EDTECH MINDSET

DECEMBER 2019 | SHAPING THE FUTURE TLV

THE END OF EDUCATION TECHNOLOGY

THE RISE OF HUMAN MACHINE PEDAGOGY

Shaping the Future TLV 2020

A world-renowned Unique, Dynamic, Ingenious and Groundbreaking event

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Global encounter with the main protagonists of the Startup Nation.

Innovators and thought leaders unfold how education is being transformed towards meeting the real needs of the Digital Learner.

A unique experience for innovators, startups, educators, investors and decision-makers to foresee and build together the Education of the Digital Age.

CONTENT

THE EDITORIAL

DR.CECILIA WAISMAN, VP R&D MINDCET

Today, education is facing a major crisis – its main user, the reason education is justified as playing a significant role in our societies, does not fit in!

The fast-emerging technological breakthroughs have transformed the way we live and are, however education has not been able to keep the pace.

This issue of EdTech Mindset is dedicated to a very significant event that chose to face this challenge and propose ways towards finding solutions. Shaping the Future TLV 2019, brought together thought leaders from across the globe to share their work and insights, in order to inspire EdTech practitioners in opening new doors that will allow learners of the Digital Age to enter, and hopefully find a system that they fit in!

"Designing Human Machine Pedagogy" is an invitation to all EdTech stakeholders to bring the digital learner to the whole process of educational solutions' development, from ideation to implementation. To focus on a generation of learners who experience an almost symbiotic relation between humans and machine, who are developing new learning processes, capabilities and opportunities, and who are actively transforming obsolete educational hierarchies towards the rise of a true learning community.

Hoping you will enjoy, learn and get inspired to take actions,

Editor: **Cecilia Waismann** ceciliaw@cet.ac.il

EdTech Mindset writers: **Cecilia Waismann and Maia Aron**

Content contributors: **Avi Warshavsky, Barak Ben Eliezer, Prof. Cristina Conati, Dr. David Weinberger, Prof. Eugene Kandel, Jeff Pulver, Guy Levi, Ilan Ben Yaakov, Lina Gomez, Prof. Markus Gross, Ran Magen, Dr. Rami Marelly, Prof. Renee Hobbs, Roy Zur, Vicki Phillips.**

EN Editing: **Nehama Uterman**

HE-EN Translator: **Perry Zamek**

Graphic Design: **Neriya Zur, Dov Abramson Studio**

Photography pgs. 40-41: **Taylor Mickal, National Geographic**

THE DAY EDUCATION TECHNOLOGY DIED

BY AVI WARSHAVSKY, CEO MINDCET

Science-fiction author Arthur C. Clarke's Third Law states that any sufficiently advanced technology is indistinguishable from magic. Clarke's law touches precisely on a sentiment present within modern society. We expect that new technology will work wonders, provide us with superpowers, and give us that same frisson reserved for magic. Clarke formulated his law many decades before the dizzying age in which we live, an age that makes us expect such magical innovations at a rate of one every few weeks. However, it is more than six decades of the realization of an intuition that it is possible to sprinkle the magic dust of technology on an educational world normally associated with less sparkling connotations. On the surface, the combination of technology and education has great potential to provide answers to some of educational challenges, and this potential did not escape the eyes of scientists, educators and entrepreneurs. However, technology has been able to meet such expectations in areas such as communication, advertising, transportation, health, and so on, but not in education.

The unsuccessful journey toward technological magic could be described as beginning in a spacious classroom, one in which all of the students wore a uniform "short-back-and-sides" haircut. The students,

THE DAY EDUCATION TECHNOLOGY DIED

with serious visage, sit in pairs in front of small tables. In front of each student is a machine that takes up most of the table. The machine is new; it is both mysterious and prestigious in appearance, and carries with it the aroma of newness. The children are attentive, active, and highly motivated. They write their answers into the machine and receive immediate feedback. A tall, bespectacled man, with the air of a researcher, walks around among the students. This man, B.F. Skinner, one of the founders of modern psychology, is in the classroom to demonstrate his teaching machine before the cameras. Skinner's machine allows each student to learn on their own, progressing at their own pace. The machine was presented as a way of coping with the problem of the heterogeneous classroom, and the challenge of motivating students. It is easy to find this 1957 film on YouTube. The gap between the educational technology presented in that clip, and what we today call educational technology, is comparable to the gap between the silent movies of the early twentieth century and the cinema of the Netflix era. Nonetheless, and in spite of countless relevant developments, Skinner not only created one of the first solutions in the field, but also set the tone for the solutions that followed him. The promise of the machine is that a student goes in on one side not knowing, and comes out educated at the other end. The machine aspires to be a kind of magic solution that saves the teacher time to deal with more important issues. Many solutions in the world of educational technology, perhaps most of them, have made similar promises - saving teacher time and covering a significant part of the teaching process.

WHAT DOES EDUCATIONAL TECHNOLOGY DO?

The Skinner paradigm's answer to the question "What does educational technology do?" - helps us educate just as we have always done, but more efficiently. Such an answer is relevant as long as our learning framework exists without technology, and where technology is a kind of external add-on that we can add, or not add, as we choose. However, in the present age, technology has moved from a tiny corner on the periphery of learning, and has taken center stage. In today's world, all stakeholders – students, parents and teachers – have come to live and operate within the internet realm. Each of them conducts a significant portion of their interpersonal communications through technological means, belongs to virtual communities, learns from YouTubers. Each of the stakeholders makes their decisions primarily on information that is accessible in the palm of their hand, and acquires skills through video games. In such a world, technology is the space, the environment, in which we operate, as well as also being the medium. Whether we like it or not, technology is redefining the whole of the learning setting – the library, the textbook, the classroom and the teacher: all of them take on new significance in the information era. In an era, such as this, there is no real justification for a defined domain named "educational technology"; its interactive content is not substantially different from other interactive content that we encounter in social networks, digital games or in current affairs websites. There is the collection of data, but this does not have to differ from the collection of data on any other platform trying to optimize its outcomes. The difference between educational platforms and other platforms is becoming more akin to the difference between a textbook and any other book – just like a textbook, platforms are educational because they are intended to teach us something, they are directed at an audience in a particular age range, and they maintain certain ethic limitations that other platforms are not obligated by. Educational technology in the old sense is dead, because of – or thanks to – the success of the technological revolution that has overtaken mankind.

THE SKINNER SPELL

Skinner's teaching machines not only defined the boundaries of educational technology, but also presented an in-built pedagogic conception. Some would describe the pedagogic influence of Skinner's learning machines as the "Skinner Spell," a kind of magic spell cast over the field and which influenced it dramatically, but which extracted from it a very high pedagogic price. Skinner's learning machines offer a paradigm that has seven characteristics which are, to a large extent, still as true today as they were in Skinner's days.

Alone: The proposed solution is aimed at the individual learner, located in the classroom but progressing at his own pace. This is an arena in which the student sits alone in front of the machine, generally without any social or communal interaction with other learners.

Savings: The machine's great promise is at savings in work – it substitutes the teacher in practice and review, in setting and checking assignments, and in individual communication with each student. The teacher's time can be devoted to what is really important – speaking to the group as a whole.

Aid: The technology is an aid to maintaining the routine of the classroom. It does not offer alternatives to existing structures or modes of learning, it makes them more efficient.

Choice: The backbone of these machines is multiple choice tasks that require the learner to make choices. These tasks may be packaged in a shiny wrapper, in a game or story framework, but it comes down to choosing the right answer from a number of options which enable immediate feedback, and are easy to implement - whether with the technology of the fifties or with the technology of the 21st century.

Linearity: Progress in learning is linear. The student cannot progress to the next stage before demonstrating understanding of the present stage. Learning is rigid and unidimensional – one proceeds along a single, pre-defined axis.

Immediacy: The system is reactive, and accustoms the learner to a high level of reactivity – he gives an answer and knows immediately if it is right or wrong.

Behaviorism: These systems operate under the assumptions of behavioristic psychology, of which Skinner was one of the founders. Under this approach, stimulus and response play an important role in learning. The system creates a stimulus – asks a question, the student responds – answers the question, and the system responds providing him with positive reinforcement or a negative signal. The motive force of the learning process is positive reinforcement, which generates motivation in the learner to act so as to obtain further reinforcement. Such a mechanism works well with pigeons, with mice, and with students as well.

It is not for nothing that the educational paradigm of Skinner's machines has survived for so long. Skinner, one of the intellectual giants of the 20th century, had a broad vision and world view, combined with a pragmatic, results-oriented approach. His machine relies on a systematic educational philosophy based on a well-reasoned psychological view of the world, one that had been successfully tested in a variety of contexts. However, the vision that aspired to open new pedagogic horizons with infinite reach, and to create personalization, emotional connection and adaptability, did not achieve its promise. Instead, it created a narrow, linear passageway, one that invites the learner to sisyphically work their way along it, on their own, using a very limited range of actions. This is years away from the magic that we are looking for in technology.

IN AN ERA, SUCH AS THIS, THERE IS NO REAL JUSTIFICATION FOR A DEFINED DOMAIN NAMED "EDUCATIONAL TECHNOLOGY"; ITS INTERACTIVE CONTENT IS NOT SUBSTANTIALLY DIFFERENT FROM OTHER INTERACTIVE CONTENT THAT WE ENCOUNTER IN SOCIAL NETWORKS, DIGITAL GAMES OR IN CURRENT AFFAIRS WEBSITES

WHEN THE DINOSAUR CRIED

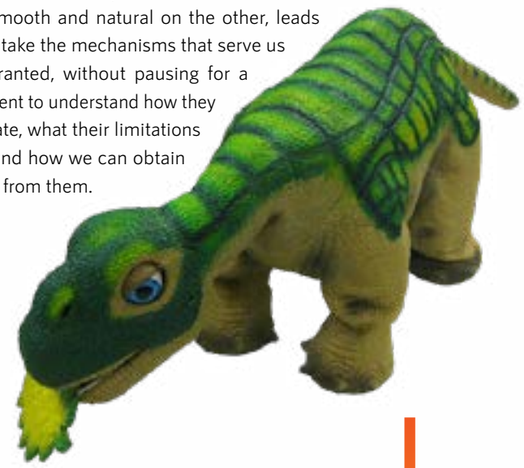
Our entry into an age in which technology surrounds us on all sides has brought about another dramatic change. "Technology" has ceased to serve solely as a tool that we use, or as a device that we hold - we have moved from a world of using tools to one in which we have a relationship with the tools. This revolution may be demonstrated when we think about Pleo. Pleo is a cute little dinosaur, crawling across the floor, along comes someone who picks him up by the tail. Paleo cries and squirms

THE DAY EDUCATION TECHNOLOGY DIED

helplessly, begging for his life. Pleo is a robot, a machine, and yet we do not remain indifferent to his behavior. Kate Darling, a researcher at MIT, asked a group of subjects to kill dinosaurs such as Pleo, giving them all sorts of justifications. Even though the participants knew that these were merely machines, all of them categorically refused to do so. In another experiment, investigators at Stanford shows that research subjects felt embarrassment when asked to touch intimate areas on the body of a robot. A variety of similar studies shows that we relate with empathy to machines with human characteristics, even when those characteristics are partial at best. An empathic response occurs not only when we are talking about robots that simulate humans or animals, such as Pleo, but even when we are talking about robots used to remove bombs, domestic vacuum cleaners, or mechanical cockroaches. Robots offer a good way of clarifying this point, but we are not talking of some futuristic story along the lines of Westworld. Today we already have daily relationships and complex interactions with devices such as our telephones, with voice assistants such as Alexa, and a variety of software. We live in an environment in which, along with human beings and animals, there are also smart machines.

INVISIBLE INTERFACES

The more we become immersed in these relationships, the easier it is for us to forget that, behind all of this interaction, there is a person who intentionally designed it, who wrote the underlying program, and who specified the interface through which we operate the machine. The better the interface design, the less we feel his presence. The machines of a previous generation required handles and buttons to operate them. As technology progressed, the interfaces through which we operated the machines came to take up a much smaller volume – first we moved to the keyboard, and then to graphic interfaces. Today we activate a significant portion of the interface simply by moving from one place to the other, with a sensor translating that movement into a request or command. Or, we can say something, and a voice sensor translates our speech into a task. Greater efficiency in the interface makes our use of technology natural and smoother, but it creates a challenge to our ability to understand the world that we are using. The world in which we operate takes on a perfect stage performance, in which we forget that there also exists a world behind the scenes of the stage on which we act. This obliviousness creates dangers and challenges. First, we become more vulnerable and exposed to manipulation or to malicious use of technology. A range of malicious web phenomena, ranging from viruses to fake news, flourishes in a world whose functioning and motivations we do not understand. Apart from the immediate dangers, an experience that is powerful on the one hand and yet smooth and natural on the other, leads us to take the mechanisms that serve us for granted, without pausing for a moment to understand how they operate, what their limitations are, and how we can obtain more from them.



NEW KNOWLEDGE DOMAINS

In order to cope with these challenges, we need to learn about new knowledge domains that did not exist in the past, and that will enable us to be active, aware and watchful users of the new universe taking shape before our eyes.These may be divided into four main categories:

Understanding: The mode of operation of the machines that surround us, is different from human modes of operation. In certain areas the performance of these machines exceeds that of human beings, while in other areas they lag behind. In order to understand these machines, and the deep level on which they operate, we need to learn the fundamentals of machine logic, the way in which complex systems behave, and basic concepts such as "variable" or "loop" - areas under computational thinking. If computational thinking gives us an understanding of the operation of smart machines, data literacy provides us with an infrastructure to function in a world in which data plays a decisive role. Data literacy helps us understand how to explore and represent data, build an argument, and hoe these representations influence our conclusions.

Communication: In order to operate in a technology-oriented world we need to understand how to communicate with machines, and more importantly, how to communicate with other people whom we meet through internet. Subjects such as new media expand our expressive horizons through tools such as video or infographics. Media literacy assists us in reading between the lines, and in distinguishing between well-founded information and "fake news." And exposure to e-activism encourages use to be active, smart citizens of cyberspace.

HUMAN MACHINE PEDAGOGY MAY BE AN OPPORTUNITY FOR REALIZING THE POTENTIAL OF THE ENCOUNTER BETWEEN THE MAGIC OF INNOVATIVE TECHNOLOGY AND THE CHALLENGES OF EDUCATION

Defense: A technology-based environment is also one that faces many threats. The first of these threats include viruses, ransomware and malware. The knowledge domain relating to this area is cyber studies – from general cyber literacy to professional training in cyber professions.

Creativity: The fourth, and most important, side of this framework is the one that ensures that all of us can be partners in this space, not only on the user side but also on the creator side. In this area we encounter, of course, the field of programming, but also such fields as **design thinking**, and **user experience design**.

HUMAN MACHINE PEDAGOGY

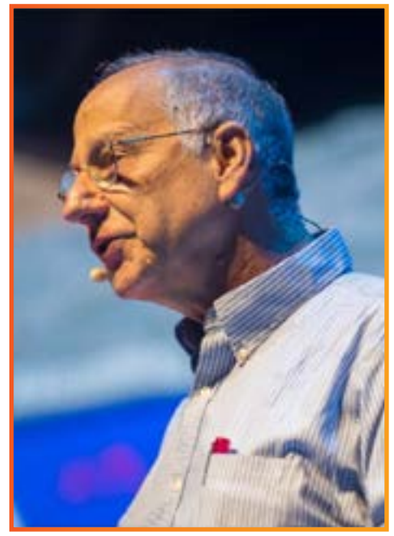
These subject areas are not just additional knowledge domains to subjects such as language or physics, but they require a formulation of a new pedagogy, and different management from those customary in the disciplines with which we are familiar. These fields have four characteristics that require a different kind of readiness on our part:

- **Corpus** – In these domains, a significant portion of the content is constantly changing. In cyber, for example, we talk of replacing about 30% of the material studied each year. This highly dynamic situation requires flexibility and independent learning ability on the part of all those concerned.
- **Teaching** – Assuming that these domains are studied on a system level, and not as ad-on, those who will need to transmit them are the teachers already in the system, many of whom lack the professional background required for these knowledge areas. These teachers will need to use relevant content specialists (virtual teachers, for example) to bridge these gaps. However, the fact that they do not need to be busy with content, will enable them to focus more on pedagogical, emotional and social aspects, as well as broader aspects such as the ethical effects of these technologies.
- **Performance** – It is difficult, perhaps impossible, to learn these topics passively, by only reading or listening. Each of these areas has a significant practical side, which can only be learned through doing/ performing an action.
- **Multidisciplinary** – Each of these fields touches on a broad range of areas, and all together create a combination that is not easily classified – these domains involve aspects of exact sciences, of engineering, of humanities, social sciences, and arts.

These unique characteristics also create an extraordinary opportunity. In a perfect world, we would be happy to also see traditional disciplines, such as mathematics or language, taught with flexibility, interactivity and wide-ranging learning. Human Machine Pedagogy and the tools to support it, may be a new opportunity for realizing the potential of the encounter between the magic of innovative technology and the challenges of the world of education.

TEACHING CHAOS

A CONVERSATION WITH DR. DAVID WEINBERGER



Weinberger has been an influential thought leader who helps us understand how internet culture, at the same time that changes dramatically our lives, it is offering unique new opportunities. Innovator, writer, technologist, Senior researcher at Google and at Harvard Berkman Klein Center for Internet and Society. Weinberg's most recent book "Everyday Chaos: Technology, Complexity, and How We're Thriving in a New World of Possibility" is the latest entry in a decades-long body of work that seeks to explain technology's impact in our lives, businesses, politics and ideas.

Let's start with how we understand ourselves, posits David Weinberg: People tend to understand themselves and the world they inhabit in terms of the dominant technology of the age. For example, the steam age gave us the descriptor, "feeling under pressure".

In the age of Artificial Intelligence and machine learning, we begin to understand that while it's impossible for humans to understand the complexity of everyday life -- let alone the world -- a set of algorithms can come pretty close. And when we receive their answers in the form of probabilities, we too can come pretty close to knowledge that was never before within reach.

Today, we receive answers at the click of a key that are based on "gazillions of bits of information" -- far more than ever were available to the world's greatest philosophers. As a result, the framework through which we understand the world has shifted. We no longer rely on great thinkers to assemble the facts that are available to humans in order to discern natural laws and craft guiding principles. Today, large-scale information-gathering and analysis are not performed by humans at all.

"This is changing our conception of how the world works," David says. "A re-interpretation of ourselves is occurring right now -- how the world works, how to explain it and what it actually means to know something."

He cites three main concepts in how this relates to education.

Overload. When the web came into popular use about thirty years ago, there was widespread concern about "overload" – the fear that we would buckle under the massive amount of information that suddenly was available. However, AI turned the tables and "overload" became something positive. We don't have to sift through massive amounts of information. Algorithms do it for us, quickly delivering what we need in the form we need it. In education today, the only students who may become "overloaded" are those who study disciplines that require mastery of large amounts of specialized information, he points out.

Explanations. Human exploration and analysis are loaded with explanations – who, what, when and where invariably are followed by why and how.

AI exploration and analysis is totally different and relates differently to education.

"Explanations that embrace the world as it's now being revealed to us in machine learning models, that embrace chaos, complexity and contingency, are being delivered to us – for example – in history and in literature," David says. "In many ways, this sort of complexity and contingency is the ocean they swim in. They want to make the world more complex for us, show us that things that may seem simple but turn out through history and literature to be endlessly deep."

Belief. "The world is a black box. We cannot open it up and fully understand it and see all of the causes and get all the explanations," he says. "It's very different than starting with general principles that happen to be simple enough for human minds to understand."

In this world, David says, students are coming to belief with one another on the internet.

"I think it would be helpful to look at the ways in which children on the Internet, on their phones, are exploring new areas and learning successfully. Let's look at how they are naturally doing this and then see how it might be improved. Let's see what we can do to build networks that embrace overload and complexity and lead people to beliefs that are human and life-saving and life- building".

EXPLAINABLE, TRUSTWORTHY AI FOR EDUCATION

A CONVERSATION WITH PROF. CRISTINA CONATI

Cristina Conati is a Professor of Computer Science at the University of British Columbia, and specializes in Artificial Intelligence as it relates to interactive systems. Her educational research captures a broad array of user data to create systems that elicit receptive cognitive processes and emotional states among users in order to motivate optimal learning. .

"I love my teacher! She answers my questions even before I ask them!"

While that level of sensitivity may be a high bar for human teachers, it's within reach for algorithms. Computer learning systems that capture a learner's communicated and uncommunicated cues are increasingly able to fulfill their needs and desires in a manner that matches their understanding and ability.

"My research is multidisciplinary, at the intersection of AI, human-computer interaction and cognitive science," says Christina. "The system builds a user model that captures a variety of user traits or states. This includes goals, domain expertise preferences, and even more esoteric things such as emotions, metacognitive abilities and cognitive load."

"Trust in AI is a topic of great concern. There are many initiatives about how to create AI systems that enable their users to understand that what the AI proposes is valuable and should be followed."

Much of the research is devoted to data collection of uncommunicated needs. An example would be the use of signal from physiological sensors to deliver user affect information based on how the user looks at the interface. A related example would be gaze and eye tracking.

"There's a saying that the eyes are the windows to the mind, and in fact we've been able to use gaze data, as well as eye tracking data that comes with gaze," she says. "We also use pupil dilation, which has been related to cognitive load and some affective states such as confusion."

Machine learning uses this data to predict a variety of user states, including affective states such as confusion and boredom. It can also predict how a user is learning.

"It allows us to understand metacognitive processes, for instance how much the user is engaging when they're interacting with learning material and how much they're engaging with self-explanation -- a cognitive skill that relates to someone really trying to go deeper in the material they're reading or studying."

Eye tracking and gaze data are crucial in this respect, she says. This is because the interaction is strictly perceptual and the only useful data for learner support comes from how the user looks at the information. A study she did that's slated for publication illustrates the link from gaze and eye tracking data to learner support: Subjects who are reading difficult material that's illustrated with numerous graphs show improved comprehension when the system highlights a graph that illustrates the passage they are reading.

The major use of AI in education is currently intelligent tutoring systems, which still are in an early stage of development.

Successful systems to date include tutors that help students practice and acquire problem solving skills and systems that improve the learner's metacognitive abilities through self-monitoring. There is also research that seeks to create motivational environments through games and interactive simulations and work that builds the interactive relationship through the use of explanations. This lends itself to learners who need to know the "why" behind the "what".

. She's currently looking at the use of hints and explanations.

"My interest is in determining when it's actually important to provide explanations -- which users want explanations and can use them in a way that increases their trust in the technology they're using," she says.

One of her research projects deals with an interactive simulation of an intelligent educational environment that helps learners understand a specific algorithm that solves constraint satisfaction problems. The research monitors how each individual uses hints, examples and explanations; whether they think they are useful, and whether they affect learning.

The system's AI differentiates positive behaviors that are conducive to learning and negative behaviors that are not.

The team picked three principles to use in supplying explanations: they should be incremental; users should be free to explore different levels of detail, and they should provide an accurate description of the underlying AI without becoming overwhelming. (This is a challenge, since the explanations are generated from a complex mixture of data mining, machine learning and AI techniques.)

The study shows some evidence that the availability of personalized help improves the benefit learners receive from the system and that there is a lot of variation among subjects in requests and usage of hints and explanations.

"The long-term goal will be to create a better understanding of which learners need the explanations so that we can add to the AI in the system not just the ability to provide personalized hints, but also the ability to provide personalized explanations to the learners that need them the most," Christina says.

"The long-term vision is to create personalized, trust-aware educational environments that can understand what's happening with user trust and also are capable of understanding how to use explanations to foster this trust."

Q&A

WITH PROF. RENEE HOBBS

Hobbs is a thought leader and advocate of media literacy as a major part of today's education. Hobbs brings academic research into helping understand the way the youth learns and relates to media, at the same time that she moves forward projects to turn this knowledge into best practices working constantly with educators. Professor of Communication at the Harrington School of Communication and Media at the University of Rhode Island, she is the founder of the Media Lab as well as the Journal for Media Literacy Education.

Q **Where do you see education moving to?**

R.H. I do feel that when we talk about schools of the future and we ask kids to imagine the schools of the future, they use all of their life experiences to imagine what it could be. They are YouTube consumers, they are TikTok creators, they are internet searchers, they are video game players. I am always trying to think about the relationship between the classroom and the culture between what happens in and outside the school. Too much of our thinking has kept these 2 things separate when really school is to prepare us for the world outside the classroom, and so this connection has to be seamless. One way to do that is to build digital and media literacy competencies.

WE ALL RECOGNIZE THAT THE RISE OF PROPAGANDA AND DISINFORMATION HAS CREATED A SENSE OF GREAT URGENCY ABOUT DEVELOPING THE KIND OF COGNITIVE AND THE KIND OF SOCIAL AND EMOTIONAL SKILLS WE NEED TO MANAGE

Q **Why today media literacy is more relevant than ever?**

R.H. All over the world the Fake News phenomena has created a real momentum to digital and media literacy. We all recognize that the rise of propaganda and disinformation has created a sense of great urgency about developing the kind of cognitive and the kind of social and emotional skills we need to manage with a world that is increasingly difficult to figure out. Who do we trust? What do we trust?

Q **Can you talk about the encounter between media literacy and educators?**

R.H. I've been really interested on a phenomenon that I am seeing with my own students and I feel that we have not figured it out yet. It started when I started demonstrating how I search online – when a student asks something and I don't know, I model my practices of searching. I discovered that my Google is not your Google, my Netflix is not your Netflix. The Google search that I train to use, that collects my data and reports back to me, produces results for my use. When my students try searching they do not achieve the same results. I feel that we experience evry day an algorithm personalization in filtered search that is pretty new to us, personalized search started only 10 years ago. Personalized advertisement that produces personalized ads based on the data when I throw off about clothing and shopping, recommendation engines that offer differential pricing, these are regular practices of personalization that many of us teachers are not very well informed. And the lack of transparency – how do we pull back the curtain to help all of us understand the algorithmic environments that we live in? On the other hand, there are real opportunities for global learning as we try to understand algorithms "Algorithm Literacy".

Q **What about the student?**

R.H. The smartphone is the most powerful media production tool that any 5 year old has ever had – a way to learn how to be a documentary film maker, away to learn how to be a visual artist, how to be a public speaker, how to use words, images, numbers, and interactivity allow us to create and share meaning to understand each other. I hope that youth media production become a vital part of how Israeli children learn to represent their knowledge as they learn about themselves, their families, their communities, the world. Youth media is a really powerful tool for learning. It brings together our thinking across our emotional identities, our personal and family identities and our cognitive skills. If you want the one best pedagogy to promote critical thinking about media you must learn how to make media, that's the secret.

SMART MACHINES ENABLING ALL LEARNERS

A CONVERSATION WITH PROF. MARKUS GROSS

Gross is Vice President of the Global R&D and Director of Disney Research. He is a Professor of Computer Science at the Swiss Federal Institute of Technology Zürich (ETH), where he is also the head of the Computer Graphics Laboratory. Gross is passionate about using emerging technologies to enhance educational possibilities, leading new research as well as entrepreneurial educational solutions.

An interesting thing happened when Markus Gross started treating his son for dyslexia: As he learned about the neural networks that cause the condition, he recognized their similarities to machine learning.

He took a creative leap, and voila! He was able to develop learning exercises for his son that were built on machine learning principles. The results were so good that the program was adopted by Switzerland's school system. And those results are proving so good that today – twenty years later -- Markus is applying his expertise in Augmented Reality and other advanced technologies to the education of all children.

"The learning program is basically a machine learning system that tries to model the internal state of learning and knowledge by the student at each and every moment," he explains. "This allows us to adjust the training to the individual's capability, strengths and weaknesses; this is what we actually do."

Markus is at the forefront of advanced technologies in his dual roles as Professor of Computer Science at the Swiss Federal Institute of Technology in Zurich and Vice President of Global R&D at Disney Company.

His original program, still very much in use, concerns dyslexia and the related condition of dyscalculia. Dyslexia, which affects 5%-10% of the western world population, is the inability to develop reading and writing comprehension while otherwise having an average or above average intelligence. Dyscalculia, which affects about 5% , is the inability to perform simple mathematical calculations.

"The conditions are very severe because they are basically spread-out over all aspects of learning in school and in professional life, and it often leads to demotivation and frustration," he notes.

As he began working with neuroscientists, Markus recognized that dyslexics are unable to develop proper mapping and automation functions. The former prevents them from constructing the building blocks of spoken and written language, while the latter prevents them from completing the "parietal shift" of cognitive power moving from the frontal cortex to the parietal lobes.

He built a team with experts from the University of Zurich that combined neuroscience, computer science and machine intelligence into a learning system that would overcome the mapping and automation roadblocks to cognitive processing.

The result was a computer-based, personalized and interactive training program based on the concept of multimodality – the ability of the brain to process information through a number of different perceptual channels simultaneously. Thus, a child experiences a new word through numerous sensory cues, such as color, motion and music. The combination of cues breaks the roadblocks.

"The fundamental idea is to basically rewrite, to transcode, the initial information that is in a word; we call this a string in computer science, the sequence of letters," he explains. We transcode it to a variety of perceptual codes. Then, to measure the amount of processing, we use a concept which is well known from information theory, entropy. The interesting aspect is that we prove this multimodal transcoding helps to trigger the parietal shift that otherwise would be delayed or not happening, and this is essential for automation."

There is now almost twenty years of data from over a hundred thousand Swiss students, whose every keystroke has been captured. The results show 30% less in pencil and paper dictation errors in the dyslexia training and up to 45% more correct calculations for dyscalculia. This is after six weeks of training, four days a week, twenty minutes a day. There is also a significant decrease in self-reported anxiety about school and learning, with more than 25% of students reporting less anxiety.

While he began as an accidental educator, Markus continued to be interested and involved as EdTech mainstreamed. Now he's in a prime position to explore and implement new concepts.

"Moving forward, I want to combine our concepts with two equally powerful concepts I learned at Disney," he says. "One relates to the notion of storytelling. I really want to make the learning experience a journey through a theme park with individual rides, shows, and a very personalized story, if you will. The second is the advent of Augmented Reality with a new generation of devices looming on the horizon."

He offers the creation of an AR music band as an example, showing how a child places trading cards with photos of band members under an iPhone and watches them come alive on the screen, singing and playing their music. The child's manipulation of the cards changes the music.

"Creativity can best be taught through play and interaction; this is our core concept," he says. "It includes both the digital and haptic -- the physical -- experience. This is why we believe that Augmented Reality is so important, because it allows us to seamlessly combine the real and the virtual world. It gives a child a haptic experience enriched with all the capabilities of virtual and digital."

"Reading and writing is an artifact of our society," he says matter-of-factly. "Evolution has taught us to communicate through spoken language. My personal area of expertise is visual computing -- conveying information through visual or audio-visual -- and this is actually the concept I applied in our therapy for dyslexia."

THE COMING OF "XR MIND"

A CONVERSATION WITH DR. ROTEM BENNET

Bennet is an X-Reality pioneer and expert in motor-cognition research. A graduate of the faculties of Computer-Science, Psychology, and Education at the Technion and the Hebrew University, he currently does VR-based brain-research at Haifa and Tel Aviv Universities and recently co-founded ARpalus, a Caesarea-based Artificial Intelligence start-up for AR-based retail applications.

Our "XR Mind" is not something that will happen in a research lab or gaming competition, or even when we don a pair of Magic-Leap or Hololens glasses. Our XR mind will be a new stage in cognitive evolution – an uncharted change in the way we perceive reality based on our accumulated virtual experiences.

So says Dr. Bennet, and he should know because his research is paving the way.

XR technologies – the combination of Augmented Reality, Virtual Reality, Mixed Reality – coupled with Artificial Intelligence will have a "huge impact" on how our brain works in everyday life, he predicts.

"**XR is disrupting our body and world perception, not only by surrounding us with a different world, but in a deeper way of perceiving and interpreting the world**," he explains. "Cognition, perception and action are tightly coupled, they are working together. So when we change dramatically the way we perceive the world and the kind of affordances that we have in the world, eventually we change human cognition."

Dramatically changing human cognition can be expected to affect education, and he provides some insight here as well:

"The way I see it in education, in the future, is changing the way we think and solve problems and all the cognitive processes that we use in the world. Future learning will involve XR practice of sensory, motor and cognitive primitives. AI will make all these phenomena much more structured, goal oriented and personalized. The combination of XR-AI will eventually be a fundamental HMP mechanism."

The research behind these predictions is related to the neuroscience theory of the Predictive, or "Bayesian", brain, i.e. the brain has a probabilistic inference mechanism. This means we experience reality as a combination of what our senses tell us and what our brain expects based on prior experience. Our brain is continually processing new sensory inputs and updating "priors", producing a probabilistic integration that causes us to perceive the world in a specific way.

"When we talk about XR, VR, AR, MR, the impact is not only when you're wearing glasses," he says. "It's injecting inputs that eventually change your prior belief about how the world should behave."

To illustrate how prior work in the non-virtual world, he uses an illustration of plates that are illuminated on one side. People viewing the illustration tend to believe they are seeing it "right side up" when the illuminated portion is at the top because that's how we're accustomed to seeing sunlight.

There are also individual priors, which he illustrates with a photo of striped dress that went viral because different people saw different colored stripes.

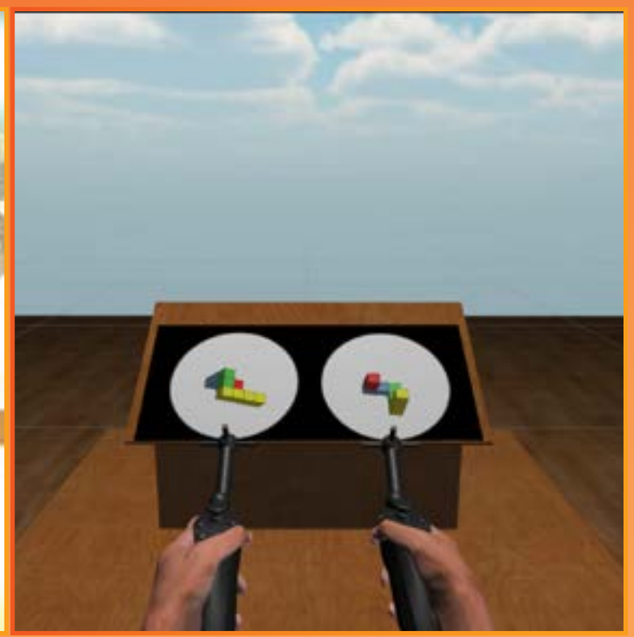
"Each one of us has evolved and developed in a different way, acquired different priors about illumination and from which direction it probably comes to illuminate this dress, which makes each one of us see the world very differently," he says. "The reason it became viral was because it's very hard for each one of us to understand, 'How can it be that you don't see the dress exactly like me? How can it be that we don't see reality exactly the same way?'"

Here's where the future enters the picture: As we're exposed to all kinds of different virtual realities, and to the extent they're individualized, we can expect our cognitive processes to shift away from the priors we've experienced in the material world, and we can expect our perceived reality to become vastly different.

"We're going to acquire very different priors about reality," he predicts. "So this example of the dress will not be a rare example. And it will span all domains, for example, 'How can it be that you don't understand this topic? How can it be that you don't feel or think like me? How can it be that you have this political view?' It's all based on our priors that make us not only interpret reality differently but actually perceive and see reality in a very different way."

As our perception of reality shifts, our sense of self within that reality will also shift, he predicts – how we perceive ourselves, our bodies, and our identities.

THE COMING OF THE "XR MIND"



"This was the motivation behind my research at the Technion," he says. "I call it re-embodied cognition, from an evolutionary point of view."

The concept of embodied cognition that's based in the world of material reality relates to how our entire body reacts to stimuli, for example a "fight or flight" coordination of mind and body that's basic to survival.

"In virtual reality or XR in general, all the basic assumptions of embodied cognition research are reshuffled because now we have a different body," Rotem explains, "and the laws of nature are just arbitrary lines of code."

His research led to the conclusion that there is marked change in cognition as adults become avatars in a virtual world, with their new bodies reacting in entirely different ways to new sets of images and experiences.

"Adults in virtual reality are kind of newborns that are re-finding this new environment and kind of getting a second chance for re-learning very basic fundamental sensory-motor primitives, which are the basis for our cognitive development when we are babies," he says.

XR IS DISRUPTING OUR BODY AND WORLD PERCEPTION, NOT ONLY BY SURROUNDING US WITH A DIFFERENT WORLD, BUT IN A DEEPER WAY OF PERCEIVING AND INTERPRETING THE WORLD

His conclusion: "XR quickly disrupts our body and world perception, which are tightly coupled with our cognition, to an extent unseen throughout the history of human evolution. This makes me believe that the "XR Mind" phenomenon, as we call it, will eventually disrupt our core definition of "human cognition" in a very fundamental way."

Q&A

WITH JEFF PULVER

Pulver is an internet entrepreneur who changed the way the world communicates, by being a pioneer in enabling free voice and video chats in internet. Founder of Free World Dialup, Vonage, Von Coalitions, etc. Pulver is a major thought leader that advocates for the power of technology in providing opportunities and transforming lives, especially for the many who did not find their voices heard in the traditional educational systems.

Q **How did technology change your life?**

J.P. So, when I was a kid, when I was in school, I had a couple of challenges, one of them was that I didn't have too many friends, I was quite lonely, and I had trouble connecting with a lot of folks. Ultimately, it was my uncle who had a hobby of amateur radio, that helped me discovered that through technology, through radio, I was able to connect with many people. There was this one moment in my life, when

Q&A

WITH JEFF PULVER

I was about 9 years old, and my uncle comes to my parents' house and takes me to his office ... and about an hour after I go into his office, he takes me for a tour around everyone, I meet all these people. I was sitting in a room, not much bigger than the size of our circle here, and there's a desk, and there's a box on the desk, and he flips a switch and I start to hear noises and the box starts to glow... And he speaks in a very cryptic language, and he tunes a dial and all I hear is noise, he hears voices, and he sits there very closely and he says: "CQ, CQ, this is K2 QQM, calling CQ," and he repeats this for about a minute and let's go of the microphone... And I was in awe, 'cause for about an hour there were people in a queue from all over the world who wanted to talk to my uncle, ..., and I never knew my uncle was so popular, I had no idea he was so interesting, and that people from all over the world spoke English, ... and what I realized after sitting at this desk for an hour, was that my uncle had the cure for loneliness, and that if I could take this radio and put it in my bedroom then I could have friends before school and after school, it didn't matter what was happening at school. But the challenge was - and I thought I was such a good nephew, at the end I asked my uncle whether I could take this home, he said "No." "But, but-" "No!" And then I learnt that in order to qualify to use this radio I had to study physics. I had to teach myself Morse code, I had to teach myself the rules and regulations to be a radio operator, so I learnt. At 9 years old I learnt that I could be obsessive, and I learnt about failure and about learning and doing. By the time I turned 12 and a half I had a license to communicate with the world, and I used to spend somewhere between 40 to 60 hours a week on the radio, exploring and discovering people where everyone was connecting on a first name basis... I was not very interesting though, because I was almost 13 years old and most people on the radio were 50 to 60 years old men... and they would talk about work and they would complain about their... well, talk about their families, and of course I didn't have a girlfriend and I didn't have a job, and so I learned to listen, to connect, to share and engage, and to let people share their stories and that opened my world and ultimately saved my life. It was my passion for radio that first connected me to Israel. One of my first friends on the radio was a guy named Danny, who lived in Ramat Aviv. Back in the '70s a friend of mine was coming to Israel and I asked Danny if he could meet him and he said "Sure, any friend of yours is a friend of mine, look me up!" We didn't have the internet back then but I got postcards, and the first postcard I got was (curious), Danny was either very patriotic or something was up because there were lots of photographs of Golda Meir and my friend had to go through security to go to his apartment, and at the end of the summer I got a one-sentence postcard "Check out how Danny spells his name." On the radio, we just [used] first names - I'm Jeff, that's Danny – and he always said his name was Danny Mayer... turns out, that Danny was one of Golda Meir's grandchildren..

WHAT I REALIZED AFTER SITTING AT THIS DESK FOR AN HOUR, WAS THAT MY UNCLE HAD THE CURE FOR LONELINESS, AND THAT IF I COULD TAKE THIS RADIO AND PUT IT IN MY BEDROOM THEN I COULD HAVE FRIENDS BEFORE SCHOOL AND AFTER SCHOOL, IT DIDN'T MATTER WHAT WAS HAPPENING AT SCHOOL

Q I can't believe this...

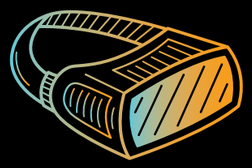
J.P. She was living with him in Ramat Aviv, that is where his radio station was set up. His been a life friend of mine. Last time I saw him he was a librarian at a Teachers' College. His been a friend for a long time. For me radio has been liberating. Ultimately it was my passion to communicate. My obsession to connect radio with telephones. Back in the 70's, cost a lot of money to make a phone call from Tel Aviv to New York. So Danny would make a point whenever one of his friends was in NY to call me, and he used me to patch his friends onto the radio. So we bypassed long distance phone calls by using radio. When the internet was happening back in '95, I had this crazy idea – what if we could do the same thing with the internet? So in 1995, by accident, and by pure passion, I created the first phone that worked on the internet "Free World Dialup", it was free, it connected the world, ... and it changed everything. I had no idea that six-months later I'd be fighting 300 companies from America who were wanting to shut everything down and that I had accidentally disrupted things. And then, ultimately that led me down a path that saved my life, because of my passion to communicate through the internet. I lost my day job at Wall Street, ...when I was fired I wasn't going to go back but I was going to pursue a passion for communications. A lot of my knowledge is self-taught. I believe, I learned, that is what I do, and that is how I just follow a dream and I ultimately hope to change the way things are. Today, if anyone looks at their phone and click on someone's face, or maybe has a facetime or video-chat, or perhaps have a voice communication and they think about where they are talking from and talking to, and it is for free, "You are Welcome!". Because in 2003, I've had a vision and I went to the government and I asked - Can we be proactive, is it possible that voice communication, by default video, that starts in the internet should not be regulated as it used to be? After a year, they said Yes. The US Gov't issued something called the Pullver Order, in February 2004, and is honored in about 100 countries around the world. That law combined with the evolution of smartphones has helped shaped communications.

Q Jeff thank you so much for that. As you just mentioned, you did amazing things for the development of the state of communication we enjoy today. And while you were telling us about your beginnings, reminded me of the lack of vision of education technology, that misses the richness of the world you were just describing, believing that kids only need a few "fun or cool add ons" on poorly-sighted educational solutions. You gave examples of how it changed your life, how you were able to communicate, reach out, share your interests, opening up to new significant worlds. You have now the stage to hundreds of people who determine how education will be, what would you like to tell them?

J.P. I'd like to make an argument for the misfits, for the people who are different, who necessarily have to fit into the mold of what you think we are. But we are ok, we can turn out ok. We have to be believed in. There should be someone in our lives that allow us to be creative and to explore the inner us to be part of the inner you. Technology is part of it but don't forget about the humanity. Don't forget about the hugs. Don' forget about the love. Don't forget about the caring. Because we are not machines and we need to be hugged and cared for, and we need to be appreciated and to be encouraged to explore. One of my passions when I was a kid was to build rockets, ... I used to build these little rockets that sometimes would explode sometimes not, I played with chemistry, not to do bad things, I took things apart. I don't think we give a chance to our kids to blow things up in a polite way as much as we used to, and explore the outer edges around creativity, and to learn that just because we do not fit in we are bad. Maybe we see things that no one else sees. If we are given the chance to become who we are, 'cause we are different and we are evolving. So, don't cast us aside because we matter to.

KIDS TALK

IF WE REMAIN PLANNING EDUCATION PURELY BASED ON EXPERTS' VOICE, WE WILL END UP WITH EMPTY CLASSROOMS. **LET THE KIDS TALK!**



We need school, it's important. There is no one in the world that knows it all. There are always new things to learn. It would be worthless to connect a USB inside our brains so we can know it all, 'cause you will not have what to learn, and then, you will not enjoy learning any more.

Yonathan, 12 y.o.

I think that maybe the students will not treat the robots like a person. A teacher is older than you but a robot is just a piece of metal. Robots are something we program, not something that we can ... that we can include, because they are not us. It looks like us but it is not us.

Avigail, 10 y.o.

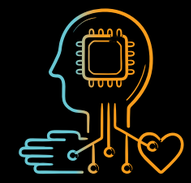
HOW WILL SCHOOLS BE IN THE FUTURE?

I think there will be teachers but they will teach from their houses and the students will be in class. The teachers will be brought as holograms. Why hologram? Because you know that a person said that to you, because the hologram is actually a person only after he said that. With robots, if there is a tiny malfunction in the chip, suddenly it won't know how much is one plus one, it will think is three. It could disrupt all mankind.

Eviatar 10 y.o.

Doors that recognize your voice to open. The books will be different, computerized. Like in Hogwart, the board writes by itself, the teacher can be far from the board writing on air and the board recognizes it and shows what she is writing. Or, maybe, when we are born, we will have already all the information on our heads.

Itay, 9 y.o.



There will be no books, or pencils or notebooks but laptop that folds into a memory card. Holograms that walk around the kids and see if they need any help. I think school will still be important, without it, if we learn everything from the computer we'll become things with head and limbs.

Ori, 12 y.o.

I'll have a helmet, like in the hairdresser, and I press enter and the wires will infuse my mind with information. But, if there is no school, we won't meet new people, we won't communicate with others and learn new things.

Massa, 11 y.o.

HUMAN 2.0: STRADDLING OUR ROBOTIC AND BIONIC FUTURE

A CONVERSATION WITH BARAK BEN ELIEZER

Barak Ben-Eliezer is a prominent Israeli pioneer in both science education and technology innovation who founded the Einstein Global Network and the Center for Future Scientists, co-founder of the Winnovation private equity fund and has been commander of the IDF Talpiot program for outstanding science students.

What is the true nature of a breakthrough?
For Barak Ben Eliezer, a true breakthrough is one that happens literally. In the 20th century, we broke through the earth's atmosphere and allowed two-way transport: nuclear energy, which had existed only in space, was replicated on earth; man, which had existed only on earth, traveled to space.
A 21st century breakthrough, he predicts, will allow two-way transport by breaking through our bodies: Creatures born of Artificial Intelligence will become more human; humans who interact with them will become more bionic.

HUMAN 2.0

"This is the first time, and I call it Humanity 2.0, that we're going to change the version of our species between what's human and what's not," he says. "We are going to break the ceiling of human being capabilities. We are going to enhance what humans can do. "

In this exchange, he says technological "dry cyber" will merge with "wet cyber" -- the cyber ecosystem of our body's neural network and all the organs, functions, fluids and bacteria it connects. Human 2.0 will be a hybrid that's wired directly to the cloud. And we'll be interacting with robots that are doing everything, everywhere.

We're already familiar with cognitive enhancement as it relates to learning, memory and cognitive disorders. What's new is the coupling of cognitive enhancement to artificial intelligence – increasing our brainpower "not by senses, not by training, not by education, but rather by hacking into biology".

The race toward Human 2.0 has begun, and wheels are turning worldwide whether we like it or not, Barak says, driven by the self-interests of powerful and well-financed nations, companies, organizations and individuals. Many of the technologies in the worldwide cyber-race are familiar to us, such as robots, mobile technology, artificial intelligence, cyber and quantum computing. This is the field from which Human 2.0 will emerge.

He offers some examples:

- We can only imagine doing a Google search with our thoughts. Yet, non-invasive helmets already do that, and Elon Musk anticipates clinical trials in 2020 to insert electrodes in our brain that can do the same thing. Once accomplished, many companies can be expected to conduct similar programs.
- "Every billionaire in the world above the age of 70 wants to invest in longevity" Barak says. "There's going to be so much money there, to stop dementia. Actually, this is the biggest market. If you want people to live to 200 years old, we just need to fix the brain."
- We are familiar with biology-based "designer babies", but we can foresee a new generation of "Biotech-Babies"; babies with specific characteristics or enhanced capabilities which, further in the future, may be created in commercial laboratories.
- Military R&D, which uses AI to enhance the "dry cyber" of tanks and missiles, and the "wet cyber" of soldiers to enhance their capabilities on the battlefield.

THE PURPOSE IS TO NURTURE GIFTED STUDENTS AND ENCOURAGE THEM TO NETWORK ACROSS DIFFERENT DISCIPLINES AFTER GRADUATION. THUS, THEIR LEARNING AND POSITIVE INFLUENCES ARE CROSS-FERTILIZED, REINFORCED AND SHARED WITH OTHERS

There is an elephant in the room, and Barak is deeply involved in addressing it. "Humanity can destroy itself or can repair everything in the world," he says. "There is a junction between Tikkun Olam (repairing the world) and Kilkul Olam (damaging the world), and we must not risk too much because we have only one chance."

HUMANITY 2.0, WE'RE GOING TO CHANGE THE VERSION OF OUR SPECIES BETWEEN WHAT'S HUMAN AND WHAT'S NOT, AND BREAK THE CEILING OF HUMAN BEING CAPABILITIES. WE ARE GOING TO ENHANCE WHAT HUMANS CAN DO

Israel has a special role in working toward the good of mankind, he believes. "We need to build a techno-spiritual civilization," he says. "The kind of civilization that is very advanced by tech and science; otherwise, we will stay behind. But it should also have responsibility and spirituality, because this is the meaning of life. So actually it's a new model of how we are going to live."

Education is crucial in teaching science and moral values together and Barak began two educational initiatives related to this goal that gained traction outside of Israel. They are the Einstein Global Network and the Center for Future Scientists: The purpose is to nurture gifted students and encourage them to network across different disciplines after graduation. Thus, their learning and positive influences are cross-fertilized, reinforced and shared with others.

"It was about 17 years ago, when both my grandfathers died, and I understood that we are the young generation that needs to lead what's going on here," he recalls when he had the idea to create the Einstein Network. The Network gathers the top 3% of outstanding students in all disciplines and metrics to work together in understanding and addressing the world's greatest challenges. "Four years after I started The Einstein Network, I found out that NASA and Google founded Singularity University" with similar aims which he praised "I'm not alone, because the same idea will be in many places."

The next step was to encourage science and technology education at an earlier stage, among high school students. That was the beginning of The Center for Future Scientists, which also received international notice and many countries expressed interest in reproducing it.

Many other educational programs can be initiated ranging from young children through adulthood, he says. We can do more to improve children's capabilities by taking advantage of the neuroplasticity of young children in order to solve neurological problems and improve cognition. "The brain can fix itself when we're very young, and we don't leverage this window of opportunity enough," he says.

For older students, we must invest more in closed-loop education – not metaphorically, as in student-teacher feedback, but literally, as in the educational equivalent of drip irrigation.

"When you give water to a flower with a sprinkle, it's not efficient; so we have drip irrigation, smart irrigation, to give the root of the flower what it needs, and we also have a sensor to see that the root has enough water" he says. "Why shouldn't we do that with education? We never did closed-loop performance with education.

"Today, we know from neuroscience how to check if neurons are getting the signals they need, the knowledge they need. And I think that in every school there is going to be virtual reality, because it's fantastic. And we can use sensors in VR to check if the neurons get what we want them to get. Much more efficient, closed loop and personalized."

The challenge for adults, he says, is to stretch their innate capabilities to the maximum. The first step is to learn exponentially, the way children do, by deciding to do something for the first time every day. The universe travels on an exponential curve, while adults who age without new experiences travel on an asymptotic curve; the two will never meet, he explains. Thus, adults must expand their capabilities exponentially in order to understand, predict, interact with and influence the mega-trends of the future.

Israel can continue to serve as an example to others, he says: In a small country like Israel, we must build a strategy to boost our brain power in a competitive world, but we also must build a strategy that unites people rather than divides them – to unite people to use technology for the good.

TEACHERS AS STARTUP CREATORS

BY DR. ILAN BEN YAAKOV,
PEDAGOGIC DIRECTOR AT MINDCET

From users to creators When we think about a startup, the first association that comes to mind is that of a programmer, dressed in a faded hoodie, sitting in a garage in front of a screen filled with lines of code, chewing on cold pizza straight from the box, and scratching his head. After some moments of frustration, his eyes light up and he starts typing furiously. Finally, he has been able to crack the complicated technological problem that has held him up, and from here it's only a short road to the celebratory photographs when his company goes public, or when he makes his exit, accompanied by newspaper headlines. Another miracle has taken place, another startup has set out on its road to glory.

However, the past decade has shown that this scenario may no longer be relevant.

First, the history of startups in recent decades has taught us that, in many instances, the idea or the solution is not the only key to business success. Many companies have actually become success stories in an environment of similar or identical offerings, not because they have a unique product, but because the company is managed properly and

TEACHERS AS STARTUP CREATORS

because it has a good understanding of users.
Furthermore, it seems that the old image, of breakthroughs taking place in the entrepreneur's fevered mind, has become outdated. Today we know that the secret of the success of startups depends to a significant degree on discourse with users and on the insights arising from that discourse. It is not development marathons in the dead of night, but getting out of the building, that is the key to success. Also, the challenges that entrepreneurs face today are no longer technological in nature. Most of the startup companies in recent years don't need to address the question of "Could it be built?". In the vast majority of cases the answer is obvious: yes, it can be built. We face no technological challenges. The big question, on which entrepreneurs rise and fall, is "Should it be built?". Does the market need this product? Does the product meet a real need among users? The task that the entrepreneur needs to address is not execution, but rather learning and understanding the users.
Notwithstanding all of this, one image has still remained relevant till recently: that of the *developer*. Sooner or later, in order to turn the entrepreneur's vision, learning, ideas and solutions into a reality, there is a need for a programmer, a person who can turn all of these into a language that the machine understands. "Wanted – Technological Partner" is without doubt the most popular advertisement in entrepreneurs' social networks.
But even this is going to change real soon now.

TEACHERS ARE THE BEST EDTECH ENTREPRENEURS

Over the past seven years, we at MindCET have been running a program for teacherpreneurs, - MindCET Fellows. In this program, teachers who face a pedagogic challenge in their work, develop technological tools as a response to these challenges. Dozens of pioneering, innovative EdTech products have grown out of this program and have proven that, when it comes to EdTech, teachers are the best entrepreneurs: their familiarity with the challenges of the system ensure that any solution that they propose meets a real pedagogic need within the system; their awareness of the limitations, but also the opportunities, of the world of learning and education contributes to the creation of a sustainable solution, that combines far-reaching educational vision with a product that is connected to the here and now of educational work; and their dedication to the world of learning and education ensures successful deployment and constant learning about the needs and insights arising on the ground. All of these have led to such creative solutions as Naraview – an experiential game for teacher and students, which turns Wikipedia from a collection of copy-paste texts to a fascinating learning journey; The Islands – which makes use of virtual worlds, similar to Second Life, for the teaching of History and Civics in the first person; Abigoo – an application through which students create music and learn to read in an experiential way; Olam ON – which ties current events to the curriculum in Science, Environment and Space, by means of a social network; and more.

THE TASK THAT THE ENTREPRENEUR NEEDS TO ADDRESS IS NOT EXECUTION, BUT RATHER LEARNING AND UNDERSTANDING THE USERS.

MAN AND MACHINE – THE ROAD TO DIALOGUE

The history of man-machine interfaces is characterized by a transition from a discourse of commands to a dialogue.
As users, the rather alienating Command Line interface was replaced by a visual interface controlled by a mouse, and later by touch screens; multi-parameter searches were replaced by search engines based on questions framed in natural language; and applications with multiple menus and settings are being replaced by conversational interfaces such as chatbots and voice assistants.

For developers, in effect, the whole idea of a programming language is an attempt to simplify machine language (the only language that the computer actually "understands") into a human language, with syntax rules and metaphors that can be understood, such as variables, loops, functions, and so on. FORTRAN was the first language that attempted to simplify programming into commands and variables that could be understood and learned by people, today referred to as a high-level programming language.

THE NO CODE REVOLUTION

In recent years, we have been witness to the rise of platforms that allow the creation of technological tools without a knowledge of programming, through graphic interfaces, automation tools, integrations between network services, and so on. All of these, together with the creation of a community of developers without programming, herald the NO CODE revolution, which challenges the rift that existed in the past between users and developers.

- Looking into four groups of tools: Database-based systems – one of the significant milestones in the area of user programming was the invention of the electronic spreadsheet in 1978. In recent years, tools have been developed that have taken matters a step further, and which allow the management, organization and display of databases, through which end users can manage complex systems, which in the past required professional development by programmers. Tools such as Notion, Airtable, and Coda allow the creation of systems for the management of projects and tasks, organization of digital content, account and customer relations management, and so on. Platforms such as Appsheet and Glide allow the creation of mobile applications based on spreadsheets (with Glide's to-the-point slogan: "Every spreadsheet is an amazing app waiting to happen").
- Automation – the transition of the world of software to the cloud, and the ability to connect different software functions through APIs, has created the new field of automation of network services, which allows users to create complex applications by connecting various services. Thus, it becomes possible to easily connect email, social networks, forms, databases, and even IOT services, without writing a single line of code. Tools such as IFTTT (meaning, If This Then That), Zapier and Integromat allow the creation of automations and the use of automations created by other users.
- App builders – open platforms for the creation of applications and tools. Within this group, it became possible to build tools for the creation of mobile apps (such as Thunkable or Kodular), the construction of chatbots (such as Chatfuel or MotionAI), the creation of voice interfaces (such as Voiceflow), virtual and augmented reality (such as Scapic), for virtual stores (Shopify), and more.
- Visual programming tools – platforms for the full programming of web applications, such as Bubble. These platforms allow full programming of web applications, including the design of the user experience, user management, database management and interfacing with network services through an API. One of the better known outputs of such tools was NotRealTwitter, created by a user in 2015, which was effectively a duplicate of Twitter constructed using Bubble. On the opening screen he wrote: "The purpose of this site isn't to steal Twitter's business... It is to show the future of software development. Because in 2025 most software won't be made by coders. But instead by people from diverse backgrounds using logic. The person who built this site isn't a software engineer... In fact, he didn't write a single line of code. And he built it in 4 days." A complete marketplace for templates has come into being around Bubble, allowing users to purchase a template (such as a duplicate of AirBnB or Pinterest) and then edit it to meet his own needs.

TEACHER ENTREPRENEURS AND NO CODE

The NO CODE revolution is particularly exciting for the world of EdTech. Many EdTech entrepreneurs come from the world of education and learning. They may have a deep familiarity with the challenges of the education system, but given their lack of technological background, their ability to bring their ideas to fruition was limited. Having teacherpreneurs join the NO CODE revolution, which shortens the distance from idea to product, may bring about a revolution in EdTech, which in turn will change the way in which we learn and teach.

CHALLENGES OF THE FUTURE LABOR MARKET

A CONVERSATION WITH PROF. EUGENE KANDEL

As CEO of Start-Up Nation Central and former head of the National Economic Council, Prof. Kandel is an authority in understanding worldwide trends in economic development and technology's role in shaping them. Prof. Kandel shares his thoughts on the economic dislocations of high-tech economies and some potential solutions. As well as, on Israel's tech versus legacy economy as a strong bellwether for the developed world.

What does it mean to live in a society whose driving force is rapid and disruptive technological change?

It's been roughly 25 years since widespread use of the Internet precipitated the revolutionary changes we now take for granted in communications, culture, commerce and computer cognition. It's a good benchmark to consider the dislocations of high-tech economies and predict the contours of a high-tech world.

What's more, there may be no better place to look than Israel: With the most predominant, nationwide, high-tech economy in the world, Israel is a bellwether of the challenges and potential solutions facing many technologically advanced countries.

Let's start with the transformative effect of Big Data on the workforce and economy.

"The world learned how to collect and analyze enormous amounts of data-- enormous, unimaginable even 20 years ago, at unimaginable speeds" Prof. Kandel says. **"We used to replace people's muscles with technology. Now we're replacing people's senses and brains."**

He points to six major technologies in this transformation: Artificial Intelligence and Big Data; Computer Vision; 3D Printing; Blockchain and Smart Contracts; Drones and Autonomous Vehicles, and Quantum Computing.

It can be argued that the shift from muscle to mind replacement is creating greater fundamental change than the industrial revolution. This is based in part on the speed and scale of change: While there's a high marginal cost to replace a manual laborer with a machine, there's a low marginal cost to replace a service worker with a processor. In addition, it can be done on a much broader scale.

This will cause two different profiles of service workers to emerge, Prof. Kandel predicts: one profile will include those with relevant but low-paying skills such as hair stylists, gardeners and yoga teachers; the other will include those with high-paying, technology-related skills such as programmers.

"People, corporations and governments have to understand that we are in a new equilibrium, we are in a world of continuous, rapid, unpredictable change all the time," he says.

"The new equilibrium is almost a disequilibrium, because things do not change and then stabilize. They change, and then change, and then change. This is a new outcome for us that leads to a variety of social outcomes."

Which brings us back to Israel as a bellwether.

Prof. Kandel refers to Israel's high-tech economy as a Zeppelin floating above the legacy economy and attached, if at all, by loose strings. Should governmental or societal forces make it difficult for those in the Zeppelin to operate, it can cut the strings and move its people, companies or entire ecosystem. This is not unique to Israel.

However, Israel is a pertinent teaching example because of the size, weight and reach of its Zeppelin. A larger percentage of the workforce -- nine percent -- works in high tech than in any other country and generates between twelve and fifteen percent of the GDP.

"There's no other country that does that, at least that I know of," he says.

The Zeppelin is kept aloft by investment, in which Israel is also a

CHALLENGES OF THE FUTURE LABOR MARKET

world leader: "We have the highest number of start-ups per capita, and over twice the amount of Venture Capital per capita as the United States, which is much higher than anyone else after that," he says.

And this leads directly to a major challenge: In Israel, wages in the Zeppelin economy are about 150% higher than the legacy economy, and the differences are growing; the difference outside Israel is closer to 50%.

"There's very little connection between the types of skills these two economies need, the types of financing, the types of regulation, knowledge and markets," he continues. "The Zeppelin economy is basically international, and the local economy is local, and they're not meeting each other.

"The growth in inequality is not a bug. It's a feature of this growing, technological economy and its impact on the labor force. It's not going away."

Thus, we arrive at the role of education, both in filling the shortage of high-tech employees and in supporting efforts to help the broader society adjust. It also brings us to Prof. Kandel's current focus at Start-Up Nation Central – workforce development – where many of his initiatives can be more broadly applied.

There is a shortage of skilled tech employees throughout the world, he says. In Israel and elsewhere, tech employers have tended to recruit from traditional streams of pre-qualified applicants. Here again, Israel is an extreme example: Historically, he says, the tech industry has been more than 80% male, from about four metropolitan areas, from middle and upper middle-class families, while this group represents only 30% of the general workforce population.

"So you're pushing out, or not accepting, a large portion of the population," he says.

Yet Israel has made great strides in identifying and recruiting employees from outside that profile in order to address two major needs –filling open tech positions and reducing economic inequality – with methods that could be applicable elsewhere. The first step is to identify and address the specific obstacles faced by the various marginalized populations. "We actually did a graph that shows stop signs where each population hits a roadblock as they go from being six years old to their possibility of getting into high tech," he says.

As the populations advance in school and toward the workforce, the steps include motivating and facilitating entry into university computer science programs; teaching tech company HR people how to identify high-potential applicants from the marginalized groups and training them in skills that are required for higher-level positions.

He points to some remarkable results, in which high-potential applicants were able to double their salaries after they received the additional skills training. However, it's necessary to start very early in the educational process, particularly with girls, and

THE GROWTH IN INEQUALITY IS NOT A BUG. IT'S A FEATURE OF THIS GROWING, TECHNOLOGICAL ECONOMY AND ITS IMPACT ON THE LABOR FORCE. IT'S NOT GOING AWAY

fundamentally change the entire evaluation system, he maintains.

"Schools use an anachronistic system to evaluate students," he says. "Testing is absolutely, incredibly inefficient, and in my opinion a stupid way to actually evaluate students, except for languages. You need to study and be tested on four languages -- your local language, English, mathematics, and computers. Without these, you're going to be mowing lawns or doing something similar most of your life."

This is a worldwide problem, and he notes that a number of countries have abolished most testing; Japan abolished thirty percent of its entire curriculum after determining that it was no longer relevant. "There has to be a bold decision, almost like a political decision, to say we're no longer going to test this way," he says. "Then the majority of education should become experiential -- history, geography, literature, arts, social sciences, civic science -- all of that needs to be experiential."

Coping with the pace and impact of global technological change also brings us back to education, he says. "The only solution is to make people comfortable with change, so they easily adapt to changing conditions; they need to be able to learn throughout their lives and not be bored with learning."

HMP AND THE URGENT NEED FOR A NEW CURRICULUM

BY GUY LEVI, INNOVATION OFFICER AT CET

INTRODUCTION – THE LEARNING AGE

In 2006, Professor Stephen Heppel, a well-known British technology and education expert, gave a lecture at the Royal Society of Arts (RSA) in London titled "Learning 2016," in which he argued that by that year we would no longer be in the information age, nor in the knowledge age; we would be approaching the Learning Age. Those who will not have learning skills and competencies will not be able to survive in the newly developed digital economy.

On the threshold of the third decade of the twenty-first century, Professor Heppel's prediction needs no justification; learning has become almost synonymous with change and innovation. Satya Nadella, Microsoft CEO in the past five years, has changed the company's organizational culture by introducing two leading values – empathy and continuous learning. The focus has shifted, according to Nadella, from "know it all" to "learn it all." This is a crucial argument because most education systems around the world are based on content knowledge and students are assessed and evaluated on their knowledge, which is the direct opposite

HMP AND THE URGENT NEED FOR A NEW CURRICULUM

of Nadella's contention and a distinct contrast with the goals of preparing the current generation for the challenges they will face in life. Students should be empowered and promoted in their learning instead of being assessed. Toward that end a new key player has entered the game – artificial intelligent (AI).

TWENTY-FIRST-CENTURY PEDAGOGY AND AI

In the introduction to her recent book, *The Big Nine: How the Tech Titans and Their Thinking Machines Could Warp Humanity*, published in 2019, quantitative futurist Amy Webb talks about the role and presence of AI in our lives: "Artificial intelligence is already here, but it didn't show up as we all expected. It is the quiet backbone of our financial systems, the power grid, and the retail supply chain. It is the invisible infrastructure that directs us through traffic, finds the right meaning in our mistyped words, and determines what we should buy, watch, listen to, and read. It is technology upon which our future is being built because it intersects with every aspect of our lives: health and medicine, housing, agriculture, transportation, sports, and even love, sex, and death." One area, significant in the space and time of human life, is missing from Webb's statement – education. Webb argues that the eventual outcome of contemporary and future developments of AI is essential and can improve our quality of life, but at the same time it could irrevocably harm humanity. Yet, she goes on, AI, machine learning, and deep learning are here to stay so we must harness them for the good and counteract their risks and negative effects.

HMP TO LEAPFROG INTO THE FUTURE OF LEARNING

Human Machine Pedagogy (HMP) actualizes the promise of the future of education, utilizing AI and machine learning technologies without sacrificing the human dimension or our privacy. We know today that creativity, critical thinking, and problem solving, among others, are the most important competencies of the future work environment and labor market. How do we harness AI or HMP (the educational definition) to leapfrog into the future of

learning? In order to succeed in such a challenging endeavor, a methodological clarification is required – we have to detach ourselves from 20th-century pedagogical language and, of course, practice. Concepts such as classroom, blackboard, desks, homework, content-based curriculum, tests and exams are ideas and methods that are no longer relevant to current learning environments, as they hinder our ability as educators to guide the student in a new educational journey. Learning happens when we are awake, all day long and in different locations, and technology – hardware and software – can enable it. HMP means, in this context, an interaction between humans and machines in iterative processes aiming at continuously improving students' personalized learning, constantly providing teachers with pedagogic information and recommendations about their students, and obviously continuously improving the algorithm by ceaselessly collecting more and more data about the learners.

AI PERSONAL COACH

The "personification" of the algorithm will be in a form of an "AI Personal Coach" (APC) which will not only lead and guide its "master" (the student), but will also "communicate" with its APC "peers" to create teamwork, group discussion, peer learning, and collaboration. This will be relatively easy in basic skills like mathematics, as well as in reading and writing in mother tongue and second language (preferably English), where machine learning and AI already exist and are progressing rapidly using natural language processing (NLP) and neuro-pedagogy. However, the K12 systems worldwide are yet to exploit and utilize even a small part of this potential.

Kevin Kelly in *The Inevitable – Understanding the 12 Technological Forces That Will Shape Our Future*, published in 2016, talks about the 12 technological imperatives that will shape the next 30 years and transform our lives. One of these forces is "tracking." Kelly argues that today we track almost everything we can, and that technology will explode as sensors steadily get smaller. This is the case with the AI Personal Coach (APC), which will track everything the learner is doing while providing him or her with feedback, recommendations, etc. Teachers will receive students' tracking information only with the students' consent, in order to protect their privacy.

THE NEW CURRICULUM

If we agree that the goal of education in the third decade of the 21st century is to ensure that every student will succeed in life, i.e. the importance of personalization as every student is unique in her or his own way, the new curriculum must reflect this goal and thus should focus on personal skills and competencies, namely the development of "student agency" as defined by the OECD Education 2030 project: "...the capacity to set goals, reflect and act responsibly to effect change. It is about acting rather than being acted upon; shaping rather than being shaped; and making responsible decisions and choices rather than accepting those determined by others."

This definition calls for a revolution in the current curriculum. It aims at shifting from a content-knowledge-based curriculum to a curriculum based on skills and competencies. Examples are courses such as Development of Curiosity, Learning from Mistakes, Critical Thinking, Problem Solving, etc., and of course Computational Thinking, Data Literacy, Media Literacy, and more. Hence, disciplines and knowledge domains like the humanities or social sciences will provide the content knowledge needed to develop the skills and competencies. HMP in this trajectory will support the students by helping them to reflect on their learning habits and understand concepts and phenomena, provide them with new directions and ideas, and connect them with experts and mentors – their teachers. In this new reality of learning there will be no need for summative assessment; actually there will be no need for assessment in its 20th-century form.

THE END OF ASSESSMENT

British Columbia, the western province of Canada, has radically transformed its curriculum to being core competencies based, focusing on communication competencies, thinking competencies, and personal and social competencies. Schools are granted full autonomy and advised by the Ministry of Education to develop the disciplinary and inter-disciplinary curriculum around big ideas. The Ministry of Education understood that traditional assessment is no longer valid when your goals are to develop students' skills and competencies; thus they define assessment literacy as "the knowledge, understanding, and application of assessment principles and practices necessary to support and empower students in their learning." To support and empower students in their learning, not to measure them. Post-2020 assessment is measurement-free as we constantly track our learning, i.e. we are developing a process of "stealth measurement" based on the continuous improvement of AI.

THE NEED FOR URGENCY

Policymakers and educational practitioners must understand that we are now in the midst of an educational revolution equal to that of 19th-century universal public education and the rise of the national curriculum, which was a response to the unprecedented change brought by the Industrial Revolution. We are now in yet another unprecedented change brought by AI, which revolutionizes our life in all aspects and realms. Hence, we have to take and embrace the opportunities that HMP brings, first by radically changing the nature of the prevailing 20th-century curriculum, personalizing and democratizing it by giving students autonomy and ownership over their learning and providing the conditions for every pupil to succeed in life.

THE POWER OF GEOGRAPHY

BY VICKI PHILLIPS AND LINA GOMEZ,
EXECUTIVE VICE PRESIDENT & CHIEF EDUCATION OFFICER OF THE NATIONAL GEOGRAPHIC SOCIETY

"At the National Geographic global headquarters in Washington, D.C., students go on a mesmerizing VR journey with National Geographic Explorer Erika Woolsey to the underwater Eden of Palau, where manta rays live in spectacular numbers. Students learned about these extraordinary fish and why their environments are threatened."

THE POWER OF GEOGRAPHY

For just a moment, close your eyes and envision a map of the world. Do you know the capital of Kazakhstan? How about the longest river in Chile? If you answered Nur-Sultan and the Loa River, then you have successfully completed one of the most classic exercises in geography. Certainly, geographic education can be as straightforward as learning names, places, and natural features on a map but that would be too narrow of a view; geography today is about insight and vision.

Geography represents the many dimensions that a region or people can contain, from the natural world and the health of the environment, to cultures around the globe, and the very future of humankind and our planet. Because our world is growing more interconnected and more complicated by the day, geography is more important now than ever before. Former National Geographic Society Chairman and President Gil Grosvenor illustrated this concept—our increasingly interdependent world—with the use of a simple pencil. He traveled to classrooms across the United States showing how the raw ingredients for the pencil made a far-reaching journey around the globe. Today, materials include softwood from Sweden and South Africa; paint from Kazakhstan and Estonia; graphite from Brazil and Mexico; aluminum from China and Mozambique; and rubber from Thailand and Malaysia, among others.[1] To understand the creation of the pencil is to understand countries and commerce, job markets and manufacturing, global trade and transport networks, production and politics, exports and economies, and so much more. The humble writing tool used by generations of educators and young learners is one that crosses continents and cultures and is, ultimately, the product of a global mosaic of people and places. The story of the pencil is, quite simply, the story of geography—one that connects people, no matter the distance, and builds empathy and engagement with our world.

In this way, geography is a comprehensive discipline—the art and science of understanding the complex interconnected workings of our human and natural systems. Geographic literacy is vital not only to answer the question "Where?" but also "Why there?" and "What is the impact?" At its core, geography allows learners to see the *whole* picture, with a special focus on how the Earth shapes our way of life and how our way of life shapes the Earth. Once students are able to understand the interconnected, 24/7 world around them, they can become globally engaged citizens, and globally engaged citizens are empowered to become passionate decision-makers and compassionate stewards of our planet.

As Grosvenor once said, geography "allows us to analyze the past and anticipate the future."[2] Given the complex social, environmental, and political challenges that today's learners are inheriting, now is the moment to promote the study and understanding of geography. We must provide students with the tools to see and measure how individual actions change the world, to assess the costs and benefits, and to decide whether to adjust the path they are heading on or keep going. We must provide young people with the tools to better understand the whole picture.

Geography is a science powerfully suited for solving problems in the 21st century. Fortunately, we are in a time in education when there are more opportunities than ever before for younger people around the world to become immersed in its learnings—to become part of a "Generation Geo" of informed and passionate young leaders working to create a brighter future.

GEOGRAPHY FOR DIGITAL LEARNERS AND STORYTELLERS

To realize this opportunity, it is critical to bring geography to life for young learners in the classroom, to make geography real and relevant, and to ignite the spirit of exploration. Imagine a lesson on volcanoes with a live connection to volcanologists standing in the foreground of an active volcano? This is an example of what is possible through National Geographic's Explorer Classroom.

Through Explorer Classroom, students experience geography firsthand by digitally connecting with thousands of National Geographic Explorers—leading experts in science, education, conservation, technology, storytelling, and many other disciplines—in every corner of the world. By connecting students directly with science and discovery, young people engage with real-world role models about their experiences, findings, and impacts in the world. We can lift and add dimension to every learning environment, enabling and inspiring students to explore opportunities beyond what they thought was possible.

Another powerful digital tool available to learners is interactive mapping. Through the study of geographic information systems (GIS), young people have a platform where they can gather, manipulate, and explore data to visualize our world in a whole new way. Through GIS, learners can analyze and organize data, discover how different factors impact a situation, and tell a unique story through maps and 3D scenes. By using this technology, young people are able to discover patterns, relationships, and connections that help them become informed decision-makers.

Have an interesting story to tell? ArcGIS StoryMaps enable learners to create inspiring, immersive stories by combining narrative with interactive maps and media. Individuals can publish and share stories with their classrooms, colleagues, or the entire world.

GEOGRAPHY REPRESENTS THE MANY DIMENSIONS THAT A REGION OR PEOPLE CAN CONTAIN, FROM THE NATURAL WORLD AND THE HEALTH OF THE ENVIRONMENT, TO CULTURES AROUND THE GLOBE, AND THE VERY FUTURE OF HUMANKIND AND OUR PLANET. BECAUSE OUR WORLD IS GROWING MORE INTERCONNECTED AND MORE COMPLICATED BY THE DAY, GEOGRAPHY IS MORE IMPORTANT NOW THAN EVER BEFORE

GENERATION GEO

Today's youth embrace the power of interconnectivity, and their concern about global issues is on the rise. According to a global survey, 57 percent of millennials see themselves as global citizens *first* rather than citizens of a particular country.[3] Today's young leaders also see past traditional silos and view issues as overlapping and intersecting. In fact, large youth movements are using interdisciplinary approaches to tackle issues from multifaceted social, economic, and environmental perspectives. For many young leaders today, environmentalism encompasses a wide range of subjects including climate change, indigenous rights, and conservation, among others. As one inspiring young leader recently told a National Geographic audience, "Young people are the world's most untapped resource for hope!"

The National Geographic Society is inviting teachers, entrepreneurs, and young people to join us in creating the next generation of learning tools and curricula that will help prepare Generation Geo (or Gen Geo) build empathy for the Earth, demonstrate critical-thinking skills, and take solution-oriented action.

We encourage you to join our community. Together, we can fundamentally change the way we connect with learners and with the educational community at large and, in doing so, we can do our part to transform geographic education.

1 "Geography of a Pencil," National Geographic Education, https://media.nationalgeographic.org/assets/file/geography-pencil-handout_.pdf.

2 Document sent by Brenda Barr (NG Education): Remarks by Gilbert M. Grosvenor, First-Ever Gilbert M. Grosvenor Lecture, Southwest Texas State University (Now Texas State University), San Marcos, Texas, May 8, 1998.

3 Western Union's 2017 survey of 10,000 millennials.

HMP HACKING EDUCATION

Human Machine Pedagogy (HMP) implies a significant transformation of the way education is defined, designed, and implemented – the content, the environments where learning is happening (virtual and physical), the agents (human and machine), and the interaction between learners and educators. Moreover, it implies a constant productive dialogue between education and user, allowing for a dynamic update and adjustment based on the emerging needs of our current ever-evolving environment.

A significant opportunity can be found in the entrepreneurial culture that offers processes that place the "user-solution" dialogue at their center. Born as an integral part of the development of the digital age, the entrepreneurial culture suggests ways to develop educational solutions which have a better chance of meeting the needs of today's learner.

At Shaping the Future TLV 2019, a few EdTech Startups presented examples of Human Machine Pedagogy in action, suggesting new contents, new learning processes, and new learning environments such as computational thinking, cyber and data literacy, as well as real-time mentoring groups anytime-anywhere.

WHATSAPP FOR SOCIAL LEARNING

Digital technology has broadened our innovative frontiers in education and learning. In the last 15 years the Center for Educational Technology (CET) has been running a successful program of virtual mentoring, assisting thousands of high school students in the periphery to thrive in advanced STEM matriculations by using online synchronous technology (Cisco's WebEx), where mentors and students are learning together on a weekly basis. The virtual mentoring team at CET wanted to reach out to a larger number of students, so in a brainstorming meeting someone suggested, "Let's use WhatsApp. This technology is accessible to everyone." The team developed a learning model in which 100 groups were formed, each comprising 100 students, moderated by a teacher. Online video lessons were developed, which were broadcast in WhatsApp, providing the teachers with the tools and methods for mentoring a WhatsApp group, as well as for how to respond to questions and lead a discussion. The program has been running for three years and the highlight is its data collection and analysis. Over 1 million messages were collected and the methods were optimized with machine learning algorithm. For example, positive messages generated an efficient discussion and deeper learning, and short, clear questions by the teachers increased significantly the level of engagement. When teachers share their strategy for solving a problem and not just provide the answer, it challenges students and the level of collaboration rises. The use of accessible technology is a win-win situation. However, it becomes almost redundant if it lacks the data collection and the analytics which continuously improve the learning process.

A GAME-LIKE PLATFORM THAT DEVELOPS COMPUTATIONAL THINKING SKILLS

Computational thinking is broadly defined as a set of problem-solving methods that involve expressing problems and their solutions in ways that a computer could execute them (Wing, 2014). Recent research has shown that students practicing computational thinking techniques show a higher level of achievement in problem-solving and mathematical and exact-sciences tasks than those who have not used such techniques (Rodrigues, Andrade, & Campos). In 2017, the Department of Computer Science at Weizmann Institute of Science and MindCET EdTech Innovation Center joined forces to create Plethora – a platform that develops problem-solving and computational thinking skills.

Plethora allows students to experience the essential building blocks of computer science and computational thinking. This is accomplished through a user-friendly interface that shifts the focus from the students' exhausting efforts to translate a solution into something a computer can understand, to a human's intuitive thinking processes. Initially, the children are introduced to a set of visual rules that drive the system. They may change these rules, and then view the effect of the changed rules on the system. They can also create their own set of rules, thus creating new challenges. Using Plethora and its intuitive environment of visual rules, students can rapidly reach game levels in which they are required to handle cause and effect, reaction chains, sequential and parallel behavior, and concrete and abstract objects.

Plethora was recently chosen by the Israeli Ministry of Education as one of the platforms used during the 2019 Israeli National Cyber Championship, thus exposing the game to over 55,000 5th to 9th grade students across the country. During the competition, at the junior-high level, the number of players multiplied by a factor of 6, in comparison to previous years, demonstrating the engagement hype Plethora was able to create. Almost 4 million stages were played. Gender diversity during the competition was 47% girls vs. 53% boys.

Computational thinking is rapidly becoming significant for the future thinking educator's arsenal in enhancing students' abilities in problem-solving, mathematics, and exact-sciences capabilities. Plethora is "doing it" differently, since it allows students to look at the bigger picture and focus on the algorithm needed to solve a problem, rather than focusing on the syntax and structure of the solution. Plethora is multi-lingual and approachable for young students from the age of 8, while still allowing the more mature students to enjoy the richness and flexibility the game offers. At Plethora we believe that ***Coding is great, Thinking is unlimited***.

DATA PLAYGROUND

LET THEM PLAY WITH DATA

The OECD has been working on a new curriculum development, Education 2030, that defines the skills and competencies required of students to successfully meet the challenges they face in life and in the labor world, including information and data literacy. We live in a data-driven world, and most of us make dozens of data-driven decisions daily, sometimes without even knowing it. With the flood of huge digital databases, data literacy is becoming a significant and even critical educational component, just like physical health and mental well-being. How much do we understand about the importance of data?

The fact that data is presented to us visually and conveniently does not mean that it is convenient and easy to interpret, or that we can rely on it. The ability to generate meaningful knowledge from data is called "data literacy" – "the ability to collect, organize, interpret, challenge, communicate, and apply data critically." This is the basis for achieving different social goals, and overcoming real-world problems. Or, in other words, data literacy enables students to understand and navigate with more ease in the world and becomes a critical component for making decisions, solving problems, and advancing our goals in our data-driven world.

A recent PWC report predicts that by 2021, 69% of employers in the U.S. will prefer workers with data literacy skills to workers who lack them. The World Economic Forum's Future View Report considers data analysis as the most important skill in future jobs. However, the number of graduates holding these skills currently is only 23%.

We see that the need for data skills is increasing rapidly, while educational systems are lagging behind. A company that can deliver a fun, relevant, and engaging product that meets this need can benefit from rapid global adoption.

Data Playground, a product of MindCET R&D Program, is a platform that enables students to develop data literacy skills and capabilities, specifically designed for middle and high schools. It allows learners to explore real data from different content worlds; offers interdisciplinary learning processes; and helps develop inference, decision-making, and data-driven problem-solving capabilities. We believe that through curiosity, interests, and play, data literacy can be developed in students, enabling them to better understand the world.

Cybint
Cyber Solutions

JOIN US IN OUR JOURNEY OF EDUCATING, TRAINING, AND UPSKILLING TO PROTECT AGAINST EMERGING CYBER THREATS, AND TOGETHER SHAPING A SAFER DIGITAL WORLD.

The battle for a safer digital world spans industries, communities and nations with millions of cyber-attacks per day and billions of dollars in damage. We face a future that increasingly relies on effective cybersecurity across all fronts. One of the biggest threats in cybersecurity is actually the human-factor. While technology becomes more advanced, people are the weakest link, and most cybersecurity incidents involve human error.

There are two main challenges with the human factor: (1) Market Shortage - a global shortage of +3 million cyber professionals; (2) Skills Gap - Most organizations report that their employees are underqualified. From cybersecurity teams to executives, developers and general employees everyone needs some level of cybersecurity proficiency

That's where leading cyber education company, Cybint, comes in, solving the workforce shortage (Re-Skilling) and the skills gap (Up-Skilling) by using accelerated learning methodologies and advanced education-technology. Cybint is a comprehensive cyber education technology platform with a commitment to protecting against emerging cyber threats through training and skills development. Born as a collaboration of global cyber expertise from the Israeli Cyber Unit (8200), with industry professionals and higher-education, Cybint's approach to combatting cybercrime fuses hands-on practice, threat-based content, adaptive learning, and accelerated training methods to maximize retention and minimize risk.

Cybint provides its learning and simulation platform to organizations to train all levels of expertise and minimize the human-risk-factor. In addition, Cybint partners with higher-education institutions worldwide, provide its advanced platform to learners in cyber boot-camps and degree programs to give them hands-on skills and make them more employable with outstanding success rates.

Now, true to its vision of Creating a Safer Digital World, Cybint partnered with the Center of Educational Technology (CET, Israel) in developing and offering a new cyber learning platform for the K12 market and providing kids with knowledge and skills for online safety, privacy and cyber literacy. The new program is based on a gamified learning platform with challenges and interactive learning paths that allow learning-by-doing in "blended" or fully online formats.

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