LEARNING 3.0

NICOLAS SADIRAC
With the participation of Olivia Karam

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BY THE CREATOR OF THE PEDAGOGY AT EPITA, EPITECH, ECOLE 42 AND ZONE 01

Editing:
Translation: Jennifer Huxta
Production & Coordination: Françoise Caille
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92, avenue de France
75013 Paris
Tel: 01 44 16 09 00
Fax: 01 44 16 09 01
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Thank you to everyone who participated
in these adventures and particularly
to the students who trusted me by devoting
themselves completely. Some had
the kindness to share their testimonials
in this book, thanks to you all.

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FORWARD

Established in 2013 to meet the demand of the digital industry which has been facing a growing shortage of IT developers in France, Ecole 42, the first tuition-free training program, is open to all and it has become one of the world's best schools for digital talents. This computer science training program was preceded by EPITA[1], which has existed since 1984, and by EPITECH[2], opened in 1999.

42 offers its training program to anyone over the age of 18 without academic prerequisites; in five years, it has trained nearly 5000 talents in France. By 2019, this training model was available in eleven countries.

Yet, unlike traditional schools, 42 is often considered a "UFO school" because it has put in place a revolutionary educational model based on peer-to-peer learning, a participatory operating style with no classes or professors that allows students to free their creativity via project-based, collective learn-

1. Graduate School of Computer Science and Advanced Techniques.
2. Graduate School of Innovation and IT Expertise

ing—the opposite of the conventional system of lectures.

In this creative and artistic space, we chose to replace some of the usual educational foundations, such as the concepts of teacher and student, curriculum, attendance, subject and theory, with a more modern method that is intended to produce students who are independent, thorough, creative and talented. We think that an education centered on the acquisition of knowledge, where the best students are those who can remember information most easily, is obsolete in the era of artificial intelligence. AI can handle much more knowledge with more precision and immediacy than a sole individual ever could... Memorizing, absorbing, and regurgitating information, like a robot but slowly and less accurately, is not useful, it's dangerous, and it impairs creativity.

In only one century, it is astonishing to recognize how much our world has changed and yet how little education has changed: must we really continue to subject our children to a school system that was put in place for the obsolete and archaic societal needs of the industrial era, an era defined by discipline

and standardization? Traditional schooling has stayed the same while everything else has evolved. It continues to uphold a system where all students are judged and tested individually on standardized skills that rarely take into account the talents and potential of each individual, whereas we believe that the interaction of our differences and our passions provides the creativity and abundance that companies and society need today.

Schools must foster collective and creative intelligence. In this dynamic, teachers are no longer the sole keepers of knowledge but rather they are facilitators, "gardeners", able to bring out their students' particular gifts.

Our training model gets its strength from its capacity to unlock the diverse talents of each of our students, making them more stable, open to others, and as such, able to integrate themselves in the abundant collective intelligence of this diversity. Collective intelligence is very common in the natural world, especially with ants, fish or birds, as explained by the African proverb: "If you want to travel fast, travel alone, if you want to travel far, travel together". Collective intel-

ligence gives the group the power to transcend its individuals, to be more creative and more innovative in order to imagine solutions to a problem or to reach a shared objective by putting the talents, experiences, otherness and connections of each individual in service to the group.

Besides, 42 includes many students that no other institute wanted. No part of the population is marginalized nor rejected as is often the case in traditional schooling, which still uses evaluation procedures and standardized programs that are not adapted to atypical young people who are often condemned to failure at school.

Even if the percentage of female students is still low, at 15% in 2018, without any positive discrimination (which can be counterproductive because of its systematic character), this rate is two times greater than the average in other specialized training programs of the same kind. Furthermore, it is growing while the whole of the scientific sector is shrinking. This situation stems more from cultural influences that lead to self-censorship than anything happening in the field or the teaching methodology. As a matter of

fact, the women candidates are admitted in the same proportions as the men and they are all succeeding very well.

This profound and necessary reassessment of our educational paradigms, as well as the values that they convey, is in synergy with the great labor revolution that digital technology and artificial intelligence is providing. The school of tomorrow must include more imagination and creativity in order to prepare young people for the challenges that await them; it must put humans, with our emotional and interpersonal powers, at the center. Contrary to a received idea that is going around in my schools and to the critiques about the emotionally trying method of the "Pool[3]", one finds many more human interactions there than in most curricula. By creating an intense and strict context and removing the usual guidelines, we are sparking a collective overhaul of the system, where mutual interaction becomes essential and the principal source of success.

In terms of new technologies and artificial intelligence, companies must go through

3. The Pool is one of the screening steps at 42; over four weeks, students discover the proposed learning method.

a digital transformation in order to innovate and stay competitive, no matter their size or their sector. To stay current and distinguish themselves, companies must get organized to be able to face these transformations. Those who know how to reinvent themselves, turn the technological corner and recruit talent will become the new leaders, similar to Facebook or Google, while the others will disappear.

42 is an advantageous solution, not only for transforming and modernizing company organization, but also for hastening the adoption of these new uses.

Lastly, although this model was first developed for learning computer coding[4], it isn't limited to coding and it is diversifying. This is the direction of our new adventure called "Zone 01" that aims to bring this revolution to its true scale. It was rolled out in September 2019. Its ambition is to put in place a network of collective intelligence centers dedicated to all parts of the digital transformation and to the new ways of working based on this intelligence, and no longer only on the code, as at 42. Places where young people in their initial training, employees in retraining, in transformation, or in reconversion, companies offering projects or in transition, start-ups looking for resources, and institutions will meet. These diversities, structured around my pedagogy and the methodologies that I have developed over the past 25 years, will bring about these intelligent collectives oriented towards common goals and the development of an innovative ecosystem to meet the challenge of digital transformation.

4. A code is the instruction given to a computer to make it complete a task.

PART 1
STUDENTS 3.0

Students' lives today are profoundly different from those of previous generations, including mine. When I was a student, there were only three television stations, no internet and no mobile phones. We couldn't wait for the Saturday night TV sitcom, the only distraction that was easy and accessible to everyone. In this void, my Physical Education teacher was a rock star. He was my only source of inspiration and value; he gave us new challenges and interesting puzzles to solve in an otherwise repetitive and gloomy environment.

For our children and the educational teams that supervise them, it's a lot more complicated: when their Physical Education teacher teaches his class, he is competing with hundreds of YouTube channels, some of which were made with Nobel Prize winners who explain things better and often contradict him. How do you expect this teacher to gain the trust of a young person today? Or even get his attention, when other interests are constantly available (music, games, sports)?

Chapter 1
Creativity Isn't Always Found Where We Expect It

The hierarchical and outdated organization of high schools as well as most universities and elementary schools is in total contradiction with what our young people are experiencing on video game platforms where they grow and change in self-organizing environments and act collectively in groups of several hundred individuals that function very well without restrictions.

Again, it was much easier for me: since I never had another model, I thought it was normal to do things this way. Playing on these collective platforms develops a greater number of cognitive and social skills than regular school.

As a matter of fact, these games must keep the players in a zone of intellectual stimulation at all times, without discouraging them or boring them, otherwise they will give up too quickly. Numerous studies show that these important and different stimulations develop learning and call on a large range of cognitive faculties, particularly metacognitive skills, which are not very developed in the conventional education system. Furthermore, interactive games introduce a dimension of human interactions that, although vir-

tual, develop real social skills. In the games, the situations are often more complex than those in real life and the virtual approach allows us to try various strategies with low risk, whereas real life forces us to conform to predefined plans. Playing online develops a sense of human relationships while "experiencing" them rather than passively learning them. More and more often, Big Tech[5] and a growing number of companies are targeting the best gamers for recruitment. Indeed, succeeding in these complex environments demonstrates abilities that are much more pertinent for handling the challenges of cutting-edge companies than those gained in more traditional ways.

However, our academic system is still trying to standardize young people[6] when the future needs the opposite approach. We diminish decision making, confrontations, and differences. Everything is organized so that there are few unexpected situations, questions, or conflicts in order to decrease

5. Big Tech, or GAFA, signifies the four giants of the web: Google, Apple, Facebook and Amazon, and by extension, other large actors in the digital economy such as Microsoft, Yahoo, Twitter and LinkedIn.

6. "School is a factory that standardizes students and legitimizes social differences", Le Vif/L'Express, 26 August 2015.

complexity—as in industrial processes where the ideal is to get rid of differences in order to gain efficiency.

But, that's where creativity is found. To make things "manageable", we remove the very essence of humanity at the risk of making "bad robots" and losing innovation. Jack Ma, the Chinese entrepreneur and head of the e-commerce giant Alibaba, says, "if we don't change our way of teaching, we will have problems in thirty years. We can't teach our children to compete with machines. They must learn useful things such as belief, independent thought, group work, [...] teach children sports, music, painting, art, to ensure they are different from machines[7]."

OFF THE BEATEN PATH

At the beginning of the year, the schools hand out a schedule (like programming a machine) and, overall it's enough to follow it. High schools don't change anything during the year that requires students to think:

7. "The founder of the Chinese tech giant Alibaba thinks that sports and painting will save the next generation facing robots", businessinsider.fr, May 13, 2018.

no change of location on the weekend, no changes in classroom or teacher. No, if a student has math class with Mrs. X on Monday morning from 9 to 11 in room 404, he can go to school each Monday, half asleep, and room 404 will always be in the same place and Mrs. X will always be there to teach her class... By paying attention more or less (a high school student pays attention 30% of the time and Mrs. X, as a good teacher, repeats everything 3.3 times) while texting on his smartphone, the student will pass his exams and everything will be fine. The message sent to students is: "If you do what we tell you, everything will be fine, but if not..." However, if this system works well in a place like the army, it isn't efficient in an economy based on innovation where repetitive production is done by machines.

We must give our children the possibility to develop their creative qualities outside of the conventional education system, which will certainly evolve but it will be too late for them. Online video games, because of their technical complexity and collective interactions, develop many cognitive skills and leadership qualities—these are the early

stages of collective intelligence. Therefore, it's no accident that cutting-edge corporations are using these games more and more to find and acquire their future talents.

THE CURRENT EDUCATION SYSTEMS ARE DETACHED FROM REALITY

Our education systems are having trouble adapting to the changes linked to new technologies and to the emergence of artificial intelligence.

The first reason is certainly linked to the unprecedented speed of these changes. It's the fastest change we've ever known and certainly one of the most radical. Until now our education systems were essentially developed to respond to the needs of educational massification resulting from the industrial revolution. As this economic model gained a foothold, which took place over several centuries by spreading out little by little from Europe to the rest of the world, institutions and mentalities evolved in a slow progression.

The second reason, undoubtedly the most complex, is the new nature of the change. During the establishment of the current system, although standardization was an important challenge, the model that was established was basically the same as the one that had been used to train soldiers and clergy, the factors for success of a factory or an industry were pretty close to those of an army or a church. We just transposed an already well established and functional system.

In the present case, the stakes are different: we are faced with a profound upheaval of the value chain and the factors for success. We can consider it an inversion, because the current education system sacrifices freedom, creativity, diversity and openness to obtain coherence, discipline and standardization. But, these are the qualities that we need to develop the characteristics that are able to integrate these intelligent collectives. It's the only answer to the very complex problems that are already there.

Chapter 2
Deleting Restrictions and Combating Formatting

FREEDOM TO EMPOWER OURSELVES

The rupture between daily experience and the school and university environment is a source of incomprehension and violence. First of all, when students must stay trapped inside a classroom taking meaningless classes they suffer from a deep malaise. This explains, as all the studies have shown, especially the PISA[8] studies, that more and more of our youth are unhappy at school. These studies rank France as having one of the worst education systems in developed countries[9].

On this subject, it's interesting that 42 does not have any problem with disrespect or degradation. A student who is forced to stay seated in a classroom and listen to words that he considers boring or meaningless will feel frustrated and he will generally turn against his environment. He starts by damaging stuff (removing the desks, graffiti tags on the walls, etc.) then he lashes out at the teacher and his classmates; the system itself isn't questioned. Even if such behavior is rare, university or engineering school pro-

8. International Program for Charting Student Progress, known by its French acronym, PISA.

9. "Are French students the unhappiest in the world?", www.slate.fr, 7 September 2012.

fessors have all had to deal with it sooner or later.

At 42, we chose not to restrict our students in this way: if they don't want to be there, they get up and leave. No one holds them accountable, they are free and responsible for their actions and choices. I think this is an essential point of success: to be free, to feel a sense of belonging to a group, to develop responsibility for the common good and to let everyone have a stake in the wellness of those around them. Troublemakers who resist this environment and have a bad attitude or harmful behavior are quickly brought to order by their peers; and they either behave acceptably or they have to quit the training. Those who stay are there voluntarily and with a shared commitment. This creates a rivalry that is essential to the success of each person.

The collective is thus able to manage its own diversity, for example, some students from 42 established a special office area for those who wished to study in silence, and they invented the technological tools to put it in place. In this quiet room, as soon as someone makes too much noise, all the screens

start to blink, this forces him to stop immediately or risk being kicked out. In this way, the students created a rich and inclusive environment by defining shared rules that stimulate creativity—whether it's chatter, noise, or calm. They also found intelligent technical solutions allowing them to implement their choices.

REINVENTING SCHOOL, EVEN FOR THE YOUNGEST STUDENTS

Surely, one can think that such problems are linked to age, but, as someone who has taught very young children as well as older students, and even if this oppression differs from one age group to another, I can confirm that it is present all the way from elementary school to university.

Evidently, we can't give young children the possibility to quit school whenever they want, as we do at 42. But, as the model of democratic schools has shown, we can organize the school so that each student feels free and finds meaning there.

These establishments, coming out of a movement started in the USA by the Sudbury Valley School in 1968, showcased a "reinvented school" where each student is free to choose his activities according to his motivations and his aspirations, this begins as soon as he arrives at school (starting at age 3). He works at his own pace, surrounded by other members of the school—students and adults alike are all equal and have the same decision-making power about the way the school works—this encourages openness to others and the development of each student. Autonomy, respect, sharing and the development of self-confidence are particularly emphasized.

That means letting go of the dogma that says all children are identical, and therefore should be treated in the same way. Dividing up the classes by desire and interest instead of age will offer students a large range of de-compartmentalized activities where they can discover themselves and grow in contact with the others.

Simply erasing the obligation of attendance in class and letting the students have the freedom to choose, as I did at EPITECH,

profoundly changes things and allows students to find true meaning in each course. Contrary to popular belief, students don't look for easiness, they seek out challenges as long as they have meaning and allow them to feel recognized.

EQUIPPING YOUTH TO FACE CHANGE

By removing the constraints of an obsolete environment, we give our youth the freedom that encourages them to develop their creativity and become more innovative. Let's return to the example of video games. Contrary to what many people think, games that are played in groups (collaborative platforms) develop children's abilities considerably by stimulating their brains[10]. Cognitive science allows us to better understand the brain's functioning and to identify more pre-

10. From a 2003 study published in Nature, by C. Shawn Green and Daphné Bavelier of the neuroscience department of the University of Rochester.

cisely, thanks to cerebral imaging, the changes provoked by one task or another.

Abuses do occur, with new risks such as addiction or violence, but as recent studies have shown, these dangers don't seem linked to the games themselves but rather to preexisting factors. A child in pain will seek a way to escape the complex and painful situation; video games are far from the worst way to run away from reality. I think it's pretty normal, and even healthy, that a kid wants to spend his time in a stimulating environment that provides him with much satisfaction when we don't give him anything interesting to do. In general, kids will vary their activities when we give them powerful and attractive activities. Many people complain that their kids spend all their time playing online but don't give them anything more exciting to do.

Lovers of war video games are not necessarily psychopaths nor cave-dwelling geeks, they don't have the same cognitive abilities as their parents or grandparents, but measuring these abilities with out-of-date indicators will inevitably make it seem like cognitive abilities are dropping. But, left alone, young people today are much more adept at solving concrete problems than the previous generation.

It's funny to realize that many professors complain about a drop in the level of education but in reality, young people have more abilities than they think, in particular around collective creativity. Certainly, they don't do as well on tests created for a bygone era, but today we are also much less effective at hunting with our bare hands than we were five centuries ago. Is this really a problem?

Recently I was invited to a meeting of university professors at the technological institute who were complaining about the level of their students: they don't know how to read or count, can't concentrate... I think that these kids are freeing themselves from a system that is becoming obsolete. Regarding their concrete achievements such as robotics competitions, there is no reason to worry about their abilities. On the contrary, the overall level is on the rise and there are more and more young people involved.

If we leave behind purely academic criteria for scholastic evaluation, and base our evaluation on concrete skills, we understand that these kids are much more proficient

than their professors. It would be interesting to organize a competition between professors and their students in an applied domain of study where creativity is important. I think that many of them would be surprised.

We must be aware that the evolution of our society, in virtual and artificial intelligence terms, is happening extremely fast. The real change is there. This speed makes us afraid: the unknown is coming so fast that everyone panics. We must trust young people: in a mutating environment, where everything is moving very fast, they are better equipped than we are to grasp the future. We must guide them by giving them resources but without trying to hold them back in our obsolete era. We must free them from our own fears of the future.

In this international race for talent, we need all varieties in order to create rich, intelligent collectives, able to meet the enormous challenges that are approaching.

FEARLESSLY OPENING UP TO TOMORROW'S CHALLENGES

For many, the arrival of technologies like artificial intelligence, cognitive science, robotics, 3D printing, nanotechnology, or biotech makes the world today more complex and less understandable. A growing number of jobs are disappearing while new ones are appearing, more companies are being upset, and more businesses like Google, Amazon, Facebook and Apple are shifting entire sectors of the economy with their unprecedented way of working. They are talking about replacing human labor not only for physical but also intellectual tasks: each day new software appears that is able to solve more and more problems that we originally thought only the most educated humans could solve.

According to a report by the Artificial Intelligence Index that gathers research from Stanford University, MIT, Harvard and Oxford, "The artificial intelligence of machines, the set of theories and techniques put in place in order to create machines

able to simulate intelligence, approaches or beats that of humans in a growing number of criteria[11]".

Thinking we're preparing them for the future, we continue to direct our kids towards certain jobs that were considered "futuristic" only a short while ago. Yet these jobs are already being replaced by artificial intelligence. That is the case for data scientists[12], very trendy and yet already accessible to basic AI[13] even though 98% of the community continues to think the opposite. It's the character not the modernity of a job that determines if AI will replace it or not: is it a repetitive or creative job? All jobs that don't require empathy or creativity, that are based uniquely on a set of information, will be replaceable by AI eventually. A job isn't protected from AI because it's new.

Finally, everyone feels threatened with losing their usefulness, their income. They

11. "Areas where artificial intelligence is already surpassing humans", Agathe Mercante, Les Échos, 2 December 2017.

12. Data scientists are responsible for the management, analysis and usage of a company's massive data.

13. According to an article published on finextra.com on 18 February 2019, "The Russian bank Sberbank confirms that it created an algorithm that 'acts like a computer scientist', creating its own models that solve the applied tasks".

feel danger for themselves and especially their children. Yet, this process is part of the global development that will liberate humanity from material exigencies. Is it really the work of humans to accomplish repetitive tasks that are sometimes alienating? The Charlie Chaplin film, Modern Times, demonstrates this aspect.

Outside of transitory social considerations, replacing a truck driver, an accountant, or a data scientist with AI is mostly a good thing. Driving a truck is a repetitive and exhausting task that leads to many diseases and accidents; entrusting this job to AI would avoid a lot of unnecessary suffering. Surely, this will have a very large impact on the labor market as much directly for the millions of current drivers as for all the spill-over effects: fewer accidents means there will be less need for rescue, insurance, legal assistance... The upheaval of our economies and our societies is being declared and it is sparking a profound societal change. Like all changes, it comes with fear. But, by freeing us from the alienating tasks that our material needs required, there is a good chance we will be able to

build a society more centered on human qualities and therefore more inclusive.

We must move forward without letting our fears trap us in the past, a past which has proved unable to build a harmonious or sustainable society. By trusting the new generation, we can get past our current limits.

NEW ABUNDANCE COMES FROM DIVERSITY

A number of studies show that our current education system can't eliminate nor erase inequality, it even tends to amplify it[14]. By targeting standardization at every level[15], it discriminates under the guise of individual selection when abundance comes from creativity stemming from diversity and interaction. This system puts forward a single model of success, only one profile, which strongly reduces diversity and therefore our collective capacity to be innovative.

14. PISA data 2018.

15. Synthesis of the Court of Auditors, "Managing teachers differently, a reform to be done", October 2017.

We must reestablish inclusion and the collective. Not only because it's socially and humanly right, but also because it's crucial if we want to arrive at a level of creativity sufficient to meet the challenges of the creative economy brought about by the digital transformation.

If we want our young people to meet the enormous challenges that await them in the very near future, we must profoundly change our schools. Their archaic ways are slowing this mutation. By trusting our young talents, we will get past the societal blockages that came from the industrial-era model and inherited from centuries of military and ecclesiastical educational experience.

In this context, we understand that the role of teachers must change. We must not conform to a "knower" who holds the absolute truth. Teachers must aim to develop students' specific qualities while allowing them to join rich collectives. By developing and maintaining a nurturing environment, supported by new technologies, the educator will enable everyone to progress at their own pace while in interaction with others. Similar to a gardener who doesn't try to change the

nature of the plants, rather he creates harmony by allowing each one to best express itself in synergy with the others.

We need a profound shift in educational dogma in order to usher in this change and meet the challenges of a world that is more and more complex[16].

16. "School of the Future: What are the changes for 2050?" objetconnecte.net, 15 April 2016.

PART 2
FROM EPITA TO 42: A GLOBAL REASSESSMENT OF PEDAGOGY IN TEACHING

In 25 years, I trained more than 20,000 young people who are today recognized worldwide as some of the best and most creative computer scientists. Close to 15% of them participated in starting an innovative company, and all of them are actively involved in the current digital revolution.

Because of the integration of new technologies in our everyday lives (digital technologies, AI, 3D printing, industry 4.0, nanotechnology and biotech), companies' need for more innovation, and changing students, I had to rethink the objectives and modalities of my training program for those who imag-

ine and create tomorrow's world in order to come to a brand new educational approach that is specifically adapted to them.

From the public to the private sector, with or without a professor, with or without a diploma, under the auspices of National Education then in rupture with it, according to a paid model then a free model, this method is exemplified in several establishments: EPITA, EPITECH, ETNA[17], Web@cademy and 42, before unfolding soon under a new identity and with a much larger offering, Zone 01. These establishments improved with each iteration and freedom is their essential value.

17. School of Applied Digital Technologies

Chapter 1
A New Model of Learning

When I joined the School of Applied Digital Technologies (known by its French acronym EPITA) in 1989, four years after its creation, the world of computer science was nothing like it is today. Only a few curious people or specialists had a personal computer. There was no Internet nor artificial intelligence; the digitization of archives had only just started, and chess players beat their electronic adversaries hands down. Most people had never seen a computer or had only seen one on television: giant gray boxes filling up rooms as big as tennis courts, lit up all over with blinking lights, made of tape drives turn-

ing constantly. Usually there was an army of technicians working around the computer as if on a carousel. In short, computers were really new, mysterious and piqued a lot of curiosity. Computer science was at best a gimmick; it wasn't a "real" job.

TRAINING PROGRAMS ARE OFTEN SEPARATED FROM PRACTICE

I had just turned 20 years old and I had already checked out all the possible training programs. I chose EPITA because it was the only school to offer computer access from the very beginning of the curriculum. At EPITA, students had access to SUN stations (developed by Stanford University Network, the American manufacturer) and an impressive Sperry mini-computer that was the same size as a large living room. It was the smallest format at the time, the fantasy of every young computer scientist who couldn't have access to this type of gear outside of school.

All the other universities made their students spend several years working on paper before even hoping to touch a keyboard... Furthermore, for most of them, computer science represented only a very small part of the training. At EPITA, other subjects were offered, though the teaching of computer science was central. That's what I was looking for above all.

However, once on this path, I was soon disappointed. I quickly understood that the practice was limited to recopying what had been taught to us in the lectures, which took up nearly 90% of our time—the same insufficient ratio, I thought, as the practical exercises still taught today in high school chemistry classes. Very happily, I still had the evening and the nighttime—computers never sleep. My colleagues and I, a small group of geeks, negotiated with the administration and got the right to use the machines in the evening after class. And finally, the entire night. I must confess that I quickly became interested in hacking, which led me to a universe where creativity and innovation are an inexhaustible source of freedom.

Maxime Kurkdjian,
EPITA STUDENT FROM 1996 TO 2001

The education that I received at this school was beneficial in three different areas: pedagogy, pragmatic project-based instruction, and collaboration. First, the pedagogy is quite different from what we are used to in high school where we still get points on a homework assignment even if the final result isn't correct. At EPITA, from the very first project, we were plunged into a different system where any grade less than 10 is rounded to zero. Many students work day and night for weeks on a project, and they only get a zero! At first, this pedagogy can be hard and seem unfair but this experience allowed us to understand that a job only has value if it is finished. Only the result counts, not what we did to get there. To get efficient results, the teaching team encouraged us to think outside the box, to use the power of social networks (real or virtual) in order to get beyond the academic rules and avoid repeating existing patterns. This trait is very sought after by companies, and it allowed me and many other students to become entrepreneurs later on. Practical instruction in a project-based system allowed us to master the theory via the practice. We racked our brains over a problem before the teachers presented the solution with theories and concepts. It was a true value added and it avoided the boredom of theory classes. Lastly, project-based work quickly develops the behavioral skills that facilitate group work and collaboration. Thanks to this education, we quickly understood that it is important to connect with other students and share the lessons. At EPITA, a lot of the teaching goes through the peer group, and the contact with older students adds a lot of value. EPITA's teaching promotes the independence of spirit that gives the student self-confidence. Its pedagogy gets off the beaten track and rejects intellectual conformity. Without a doubt, this is what allowed me to found my own corporation, Oxalide, when I finished my studies in 2000. For me, management and corporate governance have become fascinating subjects; when AI upsets "intellectual" jobs,

thinking outside of the box will become crucial to find a place in a corporation, because a machine will think better than a human lambda.

Like EPITA, all schools must teach their students to think outside of the box by taking alternative paths and using their imagination and creativity, the opposite of what they do today.

HACKING, AN ENTRYWAY INTO COLLECTIVE INTELLIGENCE

We were convinced that we had to alert people about the computer security problems that few people knew about. So, without going into details and to avoid giving people the wrong idea, I pirated the website of the then-Ministry of the Interior during a television show that aimed to reassure its viewers that: “No, no, digital security is not a problem in France”. And once I emptied an ATM cash machine on live TV.

To hack[18], you have to be able to find and execute ways to get around security systems, you must have the necessary information but also know how to question it because, in theory, nothing is ever possible. This involves a complex mental stance between open mindedness and discipline. The conventional learning model which is based on the transmission of “absolutely true” knowledge does not permit the formation of this kind of

18. Hacking is “looking for solutions to get around and overcome the security systems that the material and /or software manufacturers have put in place to guarantee the protection of their products”, journaldunet.fr, “Hacking, simple definition”, 9 January 2019.

profile. To acquire these characteristics, it's necessary to develop a mindset where each claim must be questioned, and to be able to navigate a network of knowledge that is more or less true by seeking to achieve the objectives. This develops an ability to manage complexity, doubt and failure.

The discovery of the infinite powers of the hacking world generated a tremendous motivation to learn; we became more effective than most of the students and many of our professors, and finally we started parallel classes in the evening in order to invite other students to share our passion for programming and computer science.

PROGRAMMING ISN'T JUST FOR GEEKS

Programming is a way to think called "computational thought[19]" and a set of languages and tools for creating computer programs. This mode of thought allows us to better understand and interact with all IT systems. Yet, we are surrounded by automatic systems and this is only the beginning: the

19. Thought process involved in the formulation of problems and the expression of their solutions in such a way that a computer can execute them.

internet of things (IoT) (internet-connected things that allow our physical assets to communicate), virtual reality (or computer-simulated reality) and augmented reality promise us a world in which we will soon be in perpetual interaction with IT systems that will be able to completely control our perception of the environment.

Augmented reality allows us to "control" the environment and contextualize data, meaning to put the data in the right place at the right time according to our desires, needs or even our state of mind, by using a pair of goggles which will soon be replaced by contact lenses. Although a number of examples are linked to vision, augmented reality can "augment" any of our five senses; hearing and touch are currently being enhanced with the development of auditory devices capable of "capturing and amplifying the target conversation of a listener in a noisy environment[20]" and of thought-controlled artificial limbs[21].

20. "An intelligent prosthesis that makes life easier for the deaf", Héloïse Pons, lepoint.fr, 24 February 2018.

21. "Thought-controlled prostheses", Thomas Pfefferlé, invivomagazine.com, 7 avril 2015.

For those who haven't integrated this way of thinking about the world, their environment could quickly seem like a magic place...in the same way that today a scientist can easily pass for a magician in the eyes of people without any scientific knowledge, those who, tomorrow, will master computational thought will have a certain advantage over those who haven't.

It's essential to develop these skills for everyone. That doesn't entail becoming a computer scientist, just as a scientific mindset doesn't involve becoming a scientist, but to acquire a specific mode of thought. It is fundamental to integrate it into our educational processes and to foster it within the active population.

Chapter 2
From the Jar to The Pool, Birth of A New Pedagogy

If my small programming organization received a better welcome from the students than from the administrators of the establishment, it is this complex situation that led me, several months later, to get the job of system administrator at EPITA and to get involved directly. At age 22, I found myself running the school's IT park, surrounded by an informal team that became the Jar.

A COMPLEX AND ULTRA-EFFICIENT COLLECTIVE

The Jar is the embryo of the educational adventure that I've been leading for 25 years.

Imagine a group of young people (five geeks quickly joined by a troupe of others), without any particular qualifications, sitting all day and night behind computers in a glassed-in office (hence the name) and from one day to the next propelled to the head of the school's system, with determination and passion as their only skills. I must acknowledge Mr. Doumoucel, EPITA's founder and then-director of the school, for having taken this risk.

Spontaneously, a self-organized group started developing their technical skills, strategies and abilities in order to manage a large, demanding system and the interactions with a large student population.

The level of this group progressed quickly in terms of technique, organization, and strategy. An ultra-efficient collective was put in place that created solid bonds among students and great mutual aid in all areas, including outside of school.

Concretely, we came together to manage a system that was barely set up: the previous system administrator had left the school a few weeks before the summer vacation. We had to network 200 brand-new SUN workstations of the latest technology, and we had to respond to the daily problems of professors and students while preparing for the arrival of new students, creating administrative forms and organizing the distribution of hundreds of passwords efficiently...Without the help of the Internet and online tutorials, which didn't yet exist. In order to invent an entire system from A to Z, assisted only by the little information that we found here and there in IT manuals and books, we only had

one possibility: brainstorm and develop solutions together.

We were very motivated, and this urgent situation led us to develop a collective way of working and an unprecedented mode of collaboration: co-creation, peer learning, reassessment of knowledge.

LEVERAGED TEAM SPIRIT

The strength of the collective has many characteristics: a group can come up with better solutions than one sole member. But it's also a solid driving force where each person becomes one with a larger whole and gains the power to sublimate himself, similar to animals that work in groups, birds and fish who deal with information collectively in order to move together in the same direction, or like a marathon runner, uplifted by the energy of the group, who scores better than he would during his solo trainings. These complex interactions create a collective intelligence that reinforces cohesion while developing a coherence where each person feels useful, where each person has a place, which reinforces his feeling of belonging and

creates a virtuous circle where each individual makes progress in synergy with the rest of the collective.

At school, the traditional classes continued but the students were more and more interested in activities at the Jar. To such an extent that we decided to put in place regular sessions at night to respond to the huge demand. These actions quickly gained attention and brought great success for the teaching staff who saw that they were bearing fruit. This success led to the next step in my path: the director of the school asked me to establish a C/Unix programming module, at that time it was a new computer language in the open source[22] movement that was very sought after by companies.

BIRTH OF THE FIRST "POOL"

Initially close to a traditional theory class, this program module rapidly transformed amid the phenomenal progress that the students were making during the practical seminars that we organized on the weekend. Very quickly, this model prevailed and the short 2-day seminars became 2 weeks of intensive training, leading to the birth of the first format of the "Pool", which has become mythological in all the establishments that I created. At the time, these "internships" were very organized, similar to what is today known as "Boot Camp" and which is still gaining in popularity, notably in the USA.

I must say that the results of this period surpassed all our hopes: the students were learning and they were up and running a lot faster than if they had followed traditional classes given in fragments all year long. This new success led to a supplementary step in the school's educational progression: starting the next year a complete curriculum in C programming in the Unix environment was designed, the most sophisticated of that time, on this educational model. In practical terms our way of working was completely adapted to the learning of these young people: for certain, the transmission of knowledge was still central (we even wrote a guidebook, "The Little Blue Book"), but it was founded on a project-based system: our students worked to meet the companies' specific needs.

22. Computer method that develops open access software.

We didn't know it at the time, but with 25 years of hindsight, I am convinced that the human capacities and interactions created during these group projects played a very important role in this development, even more than the acquired technical knowledge. This knowledge is the basis of our students' sustainable success.

SURPASSING THE LIMITS WITH MUTUAL AID AND COLLECTIVE WORK

The "Pool" is certainly one of most powerful moments in the training programs that I put in place over the last 25 years. It is introductory, symbolic, and practical for our students and it has also become a screening method for 42.

For the majority of students, the Pool is their first contact with the training method. The Pool takes place over 4 weeks, in the first weeks the new aspirants, who are not yet students, must face a certain number of challenges each day. The numerous challenges seem inaccessible because they are so complex: the participants think they are faced with many more difficulties than they can overcome. Even more so because they don't have any outside help... No professors to needle them, no classes, no examples to follow: they must make their own decisions. Nevertheless, the newcomer isn't alone, there are many like him who have come to try their luck. Close to a thousand candidates participate in each new 4-week session at 42 (there are four sessions per year), which allows us to have a strong collective each time.

Our experiments, rolled out over several years, have shown that the Pools must include a large collective group, around 200 participants, in order to be efficient. Participants must look within this group to find the resources needed to surpass their own limits. Little by little, through mutual aid, informal discussions, mutual advice, but also via confrontations and comparisons, each student must be able to look at himself and find his place and his own way of working with others in order to optimize his time and his results.

ENGAGEMENT TO AVOID SINKING

It's the moment when we reach our personal limits that we learn to accept them and work with them, while being conscious of our own differences and those of others. This personal work leads us to accept that we must depend on others as far as they depend on themselves, which, paradoxically, leads to a strong collective autonomy. It's obvious to me that by learning to identify our limits and to interact with others in a sufficiently large and welcoming collective environment, we free ourselves from our own technical and psychological limits. We end up integrating the confidence and the strength of the collective, we feel capable of sharing, which is comforting, reassuring and very structuring. This autonomy is much more real than that of the individual, limited to the self and built in differentiation to others.

Our era is rediscovering and applying the ideas of "altruism", "solidarity" and "cooperation". Pablo Servigne and Gauthier Chapelle[23] did a study of this that I highly recommend reading.

23. "Mutual aid, the other law of the jungle", Les liens qui libèrent Editions, October 2017.

Joining these collectives, then joining larger collectives to form an abstract global collective, creates a very strong sense of belonging to something larger than ourselves. This feeling brings with it a form of engagement that is unfortunately not experienced very often but that is found in any sports team or associative mission. Such an engagement allows us to surpass our limits in service to the collective when often we would have given up because of weakness or lack of meaning. Membership alone makes giving up practically impossible. Finally, group members are able to focus their attention in a common direction which leads to profound cognitive change, an otherwise difficult or even impossible task for many.

In only four weeks, most participants acquire the basics of programming; this usually takes two years in the traditional schools. But in reality, they assimilate much more knowledge. Because of the Pool, their perception of themselves, their limits and their relationship with others profoundly changes. For many, this is the revolution that will allow them to take charge of their future.

IS THE GROUP A BENEVOLENT ENTITY?

Although it's not commonly recognized, people are naturally good. Mutual aid is an omnipresent fact in the living world and the most cooperative groups are those who succeed best and develop more resilience to abuse, even if it only takes a few bad individuals, in a disconnected group, to create a harmful and negative environment.

Three things allow groups to bond and to feel a profound attachment to collective interest: 1) the feeling of security that depends on setting good ground rules and a strong identity, 2) the feeling of equality that erases the harmful effects of a feeling of injustice (anger, antisocial behavior, etc.) and, 3) the feeling of confidence that comes from the two preceding feelings and that allows each member to give the best of himself for the good of the group[24].

With the establishment of the Pool, the school began the rule of distributed and caring management, which corporations advocate more and more. This rule is simple: show everyone how they can benefit from

24. Pablo Servigne and Gauthier Chapelle, *ibid.*

kindness and the cohesion of the group, and in this way, develop their resilience. To consider others not as adversaries but as allies, to listen to them and their opinions, to reassess and accept their own failures—all these things will allow us to work better, in an environment of responsibility and confidence.

The example of a student who cheats is very interesting here. In an ordinary school, the students feel that the cheaters put them in danger: the cheaters get the best grades and they are celebrated by their professors and their parents. All that without any effort. Sometimes it takes years before the cheater is revealed and his schoolmates understand that cheating is useless, but this generally happens too late. In the Pool, there is no room for cheating; students are asked to think together, find solutions by themselves and develop relationship skills. A student who doesn't play the game is at fault: if he contributes nothing to the group's progress, his classmates will understand that very quickly. And he only has two options, stay and adapt to the group by playing the game or quit and form another group with those who are in the same situation, which obliges him to stop cheating or to fail.

Alicia, Age 27, Pool 42,
SEPTEMBER 2016

After a university degree in commercialization techniques, I discovered computer science a bit by accident and I wanted to try to study it at 42; I had heard about 42 in business and also in my entourage. I vaguely understood that it was a "school" that brought together people who were able to learn in total autonomy and who were interested in entrepreneurship. No professors, peer-to-peer learning, group projects, personal development, work and motivation: that intrigued me. To be free and autonomous, without any scheduling constraints, was particularly tempting.

First, I took timed tests online (memory, algorithms, etc.) then I was accepted to the next challenge, the Pool. I chose to do it in September in order to spend the month of August with my 6-year-old daughter: I knew that a full month of work awaited me, day and night. We had our floor mats left and right and showers were made available to us as well as everything we needed for our meals. What a strange test...

Each day, we had to do a series of exercises that were due at precisely 11:42pm and corrected in the shredder: if the programs and IT instructions that we were transforming into results weren't approved, everything failed. The least error could destroy an entire day's work. What stress...but what a motivator, too! I often spent more than ten hours a day on my exercises.

There were about 900 of us in this Pool but some quit very quickly, telling themselves that they couldn't stand the pressure. I found it incredibly motivating. In a few days, we met each other, helped each other to progress, to advance together. It was more than a personal experience that made me face my limits and my abilities, it was also a rare social experiment. In the Pool, I understood that there are those who sink, those who paddle, and those who swim. I had never programmed before passing this test, I was part of those who paddle but who never give up.

I have incredible memories of the work environment, everyone that I spent an entire month with supported by a team that was there day and night and willing to answer our questions, meet our needs, or deal with a problem.

I want to add that as a woman, I never felt any aggression or malice from the male students. I had some trouble during the four weeks and familiarizing myself with the IT language wasn't easy, but what marked me more than anything was being faced with myself: morally, this experience required immense strength of character and a profound personal reassessment. I learned that I needed this adaptability and it is necessary in computer science: that's what the Pool is for. We say it's like a sprint and 42 is a marathon.

At the end of September, I waited for the results with a lot of stress. I was exhausted both physically and morally and overall relieved to not be under a lot of stress, but I missed the incredible people I had bonded with.

I also missed the energy that was released by all of this work. I felt empty.

I was proud to have completed this chapter and this experience was one of the most beautiful of my life, but I was very afraid that it would stop... A week later, I learned that I had been accepted to attend 42!

Chapter 3
Putting Project-Based and Autonomous Learning at The Heart of The System

One year after establishing the system at EPITA, we got a lot of positive feedback about the level of our students from corporations and many start-ups that were having a hard time finding the operational skills that they needed. Then, a surprising situation occurred: there was no longer any correlation between our students' educational level and their performance in business. We found a total inversion: the better the student was in strictly academic terms, the less attractive he was to corporations. This was surprising to say the least.

FIRST PROJECT-BASED COLLABORATIONS

The operational level of our students quickly progressed thanks to the geek squad who had transformed into a real university pedagogy at the heart of the curriculum, and we could begin to introduce some projects within the school and very early in the curriculum this brought us to many collaborations with corporations, essentially in the areas of technique and systems. This way of working was well known in the US but hadn't yet been developed in France. However, there was al-

ready a strong demand for system administrators.

The most striking example was a collaboration with a large chain of grocery stores who asked us to come up with a project to optimize their cash registers. To optimize the network and shorten the waiting time in line, we had to develop a project that necessitated math skills. We were taking a big risk: we realized that our students were particularly deficient in math—the grade average of around 200 students didn't get above 10%. Nevertheless, and even though I was convinced we were courting disaster, we had to accept the project. Inevitably, we would be ashamed of the results: our students had trouble calculating a geometric average, how could they use the stochastic calculus necessary for this mission? It was simply unimaginable.

Against all expectations, the majority of the groups working on this project got very good results (for certain better than what we were able to do ourselves!).

To understand what was happening, we re-tested the math level of our students by giving them a traditional math table.

The result was a class average of 65%. In only four months, our students had passed from an average of 10% to 65% without any math classes, nor external help and with this project as the sole means of support. It was incredible.

Even more surprising, the order of the class's grades was completely inversed: the grades of students who were usually the best were not the highest whereas others, known for being "bad students", had obtained the best projects and often the best grades...

WHAT IF STUDENTS DON'T NEED THEORY CLASSES?

This situation sparked many discussions within the educational team, a lot of reticence too, even animosity. Everyone came up with a different explanation. Nevertheless, we decided to do the same experiment the next year but this time dividing the class into two groups: Group A would follow the usual classes then would work on the project, Group B would start directly on the

project without taking the lectures. The two groups would be evaluated via the project and a traditional test.

As we expected, Group A got around 10% on the preliminary exam, then good results on the project, and around 65% on the post-project exam. However, the surprise came from Group B: the students who hadn't taken any classes got much better grades (on the project as well as the post-project exam) than their classmates from Group A.

This was the beginning of a profound reassessment. In this situation, it seemed obvious that the classes were not only not useful but they were absolutely counterproductive: students who took the classes before doing the project didn't see the need for them because they couldn't conceptualize what theory can bring to practice—that they hadn't yet tested. This was very disturbing and many professors immediately refused this idea. Certain professors even started to doubt our ethics and our transparency: they suspected us of giving more help to the students who were doing the project than the students who weren't doing it.

As a matter of fact, we supervised the students on the projects, but we only got involved in matters of technique or programming, never math. Anyway, if that had been the case, how would we explain the students' progress on the final exam?

The next year, we decided to get rid of project supervision for the most advanced programming students, the results were similar. We were forced to face the fact that we had to review our methods in order to more efficiently develop our students' skills.

Our "investigation" resulted in two strong findings: our most academically brilliant students were not the most successful, and the project method seemed to give very interesting scores, we started introducing more and more projects in the curriculum and in more subjects.

This transformation was not easy, unfortunately. It took a lot of time and energy, because many professors were violently opposed to it and they did everything they could to stop it, perhaps out of fear of being removed from an important role. Nevertheless, the business results and the students' enthusiasm sparked these changes. Because,

beyond its efficiency, this method generates a profound investment in the students that makes them passionate.

Hence, in only a few years, EPITA gained a lot of notoriety in the IT world, notably in the start-ups that were on the rise in the early 1990s. EPITA's graduates were recognized for their technical capacities but above all for their ingenuity.

EPITECH IS A SCHOOL WITHOUT ACADEMIC RESTRICTIONS

At this point in our development, Ionis (the leading group of private institutions of higher learning in France) became interested in our project. EPITA, foreseen as a possible leader, was bought by Ionis with the intention of starting their computer engineering school. Their reputation was solid, both on the corporate and student level, but this establishment didn't offer an engineering degree at the end of the training.

For the group's strategy, and for the primary purpose of evaluation, it was necessary to obtain the engineering degree delivered by the Commission of Engineering Degrees (known by its French acronym CTI), an administrative authority at the Ministry of Higher Learning and Research. In order to conform to the standards of "accredited" engineering schools, we had to return to the conventional teaching methods and give our students failing grades, it was no longer possible to leave the system or to innovate. Which meant we had to give up the very thing that had made our method so successful, otherwise we'd risk having to kick out our "best" students, those who were the most successful in business.

In parallel to my involvement with this structure, some friends and I developed an IT security start-up and I was about to abandon the training program when an interesting perspective opened up in this area: the creation of a new structure in the group, that would continue to train those who couldn't or wouldn't be forced into the mold at EPITA.

EPITECH, this new institution, would be a way for the group to recruit weaker students to integrate them into a training program that was not as theory-based. For most

of the decision-makers at the head of this group, it was obvious that the results of this inferior institution could only be worse. Convinced of the contrary, I decided to take that challenge and to invest myself completely in this new project.

The Graduate School of Computer Science and New Technologies (known by its French acronym EPITECH[25] was the result of a split between two opposing visions of education, even of work itself. Before this separation, the two tendencies cohabited within one institution, not always peacefully, but they fed each other. With the creation of EPITECH, each school confirmed its choice: a return to norms for EPITA, which had retained as much practice as possible within the academic constraints imposed by the CTI, and a deeply practical orientation at EPITECH, where the teaching was project-based, from math to writing.

25. EPITECH changed its name and is now called The Graduate School of Computer Science and New Technologies.

DEVELOPING SKILLS RATHER THAN STORING KNOWLEDGE

In fifteen years, we developed a project-based curriculum that allowed EPITECH to become one of the leading IT training programs in France, with the most students, a great reputation and professional connections, far surpassing EPITA.

With the creation of this school, two changes were immediately put in place: we opened it to recent high school graduates and we started training them in IT from the first year. As a matter of fact, whereas EPITA recruited students after their preparatory classes and only provided a tiny part of IT education, I decided to start a 4-week "Pool" for C programming (twice what we offered at EPITA and similar to the one we put in place at 42) in order to make our students autonomous and active right away.

Because we wished to apply our principle of project-based learning to the rest of the training program, we completely rethought the system of subject-based curricula: rather than divide the learning by

themes, we grouped it by projects. The student was evaluated in the group and only on the project. We no longer tried to validate knowledge—we wanted students to be able to use it in a concrete collective project. In business, they would have all possible solutions at their disposal (Internet, reference books, etc.) to obtain the knowledge when they needed it.

What good is it to store knowledge or memorize books and manuals in the Internet era, when all the information is available in an immense data bank that is accessible 24/7 on our smartphones? Even more so in computer science where knowledge evolves at an exceptional speed, fast becoming obsolete.

Furthermore, our way of working would be considered "cheating" in a conventional curriculum: our students work together and assist each other to provide the information to help the group advance in its research. We kept a part of the individual evaluation confined to the confirmation of the basics, allowing each student to have the minimal skills in order to be able to participate in the projects which are 95% of the curriculum.

ELECTIVES AND GROUP SELF-REGULATION

Another radical change: no one has to go to class. I won't hide the fact that this new idea—a revolution, should I say? —was met with strong resistance from the professorial body. For me, it's absolutely essential. Indeed, taking away the obligation of going to class leads to questions about the interest of classes in general: why take this class? What will it provide for our students? If no one takes a given class, it's simply because the professor didn't know how to get his students interested in it or the students didn't see the concrete value added in the training.

Surely we can question a student's ability to choose if he takes a class or not. And that's the whole interest of this choice. By making the student responsible and active, by trusting him, we make him autonomous and active in his success—or complicit in his failure. If he makes—alone—a bad choice, he will quickly realize it because he won't be able to do his projects nor contribute to the group. Some will object that because there's a collective grade, this nonchalant student could hide behind his classmates, but believe me, it's a lot harder to fool his friends than a

professor... The other students won't compensate for the laziness of a friend for very long. The students call them "slackers" that the group drags with them. No one wants to work with "slackers", which leads to the formation of entire groups of "slackers" who reveal themselves to be efficient and able to equally share the work. This process is in itself a source of profound change for everyone involved.

Mickaël Camus,
ALUMNI OF EPITECH'S FIRST YEAR

I was part of the first class at EPITECH, arriving in 2002 as a third-year student. The school was totally new, but it already had a good reputation thanks to its big sister EPITA, and I knew I was joining an environment of people who were passionate about computer programming.

Everyone was very excited at the idea of starting the curriculum. We couldn't wait to learn to learn. That was what it was all about at EPITECH: learn to be autonomous within a team, learn to understand, analyze and conceive ideas without restraining ourselves to dogma.

In thinking about it today, I see that the objective was to teach us how to think, to structure ourselves, to speak about our ideas, to debate and convince others and manage our relationships with them. All of this is useful to bring a project to fruition, no matter the nature of the project.

The non-consensual way the school got us to integrate these concepts was the most striking. A project-oriented, teamwork-based curriculum, with a common goal: take

responsibility to accomplish the projects. These projects were evaluated by EPITA's senior students, professors or also by professionals.

I thought this concept was very interesting, we felt the passion everywhere in the engine rooms of the school. That's why we spent many nights working in pairs to accomplish our projects. If someone had a problem, there was always someone to help and explain it. Everyone was there for the same reason: learn to become better, live out their passions and transmit them.

I became an "Astech", similar to an "ACU" at EPITA, an assistant who helped students who needed it during the "Pool" period and all year long. Then, because I got good grades, I became a "sponsor", coaching students who were having a hard time. The goal was always the same: never leave anyone behind. The school encouraged these kinds of initiatives but it was very important that they came from the students themselves.

Chapter 4
A New Acquisition of Knowledge Accessible to All

In engineering schools and in most other schools, the traditional organization of the schedule asks professors to provide all of the courses and subjects that a project needs before beginning the project itself. The project is considered an application of the theory explained in class, a way to confirm comprehension and better memorize the information.

THEORY MUST COME FROM PRACTICE AND NOT THE REVERSE

We quickly saw that the opposite was true and we chose to start classes once the project was already well underway, near the middle of the process. Students who took the classes before doing the project didn't see the need for them because they couldn't conceptualize what theory can bring to practice—that they hadn't yet tested. Some of them, unable to memorize everything, might lose all curiosity for the course if it doesn't have a concrete meaning. We attribute many failures to the students' ability when often

it's a problem with attention and interest. Once the project is underway, the students who need theory in order to progress in their practice will be in demand, therefore more receptive, even proactive. In this way, the class will be easily assimilated and anchored in a practice that is meaningful.

With experience and technological improvements, we offered all of the classes in the form of short videos available at any moment on the school's IT network. We realized that these online videos were looked at randomly several times during the project. We were ahead of the appearance of MOOCs (Massive Open Online Courses), online training programs that feature short videos and are validated by quizzes, very widely used today; at the time, we were already transmitting knowledge in new ways, more accessible and less fixed.

Lastly, we introduced some post-project classes in order to provide summaries, analyze the obtained objectives and the problems encountered, and to confront the ideas of different groups. These breaks allowed for very vivid exchanges where the professors learned as much as their students, because

certain focused projects permitted the confrontation of ideas and difficulties that were beneficial to all.

PEER EVALUATION: AN EFFICIENT DRIVING FORCE

Centering learning on concrete projects offers a considerable advantage in terms of objectivity: it works or it doesn't. Surely, it's not that simple, because some notions of quality, tidiness, or maintenance of outcomes can be put forward. But these objections are only fake problems because these needs can always be integrated into the project initially.

We understood that right away and we broke up the projects into several steps, each one realized by a different group of students. Each time a group finished and validated a step of the project, they sent their work to a new team. For sure, the teams in question were never placed in the same step in the process from one project to another; we circled around so that the groups would be successively in first, second, or third place. In gen-

eral, when the new team would get the work, they would complain about the "bad" results that their classmates had gotten... and generally this team would be faced with the same complaints from the next group. By repeating this process, the students quickly understood the necessity of standardizing quality, much more quickly than if they had learned these standards blindly. Thanks to this evolutionary process, not only do the students learn the necessity of these standards, but they don't hate them: a student who doesn't understand the real value of these standards will be convinced that "these horrible standards are a waste of time", but if he finds out by himself that he needs them, he no longer feels this way.

The same is true for robustness or software maintainability. Surely, they require time and reflection at the time of drafting the subjects, but it's always much better if a student finds a solution himself, especially when the solution is only "temporary", or even the result of fashion or dogma, as is the case in our trade.

As seen previously, this re-centering on practice puts things right: theory comes

from practice and not the reverse. In this context, students are faced with the limits of their teachers. As a matter of fact, in IT, their theoretic knowledge collides with reality. By switching theory and implementation, many professors can no longer keep up with the concrete expectations of students who, often, surpass them. Rightly when you have established videos together... it becomes harder and harder to find a role for these teachers.

At EPITECH, we created groups of students called "assistants" that ensured the most important part of the educational interactions with other students. These groups, named "Astek", "Koala", and "Asstexte", replaced the ACUs (C/Unix Assistants) that were put in place at EPITA, first within the Jar then outside of it.

These groups assisted the students and evaluated their progress under the supervision of a referring professor (essentially there for administrative reasons). The current model is based on the idea that a training program's quality comes directly from the students' exposure to professors with the highest diplomas. The result of this system is

a race for highly educated professors who, in general, aren't the most interested or implicated in teaching. Consequently, this weakens the students' interest by drowning them in a mass of knowledge that they can't see the value of, which is often just to fill out a CV to send to a certifier rather than to a corporation.

DATA IN SERVICE TO THE COMMUNITY

We established an Intranet platform to organize this complex operation so that we could manage numerous interactions between students, assistants, professors, corporations, and the administration. The platform tracked the progress of each person while collecting all of the data relative to their schooling. Without it, EPITECH would be totally unable to function. This essential platform allowed the students to form groups, to find the content they needed, to choose the classes they were looking for and enroll, to follow their progress and to find help or a corporation. It was also a formidable source of data allowing us to analyze the curriculum of each person and to optimize the contents,

path, and rhythms which had the most efficiency and impact on the beneficial changes of our students.

All of the educational data (grades, curriculum, names of grade checkers, number of interventions on a project, etc.) gave us a sharp view of each individual but especially it gave us a vision of the collective. The analysis of the correlations among different individuals within a group allows us to make clearer and less personal educational decisions. It's not about dogmatic theories or an idyllic representation of human beings, but rather a strictly scientific report in service to the community and its performance.

Beyond developing the technical abilities of our students, we realized that this system made them a lot more innovative and better able to understand the emergent needs of corporations and start-ups. Therefore, I decided to reorient EPITECH: from IT expertise, we concentrated on innovation and expertise to finally arrive at digital innovation, "the future of IT and the best of innovation", was the promise of the school's slogan. In this way, the activities were centered around innovation with the creation

of “EPITECH innovation projects”, collective masterworks like those realized by the partners, actualizing the passage from student to accomplished professional.

Many of these masterworks led to the creation of several hundred companies, similar to Docker, an open source software platform that creates, deploys, and manages the containers of virtual applications on an operating system (that today is worth more than a billion euros), or of Melty, a generalized news media platform for 18-34-year-olds that attracts more than one hundred million visitors each month. Nearly 20% of EPITECH students participate in the creation of a business—the average in engineering schools is less than 1% and that of business schools is barely 8%.

DIVERSITY AT THE HEART OF EPITECH

My intuition was also that this model of creative development, though embryonic, thrived on diversity. The experience of the other, otherness sustained in a benevolent environment and carried by mutual aid, led by common objectives (projects) and the values and shared finalities (common progress by technology) brings out creativity and the best of each person in service to the community. These meetings are much stronger when the other is different.

With this in mind, I established a network of international partnerships (thirty at the time of my departure, in 2013) allowing students to spend a year abroad in an active common program. We set up the first Franco-Chinese program, where students from the two nationalities shared the same classes, the same projects, and especially, the same dorms. Living together is essential because that’s what leads to a real cultural confrontation. Obtaining that was very long and difficult; the administration was strongly opposed, often from fear of difference although difference is the source of the questioning that sparks the changes we were looking for. What good is studying in China, or elsewhere, if not to learn how to live with the Chinese? Staying near them without ever mixing isn’t very interesting. But, most international exchanges are like this. For ease, we avoid anything that would generate confrontation although that’s where progress

lies. When everything is smooth, and all is well, we don't learn much. Each culture has its customs, its failings, its unsaid things, its own vision of the world: confronting them allows us to liberate ourselves from our own cultural determinism and therefore open our spirits, sharpen our curiosity and be more creative together.

When this network was up and running and its offering was sufficiently diverse economically and geographically, I required students to do a year abroad. It seemed essential to building a strong character. This system has proven to be efficient for fifteen years and it allowed us to train several thousand young IT talents who are much more adapted to the needs of businesses. It also helped us bolster EPITECH's strong reputation, considered the best computer science school in France before the arrival of 42.

Robert, Age 21, Student at 1337,
AN ANNEX OF 42 IN KOURIGBA, MOROCCO

I have been passionate about computer science and new technologies since I was a child but I unfortunately (or fortunately?) had a hard time with the education system in my country, Cameroon, and the high cost of the training programs in this area slowed down my ambitions.

However, it was precisely these difficulties that allowed me to explore other ways to learn computer science. I started teaching myself, in 9th grade, then in 2016, thanks to a YouTube documentary "Ecole 42, Born to Code", I decided to join 42 in Paris. After dedicating nearly 2 years to this objective, my French visa was refused twice.

At the end of 2018 I learned about the creation of 1337 in Morocco; this time

I didn't have to put my destiny in diplomats' hands. After unsuccessfully applying for a visa, I took off. On foot.

After a month of travel, I arrived at the school, I participated in the Pool, and I was selected. Since then, my experience at 1337 has been simply extraordinary. I must admit that the first week in the pool disoriented me a bit: I had to recuperate from my trip and integrate myself into this new environment where there weren't many of us who spoke French.

My other challenges were to getting used to the rules of the game of 42's itinerary, managing my time, and adapting to self-training, corrections, 42's standards. Like many others I failed the first test because of misunderstood instructions.

But I found my feet pretty quickly, thanks to the cohesion between the students. Thanks to the ambiance, too: it's a fun school!

As we were dealing with the same difficulties and we were pursuing the same objective, a very strong bond was created among the "pool people" in spite of the language barrier and the great diversity of

students. We had fun, we fought, we worked hard and we got better each day. We became like family.

Since I became a student, the atmosphere at school has been similar to that of the the Pool, it's even better because now no one worries about getting kicked out of school. We all play the game at 42: pleasure and work punctuate our days. The school organizes many events that inspire me; each time I tell myself: "Wake up and do it!". The school even gives us transportation when meetings happen outside of town. It's so stimulating!

Thanks to one of these events, I got a job offer, and another via LinkedIn, but I prefer to finish my curriculum first, I still have three years of training to really be the best. One of the things I appreciate the most at school is discovering the beauty and originality of each student. This school is full of positive energy that emerges from the students and creates a little paradise.

WHEN SOLIDARY COACHING BECOMES AN ACADEMIC MODULE

Before getting to 42, I propose a short detour to the Web@cademy, an opportunity for students from underserved communities and dropouts from the conventional school system.

In 2010, François Benthanane offered us a partnership, as he had done with many other top training programs. He was the head of Zup de Co, a foundation that aimed to help youth from underserved communities to avoid dropping out in 9th grade, a time when many students drop out. The foundation had a beautiful slogan: "Let's erase inequality". In this spirit, François Benthanane was looking for volunteer students to talk to young middle schoolers in underserved communities in order to give them advice and possibilities for success. These discussions greatly reduced the dropout rate of youth who participated in them regularly[26].

26. For more information visit the association's website zupdeco.org.

We supported this initiative, without much conviction about the results, I must say. We organized a conference where the president of Zup de Co came to explain his program to convince our students to volunteer in these discussions. Around twenty students got involved with this volunteer opportunity and invested themselves actively and regularly.

For practical and logistical reasons linked to the organization of this activity in itself and to the tracking of the students involved, we added this initiative to our Intranet (the software that allowed us to organize the school's activities, a kind of educational ERP[27]). That's what allowed us to realize that our volunteer students were outperforming the other students and that this activity sparked a real change. It was highly beneficial. I immediately decided to encourage it in our program with the establishment of a "solidary coaching" module that we had recognized by the dean as part of the teaching. From that time on, this module became a true educational action and no longer an act

27. Enterprise Resource Planning

of charity. Picked up in numerous schools, each year it attracts many candidates.

I use this example to underline the benefit of collecting anonymous data on the progress of all of our students, even if we don't know what it will be useful for. In a conventional system, with students distributed over several years in different modules, it would have been impossible for us to do this type of observation. Because they only had a few students participating in this project, each professor would not have been able to observe its benefit. With our system of internal data, we were able to utilize the data without basing ourselves on preconceived ideas and to enlarge our principle of project-based educational tutoring.

Once put in place, our mechanism of solidary coaching was presented at the "Cordées de la réussite" initiative at ESSEC that year, a system put together in partnership with the politicians of the city and that aims to remove the psychological, social and cultural barriers that slow the educational ambitions of young high school and middle school students from poorer backgrounds.

It's worth noting that these national days are a failure overall; in spite of many initiatives, France is the second to last OECD country in terms of social mobility and our education system is without a doubt the reason for it[28]. More than 120,000 youth drop out each year without any opportunities or even a future; the underserved neighborhoods are at the forefront, not because the youth there are less gifted but because the system wasn't made for them.

This colloquium presented different mechanisms established to reduce inequality at school. The discussions were about the causes: it came from the parents or, to be more politically correct, from the environment; youth from difficult neighborhoods didn't have access to cultural life (the last suburban plan considered putting theaters and operas there). I supported the thesis that school was probably not doing a very good job: in one hundred years, it had hardly changed its codes and learning when the reality of young people was fundamentally different, especially in difficult neighborhoods.

28. "Social Mobility: France is in the bottom half of OECD", expansion, lexpress.fr, 15 June 2018.

Even if my words didn't seem to do much, the improbable challenge to change these young dropouts into qualified and employable adults was launched: to face it, we created the Web@cademy.

WEB@CADEMY IS A TRAINING PROGRAM THAT ACCEPTS EVERYONE

First step, first difficulty: convincing them. How to get them to accept youth from difficult neighborhoods, without a diploma, on the campus of a private group with selective entry criteria? I just about heard it all: "They're going to steal everything, break everything, make the other students run away and steal from them; not to mention the drug problems...". Once they got over these fears, the possibility of success was a problem, because no one—absolutely no one—thought it was possible to train these "wild ones" who didn't even have their high school diploma.

As a matter of fact, at the beginning EPITECH had chosen to allow some students without a high school diploma to enter, but

they were always students from the science sector and mostly from "good families". The idea was quickly abandoned. So, it was contrary to the culture and beliefs of the group to imagine that we could train these young people without this background. Even more surprising: we had to convince the youth themselves. As a matter of fact, for the large majority of them, it was impossible to access this type of training and trade. After fifteen years in the French education system, they had been convinced of their intrinsic "stupidity"; they no longer had any confidence in themselves, and they had no confidence in the word of adults nor in education.

However, after much determination and effort, we opened this new training program to youth from underserved neighborhoods in order to lead them to the jobs in high demand. For two years, before graduating the first students and seeing them obtain the expected results, we had to give them daily coaching. We had to give them confidence in themselves again, so that they dared to take the risk to stay in the program and work very hard without being assured of an outcome. For some, they had already been promised

many training programs that would lead to a career and a job, many times nothing happened... Why should it work this time? We organized weekly meetings to support the youth who thought it was impossible for them to succeed or really become web developers. Twelve months of training followed by a one-year rotation to change their future.

We changed and adapted our methods, the Pool was Web-oriented but it was developed on the same principles. This essential time, beyond the fast acquisition of knowledge, is a moment to build the collective and dialogue. A way to bond with others and to get stronger not in individualism but in otherness. Diversity gives each person a part of the joint construction: an important step for these young people who are losing their individual and collective confidence. A mechanism that allows each person to surpass his imaginary limits by and for the collective. Once this confidence is restored, it's only necessary to provide an environment that is good, secure, and full of challenges: a project-based curriculum shouldered by our Intranet and supervised by student assistants. The same things that made EPITECH such a success.

A success that owes a lot to the constant perseverance shown internally and administratively. Before we can know the real benefit of a training program, we must wait for the end of the process. For the Web@cademy, we needed two long years to do the observation. Two years of disparagement, doubts and discouragement. (Here I want to thank the direction of Ionis Group who supported us all along this project.) I was used to this with EPITECH as it had long been considered a lesser training program because we didn't follow the standard path or because the students didn't learn math by heart as in the prep classes... But this time, it was worse: it was hard for many people to accept that "good for nothings" could do quality work.

Again, I heard and experienced incredible things. For example, many of the students came from far away and they had gotten travel passes paid for by their local mission. One day, several of them hadn't received the pass, without explanation and in a random and visibly arbitrary way. I made many phone calls to different organizations, offices and services: no one was able to tell me who made

this decision and even less about why it was established.

I was told several times, “in any case, there’s no point, as long as they stay home...” After four months of trying to solve this problem, we got a meeting with regional members and leaders of local missions to try to find a way to secure our students. Nearly half of the actors in the region signed up but did not attend the meeting and it was a total fiasco—everyone was settling scores and yelling louder than the next person like in a boxing ring. Happily, we found an agreement with the RATP transportation network.

Finally, and in spite of all the setbacks along the way, we saw our first students graduate and we launched a second class. 100% of the youth found good jobs in web development, and some of them even started companies. Once free from the grip of the conventional syllabus, the classes and teachers, the young students became autonomous and actors in their own success. Web@cademy showed them that it wasn’t necessary to have academic knowledge nor come from a “good neighborhood” to succeed, but to be passionate, perseverant, have talent and the

ability to co-create. This success made us push the limits of our trainings and to further develop this model by creating an even more innovative school, which the press called a “UFO school”: 42.

Fara, Age 27,
WEB@CADEMY ALUMNUS, 2016-2018

After the traditional educational route, I received my Bachelor of Science degree as an external candidate so I could work and pay my rent. I wanted to study bioinformatics, but in those years when all the millennials were starting university, the spots were expensive; I wasn't able to sign up despite two years of PACES[29]...

As I was interested in IT science, I decided to try the Pool at 42, which I joined in August 2016. But without success: I felt lost in this anthill of students. So I went to the Web@cademy; with only twenty students per class, it seemed a lot more accessible.

I have great memories of this experience. The students work together, take time to support and help each other, in a welcoming and familial atmosphere.

Those who didn't play the game, preferring to work alone, left voluntarily.

When I left I was fulfilled by those two years and I was convinced of something important: the power of the group allows each person to unfold and to give the best of himself.

Today, I have a professional training contract at ETNA[30], another Ionis school, and my employer is ready to hire me. Before going straight into professional life, I'm going to finish my studies and try another new school.

29. PACES is a preparatory year of study for students who want to join the medical fields.

30. School of Advanced Digital Technologies, known by its French acronym ETNA.

PART 3
NEW TECHNOLOGIES ARE RESHUFFLING THE CARDS OF PERFORMANCE

The birth of 42 came from the correlation of several factors: talent, funding and experience.

A young woman, who had been part of the first year at the Web@cademy, had joined Xavier Niels' team. For a long time, Niels had been employing many alumni from EPITA and EPITECH in his technology companies. This young woman was quickly noticed for her technical abilities and creativity and she was identified as an exceptional and atypical talent. She met Xavier Niels who wanted to know about her career, curious to discover what she had been doing before joining his team. He was very surprised when she said that two years earlier she had been selling hamsters in a pet store. He, like most of the great French executives, thought you could only be good at IT if you had math or scientific training. How could this young woman, a high school dropout from an underserved neighborhood, be among the best talents of one of the most cutting-edge high-tech companies?

Following this meeting, Xavier himself contacted me to learn more about this "miracle". How was it possible? Were there others?

I explained what we had devised, how we trained a hundred of these "miracles" per year but that was the maximum that Zup de Co could fund. Shocked but already convinced, Xavier immediately told me that businesses needed thousands of talents like these young people. If it was only a question of funding and if I was ready to get completely involved in this project, he was able to fund the training of ten thousand youth in ten years. That's how 42 was born.

Then, everything went very fast. I trained a team made up of EPITECH alumni and we created, from scratch, in less than six months, the largest IT school ever opened in France. From the beginning, it could welcome a thousand students per year. Five months later, we received a thousand students for the first Pool. This period was incredibly intense.

Chapter 1
Knowledge Acquisition Is for Machines

I decided to leave EPITECH for 42 because this school gave more people a chance, but also because it offered me greater freedom in pedagogy and action. The contract was clear: train the best computer scientists with no restrictions. How could I refuse?

I was allowed to rethink everything and to explore the long-term intuitions that I had put in action at EPITECH but that various obligations (recognition of a diploma, group culture, etc.) didn't allow me to explore completely.

Today, 42 is considered one of the best coding schools in the world. A school without professors, without a curriculum, accessible to all and without restrictions. This mod-

el, where creativity emerges from diversity, trains a thousand young students each year. Three thousand youth were trained with this model and they all found jobs. Nearly 30% of them started their own business.

LEARNING IS USELESS AND IT MAKES YOU STUPID

I had strong intuitions gained from my experience with training 15,000 young talents over twenty-five years, and I was lucky to have complete freedom to establish the educational and structural strategies at 42. Above all, I was convinced that value added comes more from innovation and creativity than technical mastery. When the students arrive, I often tell them that "learning is useless, it's dangerous and it makes you stupid...". It's not provocation or demagoguery, it's what I think and I've collected the proof over the years.

As a matter of fact, knowledge, in our skill area in particular but also in a multitude of other fields, is easily achievable thanks to

very efficient tools that allow us to get valid, pertinent and quality information: why keep spending a lot of time forcing our brains to store it when it isn't very effective? It's worrying that the majority of our training programs focus on this point; how many students spend their time repeating information over and over in order to memorize it when Internet access does the same thing, better and more quickly?

Automated processes for accessing information (what Google does, for example) have only just begun. Day after day, a lot of rapid progress is made on two essential themes: the quality of information made available to people on the Internet and the ability to correlate this information to the question asked. Thanks to the progress of AI, information management tools are able to get answers that are more and more targeted to more and more complex questions. In the near future, any computer will certainly be able to do a lot better than a human being in this regard.

Furthermore, today we access this information via a computer or a smartphone (basically the same thing), yet specialists are quickly advancing with neuronal interfaces:

it's already possible to read thoughts and analyze them (only partially for now and only conscious thoughts). We also know how to inject information to make a blind person see and a deaf person hear... We even made a prosthetic hand that allowed the person to touch, move and feel objects.

Very soon we'll know how to understand a question directly in a brain and respond to it in the same brain. Recently a team of American researchers devised artificial intelligence able to convert the brain's electrical signal into speech via implanted electrodes, yet the person didn't make any effort to think... These technologies are very new but they mobilize a lot of energy and are making immense and rapid progress. It's not science fiction, it's our very near future.

CONVEYING EXPERIENCE IS A NEW CHALLENGE FOR RESEARCHERS

In the mid-term, all this implies that anyone connected to the Internet will have access to all knowledge. There's a strong bet that our children's children will not know

the difference between their own personal knowledge and global knowledge, and accessing it would seem obvious to them. Young people are already there: they talk to each other all the time with their phones in their hands to look up information and validate it; the phone is an extension of their cognitive system.

But the most important change that this type of technology will bring is in the nature of the transmitted knowledge. Today we can only transmit abstract information that is formalized in language, but soon we will be able to convey experience, too. Soon, when you're looking for a recipe, you will not only have access to a list of ingredients and different steps to make a meal, but you'll have the same experience as the great chefs in a kind of synthesis (similar to the main character of the Matrix who learns kung fu in this 1999 science fiction film that marked an entire generation). You will feel the structure of memory, the fruit of collective experience, rather than have abstract knowledge of a principle or method.

Researchers already know how to do this on simple animals with brains that are

easier to explore than ours. By stimulating very precise zones in their brains, they can generate images[31], manipulate their memory and implant "fake memories" and false sensations linked to the memory[32]. We already know how to interact with the human brain by using prostheses directly connected to the brain that are able to "transmit rediscovered sensations[33]".

In such a context, let's admit that it doesn't really make sense to consecrate so much time and attention to learning ...

Otherwise, particularly in our field, but more and more in all the others, information quickly becomes obsolete, even if few people realize how the evolution of IT knowledge is different. In science, researchers study nature outside of us, which implies that when they make an observation, it is always valid. By establishing theories that are supposed to explain a part of how the world works, they outline a group of experiences, theories that evolve. But physical reality doesn't change.

31. "AI plugged into a monkey's brain generated very strange images", ulyces.co, 3 May 2019.

32. "They are putting fake memories in a mouse's head", tdg.ch, 26 July 2013.

33. "Thought-controlled prostheses", Thomas Pfefferlé, invivomagazine.com, 7 April 2015.

If, for example, you teleport a Greek architect from antiquity to our times, he could construct palaces exactly like they were 2000 years ago. This architect would have a completely obsolete concept of physics but the physics in itself would not have changed, therefore his knowledge would be usable and he would have an advantage over those who don't know physics.

Computer science is completely different. It rests on a set of conventions between human beings. At each evolution, computer science itself changes, not the idea that we have of it. Concretely, that means that this time if you teleport a coder from 2012 and he hadn't updated his knowledge, he couldn't do anything with the current systems.

IT'S IMPOSSIBLE FOR HUMANS TO FORGET

There is a profound difference between knowledge in a domain like computer science where there aren't any stable elements and everything changes very fast, and knowledge in a stable domain where the underlying foundations don't change.

In this picture, accumulating knowledge seems absolutely useless. It's worse: if our human nature makes us efficient for learning, it makes us basically unable to forget. You have undoubtedly noticed that the more you try to forget something, the less you can... When you learn something new that is totally opposed to your previous knowledge, you still remember your previous knowledge.

But most of our decisions are born unconsciously, we don't choose which knowledge will be used—that's what leads us to reproduce behavior that we know is harmful to us. "Humans create the world via their representations and imagination[34]."

Often I meet parents who tell me, speaking about their child: "He will learn something, at worst it will be useless but it can't be harmful." Actually, yes it can! Our knowledge isn't only layered data, it influences all our future decisions. Experience is more important than content. We must pay attention to what we learn and to our way of learning, because

34. Creators of worlds. Our possibles, our impossibles, André Solé, Éditions du Rocher, 2000.

it's practically impossible to erase the knowledge linked to our experience.

While I was at EPITECH, I had an experience that illustrates this thesis. I was brought in to retrain some older computer scientists whose knowledge had become obsolete (they were around 40 years old, I'm 50 today). Corporations could not employ them or they weren't able to adapt to the evolution of their professional environment. The school welcomed groups of around forty of these "seniors" that we mixed with youth who didn't yet have any knowledge. Surprise: on most of the projects, the young people could find pertinent solutions and the seniors could not (the exact reason for their obsolescence in business). It wasn't that they didn't know what the problem was, because the youth didn't know any more than them, but it was what they already knew, with a kind of rigidity that stemmed from it. They were definitely able to find information, overall, older computer scientists are engineers, often converted chemists, who know how to read and use the Internet. I'm not talking about the cliché of an older generation overtaken by technology.

The problem is more complex. As a trainer, my first instinct was to teach them new ways of working, new information. These older computer scientists are intelligent people who did lengthy studies and know how to learn, so I didn't have any trouble transmitting new information and appropriate methodologies to them. Overall, they were very positive and motivated. Their courses were validated by exams and they got very good grades, same thing on the practical tests. In the projects, too, the results were very satisfying... So, they returned to the company, convinced that they could reintegrate the working world without a problem. It was a total catastrophe: these computer scientists did the same thing they had done before coming to school and they again became useless and obsolete.

But why? It's pretty simple: our decision-making process isn't static, it depends a lot on stress levels. School is a caring environment (ours is anyway) where the student is surrounded by people who are following the same path, who are trying the same things. In this environment, they can—they must—take risks, meaning using new and little-used in-

formation, and they have enough time to do it. Back in the corporate environment, they must prove themselves, especially if they are new and senior. There are contradictory personal matters, a certain defiance... so, they return to the security of the old ways of working that helped them during their twenty-year career. Those exact same things that made them obsolete but that are impossible to really forget.

At the time, the only solution that I found to rectify this system of organized failure was to place these people in sectors that required the acquisition of new skills: a network engineer placed in development, a developer in quality control, etc. At 42, I recently started some programs where the specificity comes from a "mélange" of seniors and youth who get very good results. It's no longer about conveying new knowledge. It's about creating a new experience of life. Furthermore, these modules are much longer than the previous ones: they have gone from just a few months to an entire year. In partnership with the Pôle Emploi (the French employment agency), we started a program for long-term unemployed people who are over 50 years old (it's the

worst situation because the probability of returning to employment is 3%). After one year, 75% of these seniors had found a job.

It's obvious that learning (in the sense of memorization and cramming) isn't only useless but frankly dangerous, because there's a risk that we'll be stuck in an obsolete vision of the world. As we have seen, whatever enters our brains stays there always, notably our experience, our habits.

Chapter 2
Freeing Ourselves from Information to Deploy Our Creativity

The last shortcoming centers on the use of the stored information. When we have a decision to make, we are faced with two cases: either we know the "solution", the expected behavior, or we don't know it. In the first case, it's very simple, we are applying what we know and everything is supposed to go well. In the other case, we are going to have to find a solution, if not invent it, and maybe even act at random. In any case, that's going to create doubt, a possible level of error, and anxiety. But, our capacity to accept this anxiety, and the level of risk, depends on what we are used to.

NEW COMPUTER SCIENTISTS ARE CREATORS WITHOUT LIMITS

In a conventional school and university environment, an exam is an evaluation of theoretic learning: classes and methods

were taught beforehand, the students only have to recognize and find the principle or the useful notion and apply the given rule to answer the question. They just repeat what they have learned.

In such a system, no one ever has to take risks. Overall, our decision-making process is to identify the problem and look for the answer in our memory. Risks taken: zero. By repeating this process from childhood, we become *allergic* to risk taking and… lazy.

Finally, this mechanism traps us: faced with a problem that we don't have a solution for, we think we have badly identified it. This misunderstanding leads us to wait for a solution to be brought to us—which will always happen. Surely it's an unconscious process. At the conscious level, feeling like we don't have the solution creates frustration and a feeling of injustice. That's why I say that learning makes us *stupid!*

Freeing ourselves from information doesn't mean not having access to it, on the contrary: by having fluid access to information that is available at any time, we free ourselves from its restrictions and we no longer need to try to accumulate it. Knowing that

we're at the center of a "find-able" collective frees us from anxiety and confers a deep trust in ourselves, a source of creativity.

This creativity is essential today. The need for humans to do repetitive jobs is shrinking more and more in all areas, these tasks are replaced by machines and artificial intelligence. In computer science, this transformation is already well underway—but far from over. We have less and less need for people to simply execute knowledge when computers succeed in this domain. This explains why so many former computer scientists are no longer employable.

This is the case for developers, a repetitive trade in basic programming, their only task is to translate a human representation into a computing language without adding any value other than the knowledge of this language. Or that of system operators whose job consists of repeating commands or updating router configurations: when I retrained people who did these kinds of repetitive jobs (since replaced by automats) and showed them how to automate their tasks, they didn't understand why it was necessary to have seemingly complex mechanisms do

what they did pretty easily. They only understood when I showed them that once a mechanism was in place, I could update a thousand routers in a few seconds... something that would have taken them nearly a month.

It's exactly this way of thinking that we must suggest and develop; it's not interesting to know if such a mechanism exists and to be able to use it. We must know how to invent it. This is the job of "DevOps", a very sought-after skill.

BECOMING SOLUTIONS INVENTORS

In a more general way, all tasks that are only the result of knowledge and deduction will be done by automated systems that are a lot better than humans. In each current job, or nearly, there are elements of this nature. I don't think we're going to see the disappearance of a great number of jobs, as the media want us to think. However, I'm sure that all jobs are going to change. All of them. Computers will take care of knowledge and deduction while humans, working collectively, will do things that are creative and empathic. The result will be a kind of collaboration

between human collectives and automated systems. These changes will allow everyone to express their creativity in the area they are passionate about, without having to master the technical components that are currently associated with it. For example, everyone could imagine a house without needing to know the material and technical constraints necessary to build it, these will be validated in real time by a computer. Only your imagination, in interaction with a computer, will allow you to obtain simulations closest to your dream.

These changes will erase the current barriers to entry for these jobs. My intuition is that even the notion of trade will disappear for the benefit of our interests and passions, and that we will be able to go easily from one area to another, exploring what we like best, what brings us the most satisfaction, because artificial intelligence will provide the structural elements of the field. Our creativity and our connections could be used in a multitude of different projects, nourishing one another. In reality, it would be like going back to a form of humanity that corresponds with our nature: freedom from the segmenta-

tion imposed by the current hyper-technical system and a return to a more holistic idea of passion at work.

CREATION BEYOND INDIVIDUAL LIMITS

We are currently looking for computer scientists able to co-create future products and services with a corporation's employees, the demand for this is in exponential growth. This is an essential function because digital technology is becoming central both in the interaction with clients and on the whole chain; it allows them to realize and support the processes of collective intelligence that can encompass all involved parties, from clients to subcontractors. In this kind of ecosystem, value added is intrinsically linked to the information system.

But, to develop creativity, we must create an environment of freedom and trust where everyone has the possibility to discover or recover their real motivations, their deeper natures, their passions. A place where time disappears, where effort becomes pleasurable, where complexity provokes illumination. When we are able to return to this place in synergy with others, we form intelligent collectives that are able to see beyond the limits of each individual. Today, this is the only way to pass on these very complex issues. Collectively, we can imagine and conceive of solutions that a sole individual couldn't grasp.

Chapter 3
Succeeding in A Full and Human Environment to Prepare for The Businesses of Tomorrow

THE BENEFIT OF "PEER-TO-PEER LEARNING"

When I established a training program without classes, professors or tutors, exclusively a peer-to-peer learning community structured around an information system encouraging the emergence of collective intelligence, I wasn't trying to convey knowledge, I was trying to make the students autonomous to know everything, and as such, open to creative collectives. It's a kind of human block

chain where the word of each individual has the same value, where the entire community constructs and guarantees information, not a supposedly omniscient and all-knowing central authority.

In this system, it's not about learning to learn or learning for learning's sake, but to know how to work together to find, connect and activate the elements that we need for actualizing our projects (knowledge, resources, talents, contradictors, etc.) when we need them, and to know how to integrate it into the collectives that are made intelligent via their interactions. A progression where each person, in a rich and welcoming environment, takes responsibility to build his path collectively by following his own objectives, resources and meetings. In so doing, he develops an active openness of spirit founded on self-confidence and trust in others that is crucial for the establishment of collective intelligence.

This process stimulates solid and sustainable qualities that are in step with the digital economy, which explains, for twenty years, the success of the older people who benefited from these transformations.

Alexandra,
42 SILICON VALLEY, JULY 2018

How to sum up the Pool at 42?
A human experience where I learned that failure can be a driving force for self-confidence.

At the Pool, the diversity of the group's participants was what enriched me the most during this immersion in learning to code: spending one month with a young Russian woman who works in a university, an investor from Kazakhstan, a French police commissioner, a young graduate from

Silicon Valley, a couple of South Africans allowed me to open myself to others and see the world differently. All these people with different profiles and stories had their motivations and their reasons for wanting to meet this challenge. To be able to interact with them was a real source of energy on the day to day.

I am convinced that learning is about opening oneself and improving oneself with others.

From a technical point of view, learning a computing language is very demanding and 42 is rather strict about this: a code follows a very clear standard and necessitates an exact response to the question. No more, no less. The least error is punished with a score of zero.

Obviously it's not easy, but it teaches us how to be consistent and rigorous in our coding, and it forces us to test, test, and test again. What's better than "test & learn"?

But the discipline and strictness of the practical exercises at 42 would be incidental without peer-to-peer learning, the method of teaching at 42.

No professors, only students who learn together, correct and inspire each other. This unique method allowed us to see that spontaneous mutual aid is an educational force that is too often overlooked. Mutual aid creates a real community that pulls all the participants to the top. Without competition, learning resides in the comprehension and solidarity between students.

We can only wish that schools and universities take inspiration from these innovative methods. My immersion in the Pool at 42 to learn to code will always be a striking experience and I encourage everyone to challenge themselves to find their best.

RETHINKING THE SYSTEM SO THAT QUALITY ENDURES

Faced with the profound and rapid changes that new technologies are bringing, we must entirely re-think our educational processes. The essential part of our education system aims above all to transmit knowledge and normative behavior to prepare students for an industrial world that no longer exists. In a context where mass production can be automated and no longer represents an important competitive advantage, the capacity to invent new products and services to better serve the specific needs of each consumer will take center stage. We are at the beginning of a profound economic change and digital companies are only at the early stages.

In this context of rapid evolution, young students are already progressing toward a future that conventional schools can hardly glimpse. These gaps provoke a strong malaise that generates a context unfit for development, as well as incomprehension both on the side of education professionals and on the side of the students. School must profoundly change both in its form and in its objectives.

Alice, Age 20,
STUDENT AT 42 SINCE NOVEMBER 2017,
SECOND-YEAR STUDENT AT SCIENCES-PO PARIS

42's teaching method, in rupture with the traditional system, immediately seduced me. Sharing, autonomy and solidarity: that seemed ideal when I heard about the school from friends. Coding is a field that always interested me. I had already participated in the Pool in July 2017 and began school in November of the same year, in parallel with Sciences-Po Paris. I passed the test during my last year.

The Pool was a positive shock in my life. I had never been as stimulated! I was always bored in class and I was one of the best students. During this experience, each day I was learning but not in a boring, monotone way as in high school and even at Sciences-Po. I felt like I was high, my brain was boiling so much. For once, I was having fun. Each day was a challenge. I have always been very competitive, I like adrenaline and winning first place. Socially, the Pool was good for me. I met a lot of people who wanted to help each other and work with openness. Thanks to them, I got out of a depression that had plagued me since 11th grade.

Even if I had some not-so-nice moments—in my first project group project I was with two boys who wouldn't let me touch a single line of code, they would only let me change the syntax and color— I rediscovered confidence in myself in this dynamic and positive environment surrounded by kind people.

My double curriculum at 42 and Sciences-Po helps me to better understand the world and better decode it. At 42, my technical assets (via coding and networking) help me understand how things work and create them myself, notably finding solutions to problems in sustainable development.

Furthermore, at 42, I became more autonomous: at Sciences-Po, I am applying the 42 method, I never go to lectures, I work by myself. I also developed a strong ability for adaptation: when a problem arises, I look at it from all angles and establish my reflections according to the type of problem. Finally, I think that Sciences-Po teaches me to think, but 42 teaches me to think for myself.

TECHNOLOGY MUST FIND ITS PLACE

To undergo such an evolution, we must have a deep knowledge of each student and their interactions with the others. This is possible with the adapted tools for handling information that we developed at 42.

But this data must be used wisely. Precise but badly used monitoring tools might lock students in a unique and normative transmission system. Currently it is unusual to see projects unfold this way. Technology offers us inestimable means but it must work in parallel with new objectives, or risk the opposite effect.

Educators must make room for peer to peer interactions that are much more numerous than in a normal classroom that is centered around a teacher. These interactions represent the essence of development, while encouraging a prolific and caring environment.

Teachers must encourage shared work, instead of the usual individualism paired with endless competition among students, by evaluating them collectively in a way that doesn't punish them but rather gives them some guidelines for a common goal.

Didine, Age 30,
ALUMNUS OF THE WEB@CADEMY

I grew up in the Parisian suburbs, in a not-so-great neighborhood. School wasn't my passion; I was pretty good but I acted a bit like a kingpin and the professors didn't like that. I got kicked out of several institutions. After two years of a BEP in accounting, I stopped going to school and I started earning a living by doing small jobs (server, delivery etc.) before finding myself locked up for a few months when I turned 18.

After getting out of prison, I had the chance to meet the president of Colombbus, an amazing person who introduced me to his association that does training and professional integration via computer science and the Internet. At the time, I wasn't a geek but I was into video games, like all young people my age, but I found it interesting and I really got into it. Since I had found a short-term contract at the FNAC, he suggested that I do a real training program and to go to the Web@cademy in February 2012. The Pool was a real revelation for me. I was never passionate about coding (I was the worst of the

students), but the school's atmosphere was fabulous: everyone helped each other, listened to each other, and supported each other with kindness. There was a rare cohesion instead of competition. Everyone was in the same boat, with moments of anger and doubt but also success and happiness. I spent nearly sixteen hours per day behind my screen, and slept in a sleeping bag when my eyes could no longer follow the lines of code; all of my time was dedicated to work. I loved it!

After the Web@cademy and three years of a rotation at ETNA, today I have my diploma in engineering studies, the equivalent of a baccalaureate +5, and I have a long-term contract. This training saved me from the wrong path and it has made me a happy employee, but most importantly, it taught me an essential thing: alone, we can't do much, and we move forward when we work together in groups.

FREEDOM FROM THE REQUIREMENT OF A DIPLOMA

A new way of grading and evaluation comes from this collective system and it raises a problem with diplomas. A diploma is a certificate of conformity: conformity to a basic skill set, and to the standardization of behavior, ideology, even dress code. In reality, men and women are often considered "spare parts" in the system: when an employee quits, they try to replace him exactly so as not to disturb the rest. This model is logical in a system based on replication (an army, a factory, etc.) but it doesn't work in sectors where innovation, creativity, and diversity are the essential elements; tomorrow these sectors will be the norm in most of our businesses. The very idea of a diploma is in total opposition with the goals of a training program that can bring our youth to this kind of employment. Too often, we think that conventional intelligence, diplomas and experience determine how efficient someone is in professional life.

By removing the requirement of a diploma, 42 was able to make itself available to

all: by increasing the possibility of conflictual interactions (in the constructive sense of the term), the development of intelligent collectives is enhanced.

... AND FROM HIERARCHY

It's becoming clear that only collective intelligence can solve extremely complex problems. Even the most brilliant and intelligent people are limited. Hierarchical organizations are able to solve problems of size, but they can't offer efficient solutions when the complexity is too great. The creation of animated films from the American production company Dream Works or certain video games involve creative processes (effects, decoration, interactivity, imagination, etc.) that are so complex that they necessitate the establishment of intelligent collectives. We are witnessing a mutation of innovation and research structured around the establishment of intelligent collectives oriented towards common and shared goals. By proposing environments that are favorable to creation, some businesses have accomplished this mutation. They have become

leaders in their field by introducing group work where a collective of individuals aims to attain a common goal by combining each contributor's efforts.

These collectives' precise ways of working aren't totally known, but some rules are starting to come out. They are often counterintuitive to us because we have been educated to base everything on individual performance and hierarchy. For example, a large collective of non-experts gets better results than a hierarchical organization made of experts. Even more surprising, the least consensual elements of a collective seem more important than those that are consensual: taking away the divergent aspects of a collective lessens the response quality of that collective only if it's the consensual elements that are erased (this last example only works with a larger collective).

Mickaël Camus,
PROFESSOR AT EPITECH 2002-2008

In parallel to a PhD thesis at the University of Paris IV, I got a job as a professor of system programming and artificial intelligence at EPITECH at the end of my program, in 2002. My work on projects for the European Defense Department and the European Space Agency led to my interest in autonomous systems (drones, robots, satellites) and I got to develop the research laboratory that we established at the school. My goal as a professor was always to bring the students as far as possible, to attain a sharp expertise to excel in problem solving. The objective wasn't to explain to them how to solve the problem, but to give them the necessary tools so that they could find the ideal solution themselves.

Like the other professors, I was very strict with my students: a project that doesn't work completely is a project that is unusable. Their grades were very low... This way of doing things was very critiqued but I think it was legitimate, like the adage that I told my students many times:

"If you didn't do it, it's because you don't know how to do it."

I quit my job as a professor at EPITECH in 2008, after defending my thesis in September 2007. Since 2008, I started three companies (www.mims.ai is the last one to date) and I work in industry on autonomous systems in Canada.

HACKATHONS TO EXPAND BUSINESSES

In a curriculum like 42, the essential characteristic is the capacity to be part of an intelligent collective and contribute to its development. Today, 42 students find and develop the ability to join intelligent collectives and are able to solve very complex problems when they enter the job market. This is what we observe particularly during the hackathons organized at school, where businesses, associations, the army, and heads of State and region come to find solutions to problems that are too complex to be solved, or even understood, by conventional methods.

Let me add that faced with robots who will soon be able to do anything that only requires knowledge and deduction better than any human, only intelligent collectives will be creative enough to deal with these complex problems and cooperate with artificial intelligence.

Chapter 4
A Necessary Mutation of Businesses

What good is it to train impressive students if businesses aren't ready for them? Many companies only use a small part of the creative capacities of our students by assimilating them into already-established processes. They are contributing to a global transformation of business, but it's still slow and its impact is largely low and far from optimal. Therefore, it's necessary to develop processes that aim to shift part of the conduct in businesses and invite these businesses into the school in order to make convergences.

DIGITAL TRANSFORMATION, ADAPT OR DISAPPEAR

From EPITA to 42, we led several kinds of programs going from sensitization to collective intelligence to the total reconversion of employees. In partnership with the Pôle Emploi (the French employment agency), we retrained seniors (older than 50) who were looking for a job for more than two years ("long-term unemployed people"). This population generally has less than a 3% chance of

finding a job, but they got a position in only twelve months with a score of 75%. A "miracle" due in part to mixing these seniors with young students: by interacting with them, these "older people" are forced to get out of the usual habits that stop them from evolving. We also transformed fork-lift operators, and other workers in repetitive jobs who were very exposed to robotization, into creative developers with a nearly 100% success rate. By combining training, reconversion, and digital transformation, we increased the diversity of these collectives, contributing more deeply to their fulfillment and a real transformation of businesses and organizations.

It's essential to develop places that are open zones, communities of learners where these digital transformations will emerge, for and by the ecosystem. Spaces that bring together youth in training, others in reconversion, employees, businesses, institutions, etc., around shared creative projects. This is how we will redesign a new value chain and create an unprecedented relationship to work.

To be able to maximize innovation, businesses must radically change their re-

lationship to work by centering themselves around intelligent collectives that are working simultaneously on different projects that go beyond the boundaries of each business, improving themselves with shared experiences. A model of open innovation in a context of agile businesses.

STRENGTHS AND WEAKNESSES OF ADAPTATION FOR STUDENTS OF 42 AND ELSEWHERE

The new generation is entering the work force with a modern and innovative vision that is pushing businesses to rethink their strategies to recruit the best talents.

These young people are looking for a balance between their professional and private lives, they want an evolving career, they are often open to international experience, they have a real willingness to discover the world, cultures, the values of other countries. For them, the business culture is crucial. They want to be autonomous and responsible in a context of mutual trust with their managers. They want to find wellness and

personal fulfilment at work, so the purpose of the business and the meaning of its actions are the decisive factors for choosing which establishment they decide to work in.

42 is a liberating educational experience where students participate in caring, co-creative and effective communities, restore their self-confidence and their bond with others, and find their independence. After leaving this environment, students will have a lot of trouble dealing with a managerial environment that is out of date and uncool. That's why certain businesses will have difficulty recruiting them and even more trouble getting them to stay. However, some will remain in the job, often because of an interesting mission where they think they can add value.

Fortunately, more and more companies are retraining themselves to become "liberated businesses[35]" as Frédéric Laloux describes it in his management text Reinventing Organizations: Toward Inspired Working Communities[36]. The performance of these businesses is quite superior, even more in a sector

35. "Managerial Transformation: What Can Liberated Businesses Teach Administrations And Public Organizations ?", modernisation.gouv.fr, 11 February 2019.

36. Diateino Editions, 2015.

where innovation has a great role. Managers there listen to their employees, they encourage them to take risks rather than controlling them or limiting the amount of information they can access; they wake up their "human potential" and leave them alone so that they are "happy and efficient at work[37]". This movement is even more important because, in the midterm, noncreative economic activity will be mechanized, it will lose all value and this will lead to the disappearance of businesses or organizations who don't know how to adapt.

People often blame me because our old students don't adapt to certain businesses. I would say that they are excellent indicators of the company's maturity level.

THE LIMITS OF STANDARDIZATION

The current economic and societal transformations are fast redrawing our value chains. We are leaving the industrial era where the major issue was the mass production of quality products, where all effort was concentrated on production in

37. Freedom & Company – When Employee Freedom Makes Businesses Happy, Isaac. Getz and Brian M. Carney, Fayard, 2012.

order to increase quantity while maintaining quality with a yield increase through an economy of scale. This process led to great standardization. The arrival of digital and associated technologies such as 3D printing, robotics, and more generally what we call "industry 4.0" is completely game changing. Our ability to capture, analyze, treat and retain information opens up new perspectives for products that are totally individualized.

Currently, the most complex part of producing a car, for example, is to conceive of a factory and the processes that surround it. Each option complicates the entire mechanism and even if we make a lot of progress, in large part because of the information system (choice of options and associated automatic production), the options remain limited because they are expensive to put in place on the assembly lines. Imagine for an instant that these cars were no longer produced on an assembly line but via a 3D printer: there is no longer any reason to print the same car twice, no longer any reason to condense the production. We can imagine 3D printers or fabrication centers deployed all around, creating all kinds of objects "à la carte". In this way, the value chain is completely modified: the ability to produce becomes a commodity without great value. The capacity to invent new models, even co-invent them with users, becomes central. This resembles products made by very good artisans but accessible to all because the production is ensured by an automatic system. If you add to that some artificial intelligence that manages the physical constraints linked to the printers or the robotic production tools, you have an economy where the principal source of value is creativity and the ability to interact with the client in order to co-create products and services that will bring him the most satisfaction.

In reality, this process is already well on its way. It's a return to an "artistic" mode of production that was only available to a very small minority because it requires a lot of human resources. Soon we will all be able to access these productions to the extent that artificial intelligence, robotics, and digital technology give us access to labor and high technicity for a much lower cost than human labor.

For example, in clothing, we can already get perfectly comfortable and well-priced 3D printed shoes thanks to digital images of our feet obtained with a simple scanner. The same result developed by humans would be less precise and more onerous. In the medical field, it's more and more usual to custom 3D print orthopedic tools (orthopedic soles, orthotics, braces, etc.) or prosthetic limbs adapted to each patient with ideal precision. Soon, we will be able to print organs from a patient's own cells...

Therefore, we can no longer focus the training program only on information and its deductive manipulations. In the field, computers will always do a better job and even if that's not yet the case for certain places, that will come very quickly. By developing the originality of each person, we will be able to obtain intelligent collectives capable of creating a value added that complements artificial intelligence.

THE AMBITION OF THE ZONE 01 PROJECT

The next step of the 3.0 pedagogy is to optimize the transformational power of youth in current businesses. Certainly, a

large part of them will create their own occupations, and for certain supplant the old businesses in place, but in a logic of global transformation, we must also help them to manage their professional goals. This is the ambition of the Zone 01 project that I am currently developing. It aims not only to spread this educational process to a larger public, but also to help transform staff already in business. We will do this by creating centers of collective intelligence across the world where students, businesses, and institutions will meet.

At first, our strategy is to concentrate on Africa, where the largest concentration of available human brains is found (in 2050, 50% of people under the age of 35 will be African). Therefore, this transformation can have the most impact there. My objective is to open two hundred of these training centers across the whole of Africa within ten years and train one million young Africans.

Today, AI knows perfectly well how to copy and reproduce what already exists; tomorrow, human collectives will imagine things that don't yet exist and the machines

will execute them. Vehicles, connected objects, and thousands of ideas that are today inconceivable.

Remember the 90s before smartphones, tables, Google and other applications? Who could imagine that a whole digital universe was going to invade our daily life so quickly and yet often come in handy? AI liberates and concretizes the potential of human collective intelligence that will invent our future.

Therefore, it's essential to put in place educational processes so that our society can lean on a great talent pool that is rich in diversity. If we don't make it and we miss the curve of the digital transition, there is a real risk of regression, like those countries that missed the industrial revolution. Especially, today there is a great opportunity to create an economy where each person contributes with his passions and his originality in interaction with intelligent collectives.

Fortunately, these new generations have already largely integrated these changes. We must trust and help them. We are in a new and complex situation. Past successes can be a handicap if we try to reproduce the old ways. We are in a profoundly different environment. We must be able to combine this experience with the new generation's intuitions and behavior in order to better help them in the construction of these new models.