5 students, and not be able to talk with the other 595. But if there would be a chatbot, I



could duplicate my presence, at least for frequently asked questions (FAQ), the questions that come up constantly.”

And making this time available could itself make you a better teacher, because you would have time for the more important things – to improve yourself, to find new materials...

“To deal with those who are at the upper end of the scale, the best students, and those who are at the bottom of the scale, those who are having the most problems.”

“What I am saying is that the role of the teacher is changing radically. We may yet come to miss the old-style teacher. The teacher of the past, much of what was appreciated about him, and much of the definition of his role, is what is taught in drama school. A good teacher had to be a performer. This business of chatbots, among other things, lessens the importance of the teacher’s performance, or concentrates the importance of performance in a single teacher who happens to be a good performer, and can do the performance for all the others, leaving the teacher to be a listening ear, a mentor, an assessor, and so on. On the other hand, there are hopes that intelligent machines will be able to do these roles of listening ear, mentor, and so on. That’s where the chatbots come in.”