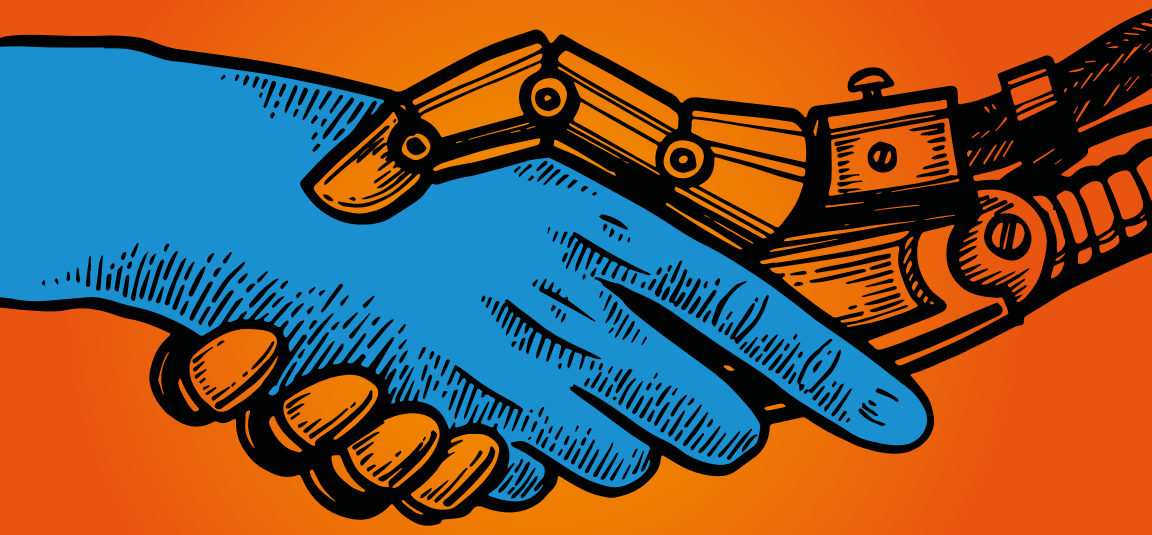
Education for humans in a world of smart machines



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Lluís Cugota, narrator

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Education for humans in a world of smart machines

100 Ideas and Thoughts
About the New Education
Our Society Needs

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Lluís Cugota, narrator

PRESENTATION

In this new, global world, information is always at our disposal and machine translation has become a reality. Humans live alongside smart machines that are capable of doing more and more tasks that were previously considered distinctly human. In this new scenario, bold ideas are quickly transformed into everyday services or objects.

This future is almost upon us, so it makes no sense to teach young people how to do tasks that can be done by machines. Humans are very different from machines in many ways. Our essence as a species lies in the empowerment of human characteristics: curiosity, creativity, imagination, critical spirit, empathy, collaboration, sensitivity, the ability to conceive ideas, to manufacture, to build with our own hands... These are probably the most distinguished human skills and abilities.

In this changing and diverse scenario, education faces a great challenge: to discover each individual's talent and encourage them to develop it to the fullest by deploying their own skills. This new education is based on such basic concepts as experimentation, collaboration and integration, that is, our remarkable ability to create something new by combining the most diverse components.

We are committed to transforming education and adapting it to new contexts. In fact, we now have the opportunity to be one step ahead of the future. But we have to do it together, in new educational spaces structured according to the goals we pursue, and with a new team of committed educators, who are well-trained and specialized in discovering and enhancing the most useful and effective ways of learning for each individual.

It is a new education. A radically human education in a world of machines.

Alfons Cornella
Founder and CEO of Infonomia

SUMMARY

PART I
Future society: global changes, bold ideas and smart machines

1 |
A DIFFERENT WORLD

Globalization will shape the future world and smart machines will play an important role. In a world run by artificial intelligence (AI), the educational challenge focuses on enhancing individuals' most human features, those that machines find difficult to reproduce.

1 | The digital revolution

In recent years, the digital revolution has deeply transformed the way we work, human activities and how value is generated. We cannot talk about the future without taking into account that everything has changed immensely in the last twenty years as a result of the **digital revolution**. Our present reality is only a glimpse of what lies ahead.

We are witnessing an acceleration of transformation. Technology is developing very quickly and is being integrated into new devices waiting for us to find a new way to use them.

► Education must change because we are heading towards a new world. The world will be a very different place in the coming decades.

2 | The four sides of the future

Four interrelated pillars underpin the construction of the new future: science, technology, society and organizations.

Science is understood as the discovery of the phenomena that occur in the natural world. It is an accelerated process. We have increasingly better technology in labs, as well as better tools, which allow us to improve and enhance our study of the phenomena of nature.

Technology gives shape to nature. Technology studies a phenomenon of nature that has been discovered by humans, understands it (although not always), shapes it and uses it for our convenience. In other words, technology manipulates nature's phenomena according to our needs. For example, researchers discover coherent light, that is, a light beam condensed in space and

time. From there they develop lasers and then technology allows us to apply this phenomenon—lasers—to multiple purposes.

Society has to face increasingly complex problems as it becomes more sophisticated. Technology must provide answers to these problems and needs that are raised in society, and it will do so with new types of **organizations**.

► In the coming decades, we will experience great changes as a consequence of new natural discoveries systematized by technology to provide society with answers through the creation of organizations. These four elements that make up the future will also change. How we produce science, how we manufacture technology, how we understand society and people and how we manage organizations will all be different. Let's have a look at some examples.

3 | Genes and data

In science, **human biology** is showing great potential for making remarkable discoveries over the coming years, especially in terms of precision and personalized medicine. Developments in this field, such as a better understanding of personalized genomics and discovering the importance of microbiota, could result in a major conceptual change in medicine over the next twenty years.

On a different note, now that we understand that DNA is the genetic code of living beings, we have begun to "**rewrite life**" and we are already testing new ways of transcribing this code. In one such experiment, a British research group successfully introduced two artificial components to the four natural components of DNA, which is what has led scientists to now talk about **6-letter DNA**.

Medicine is increasingly becoming a discipline based on interpreting large amounts of data. **FDNA** is a company that uses AI to detect physiological patterns that reveal disease-causing genetic variations. That is, they can detect a genetic modification (genotype) using just a photograph of someone's face (phenotype).

Figure 1.1 | FDNA [https://www.fdna.com].

4 | Life on a chip

Another interesting company is **Emulate**, which has created Organ-on-Chip technology that emulates the physiology and pathological states of a person's organs, such as their kidneys, intestines and even their brain. The cells of a specific organ are cultured and fed with blood and other nutrients, and then their tissue microenvironment is reproduced. This is how you simulate an organ on a chip.

Figure 1.2 | Emulate [https://emulatebio.com].

5 | Quantum computer

Quantum mechanics has incredible potential. This discipline was born at the turn of the 20th century from the purest theoretical interest in understanding nature. It is now beginning to offer potential technological applications, such as the **quantum computer**, which will become a reality in the near future.

► The power of science will lead to decisions that will bring great changes in the coming years. Science is no longer merely a group of people who devote their lives to research, but rather it is the root of knowledge that is then transformed into technology. Of course, these new demands will require a different education.

6 | Drones

Technology is facing many challenges, drones being one of them. **Drones** are actually the answer to a question that has not yet been asked. In other words, we have a technology that can do many great things, but we are still waiting to see all its possible applications. For now, drones are being used in many fields: agricultural control, weather service, repairing complex installations, military use, etc.

7 | The digital industry

An interesting concept stands out in the industrial world: digital twins, that is, reproducing an entire industry in digital format. This **digital replica** allows us to simulate any desired change. So, before modifying a process in a real industrial facility, which can entail many risks, the same changes are made to its digital twin.

3D printing represents a major development in the industrial model. Taking one step further we find the Chemputer (a play on words between *chemistry* and *computer*), a "crazy idea" conceived by BAE System, an English aerospace company. It is a **chemical 3D printer** which is not fuelled with a specific material, but with the molecules and nutrients needed for them to grow industrially. It is an important development from the point of view of digitalization and using new mechanisms of advanced manufacture and low production (nanomanufacturing).

On top of all this, we must not forget the **energy revolution.** The introduction of solar energy, energy storage and geoengineering applications should allow us to undo the damage that has been done during the past two centuries of polluting the planet.

8 | Food production

Another major technological and agricultural challenge is how we will produce enough food for the 9 billion people that will exist in 2050. How can we make better use of the seeds at our disposal—a treasure that must be preserved—with new agricultural models?

Kaiima is an Israeli company that is showing us how to move towards **precision agriculture**. In a study, they broke down the crop fields into smaller plots and observed that each of them behaved differently. By better understanding the behaviour of each seed, they can take action on each plot at the right time and, for example, water it when it is most convenient. As a result, harvests are improved (without any genetic modification).

Figure 1.3 | Kaiima [www.kaiima.com/technology].

► Technology utilizes scientific discoveries, in other words, technology arranges the discoveries from nature to give answers to society.

9 | Global society

How will society change in the coming years? What does the future hold for us? We have at least two prominent leads. A very important one is the rapid

adoption of technology. We will experience an accelerated process of incorporating new technologies into our daily habits.

The other one is **globalization**. Getting around the planet is easier than ever. Travelling will surely increase thanks to **machine translation**, which is another of the great changes to come. We can already see significant advances in the machine translators available to everyone.

Moreover, it is no longer in the Western world where things are created and then applied elsewhere. The world has changed. Now, any country can produce new technologies. For example, India is the first country in the world to have digitized the biometric data of all its citizens.

► When children who are now in school grow up, progress will be generated in many different parts of the world.

10 | Associated conflicts

What problems will social and technological changes cause? We are already seeing more and more **security** problems. Hackers could interfere with basic systems (such as electric power distribution) or seriously alter the running of a company.

In addition, there is another problem: **poverty** as a source of social inequality. In many English counties, a significant proportion of children already live below the poverty line. This terrible reality is not found in developing nations, but in developed ones. According to UNICEF, Spain is the fourth country in the European Union, only ahead of Romania, Bulgaria and Greece, in inequality in child well-being, based on family income. The Spanish Institute of Statistics also reports an 'at-risk-of-poverty rate' of 22.3%, based on data from 2016.

11 | Organizational models

We have to come up with new organizational models that are faster, more agile and more responsive, in order to meet citizens' needs (consumers or clients).

Companies must not be oriented towards supply, but towards **demand**. Society demands new solutions and companies must respond quickly.

This is a controversial subject, because some people think that companies impose on people what they should buy, but it is becoming increasingly clear that this is not the case. Admittedly, there is a marketing push to create new

products or services, but these are not successful if they do not respond to the public's concerns, needs and desires.

Therefore, we need modern organizations that are capable of using technology very quickly. This means keeping a close eye on scientific and technological advances and turning them into useful answers for society, thereby generating resources that will enable people to find work and maintain a balanced society.

Figure 1.4 | Ikea. "Sustainable living at home" [http://www.ikea.com/].

► Education must provide people with the tools to make coordinated use of these four components of the future world. It is clear that some people will be more oriented towards science, technology, society or companies. In any case, any discipline we might consider should fit into these four pillars of change.

12 | Art

Is there an example of a human activity beyond the four components that identify change in the coming decades? Indeed, **art** is the fifth, cross-cutting element. It is a manifestation of those very human, creative qualities that are not linked to any kind of production system, or to the pragmatic act of producing an object or a solution, but rather that simply exist to create or enjoy something.

However, the notion of what is beautiful or pleasant—art, in short—will also change in the coming years as a result of the four forces of change.

Therefore, we need a different education that can arm us to face these challenges. There are many proposals. For example, the **XPRIZE** foundation has

global reach and regularly launches great challenges for the most intelligent people in the world to work on. One of their initiatives was a competition to contribute new ideas that would revolutionize global learning. The winners were to share as much as $15 million.

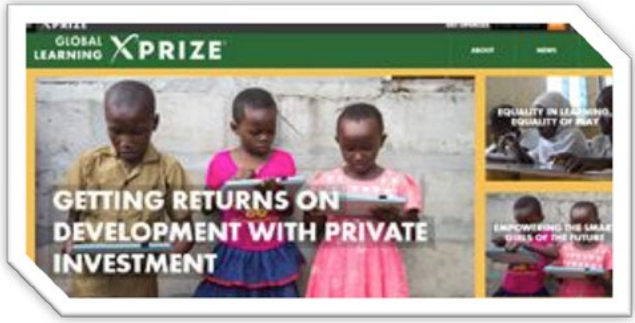

Figure 1.5 | XPRIZE [learning.xprize.org].

► It is important that education evolves in response to the transformations that global society is experiencing.

Education is sometimes sidelined, and some people think that it should take other forms. However, it is essential to have an education that can adapt and respond to the needs of society as a whole. In the immediate future, education must focus on responding to social demands. And that means that we all have to have access to education. We must transform education not just for the sake of it, but because society demands we do so.

2 |
RADICAL IS NORMAL

Radical ideas can quickly turn into everyday concepts. Young people must be prepared for a world where the gap is closing between what we consider radicalism and normality. They must be a generation that questions why things happen and that thinks boldly.

13 | Ford's exoskeletons

The world has changed considerably and will continue to do so in the coming decades (chapter 1, "A Different World"). But if one thing is for certain, it is that some ideas that might seem radical, extreme and even outrageous, become normal and widely accepted overnight. In a very short space of time, a **radical idea** is easily incorporated into our regular, everyday life.

The automobile manufacturer Ford recently released a video of a very advanced test, which has already been put into practise at the factory in Valencia. The **Ford** factory in Almusafes is the first in the world to incorporate exoskeletons to help workers on assembly lines.

Figure 2.1 | Ford Spain [www.ford.es].

14 | From the lab to the high street

How far is science from science fiction? It sounds like a simple question, but it is a lot more complicated than it might appear. Nowadays we accept amazing discoveries as if they were quite natural. For instance, a contact lens fitted with a sensor that measures intraocular pressure, created by Swiss company Sensimed, or a different contact lens that records what you are seeing thanks to a built-in microcamera, as recently patented by Sony.

► The generation now in school will have to get used to considering very ambitious and disruptive ideas that will go from the lab to the market very quickly. The distance between research centres and distribution channels is sometimes extremely short.

15 | Flying at ground level

There are many brilliant ideas that for now seem unattainable.

In the transport sector there is one project that truly stands out. The **Hyperloop** is a low-pressure tube that allows vehicles inside it to travel at 900-1,000 km/h using magnetic levitation. The project is still undergoing research and was launched by Space Exploration Technologies Corporation (SpaceX), founded by Elon Musk, who also cofounded PayPal, Tesla Motors and SolarCity. Musk is convinced that we have to change the way we travel over long distances.

For now, the prototype has been designed to connect San Francisco and Los Angeles, which are 600 km apart. The idea is to create a device that carries both passengers and goods.

But perhaps the most interesting fact is that Musk launched the proposal, built a 2 km tube and invited research teams from around the world to come up with ideas on the subject. Now, dozens of engineering companies are competing to reinvent the way we will travel in the future. This is a radical idea that could become a reality sooner than we may think, as intelligent people often embrace these ambitious challenges with passion.

Let's have a look at some more examples. The **Volocopter 2X** is able to transport citizens thanks to everything we have learned about drones in recent years. It is a silent and simple electric vehicle. With an 18-rotor propulsion system, the Volocopter 2X can be piloted using just one hand thanks to a single joystick that allows for vertical take-off and landing.

The **Lilium Jet** is another electric vehicle for medium distances that also allows for vertical take-off and landing. With a 300 km range, the Lilium Jet reaches a steady speed of 300 km/h and was originally designed as an air taxi for up to five people.

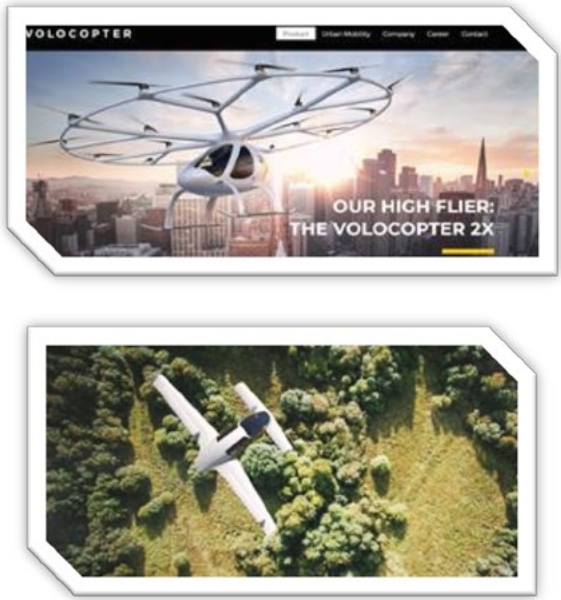

Figure 2.2 | Volocopter and Lilium Jet [www.volocopter.com/en/] [https://lilium.com].

► What is a radical idea? Thanks to our current scientific and technological abilities, some radical ideas (or ideas that at another point in time would have been considered radical) only require one more element to become a reality: money. Science, technology and economic resources come together to combine talent from around the world in the realization of bold projects.

17 | "We're going to Mars!"

Mars One is planning to go to Mars in 2023. To what extent should this be considered a crazy idea? Many people are taking it very seriously and consider it a viable project.

Mars One is very ambitious: their goal is to establish a permanent human settlement on Mars. Several unmanned missions will go beforehand to prepare everything and eventually carefully, selected and specially trained crews will be launched up to the Red Planet. They claim that "the Mars One team, with its advisers and established aerospace companies, will evaluate and mitigate risks and identify and overcome difficulties step by step".

This global initiative calls for collaboration and teamwork, always in good faith. Their advertising states: "We're going to Mars. Come along!".

Figure 2.3 | Mars One [www.mars-one.com].

18 | Kepler-90

Exoplanets have fascinated us since the 1990s. An exoplanet is a planet that orbits a star different from our Sun and therefore does not belong to our solar system.

The **Kepler project** studies a portion of the sky that surrounds the Cygnus constellation and analyses the radiation coming from a star. When this radiation decreases, scientists interpret that an object has passed in front of it. If this happens regularly, it may suggest the presence of a planet.

This seemingly simple technique has helped us to discover 4,000 potential planets, 30 of which are the size of the Earth and are far enough from their star

to potentially host water. This is a significant conjecture, especially because we already *know* that there are more planets like the Earth in the universe.

To be precise, scientists have discovered a planetary system with eight planets (like ours), known as **Kepler-90**. It even has a similar arrangement, with small planets orbiting near the star and large planets positioned in more distant orbits.

Figure 2.4 | Kepler-90 [www.nasa.gov]. Photo: NASA / Ames Research Center / Wendy Stenzel.

► What would happen if someday we discover that there is life beyond Earth? It would represent a huge change in global identity and it could happen over the next generation! It is essential to understand that we need to prepare young people for a world where radicalism and normality are never far from each other.

19 | Astronaut worm

One of the most exciting initiatives in recent years is the **Starlight** project from the University of California, Santa Barbara. It consists of sending probes containing relevant information to Alpha Centauri, the closest star system to the Sun, about 4.37 light years (41.3 billion kilometres) away.

Given its small dimensions, the object is easily placed in Earth's orbit and is stimulated by a laser until it reaches a high enough output speed, then continues to be stimulated until it reaches one fourth of the speed of light. Now, that is true science fiction. This initiative aims to launch a **relativistic spacecraft** into space. It would take around 20 years to reach Alpha Centauri.

But the most audacious aspect of this project is to send to Alfa Centauri a *C. elegans* worm to monitor what happens to a living being at such unimaginable speeds.

20 | Immortality

To say that some of the children currently in school will live for 150 years is no exaggeration. The quest for longevity, and even the idea of **immortality**, is a recurring theme in human history. Thanks to cellular repair techniques, it seems that we are getting closer and closer to prolonging life (almost) indefinitely.

Figure 2.5 |Technology for immortality [National Geogrpahic]

► Radical is normal. In terms of education, what does this mean? It means we have to shape a generation so that they are capable of thinking boldly.

While the conclusion of the first chapter ("A different world") was "Adapt to a rapidly changing world", the conclusion of the second chapter is "Dare to think radically". This does not mean that everyone has to be a mastermind, but that in whatever discipline we engage, we should question the status quo, be well informed about our environment and be ambitious. We need to think about why things happen and think boldly. We must adapt to a rapidly changing world and dare to question it.

3 |
HUMANS × MACHINES

With this new reality come smart machines. We must get used to a world where machines will do much of the work that humans have traditionally done. We have to learn to compete *with* machines, not *against* them, and we must train this entire new generation to use machines in their favour.

21 | Artificial intelligence

The developments we have seen in terms of AI over the last ten years have been unexpected.

Sergey Brin cofounder of Google and one of Silicon Valley's most successful entrepreneurs, admitted in an interview at the 2017 World Economic Forum Annual Meeting in Davos that he did not foresee the emergence of AI, which has reshaped the technology industry. The reason for Brin's "oversight" may be that when he studied information technology (IT), the processing power of computers then was far from the computing power needed to process the large amount of data that sophisticated AI algorithms require.

However, the emergence of video games, which require extremely complex image processing, forced us to improve computer circuitry by adding a graphics processing unit (GPU) to the central processing unit (CPU). GPU, and in particular the company Nvidia have boosted our computing capabilities and have made AI possible.

► The great challenge over the next few years is for smart machines to do tasks that up until now only humans have been able to do.

22 | Atlas, a jumping robot

Boston Dynamics' **Atlas** is today's most advanced humanoid robot. He jumps over obstacles, turns on the spot and does backflips. When he is about to fall over, he balances himself like a human. His control system coordinates the movements of his arms, chest and legs for total body movement. He is also very good at handling objects, can maintain his balance when he is pushed and gets up if he stumbles and falls.

Surprisingly, some of these abilities are not programmable. This device is capable of responding to any situation **in real time**. This is a major achievement.

Figure 3.1 | Atlas [www.bostondynamics.com/atlas (VIDEO)].

► AI systems are capable of understanding their surroundings and responding autonomously depending on the situation, without any prior programming.

23 | Smart machines

When we talk about robots, we usually mean human-shaped robots, but this is a mistake. The most advanced robots have different appearances. Let's have a look at some examples.

Kiva robots (resembling a large vacuum robot) manage Amazon's warehouses, where diverse arrays of products are stacked in tall, transportable shelving units. Amazon's millions of items are arranged in a seemingly chaotic way, as they are placed in one of these units upon arrival at the warehouse. When an order is placed, a Kiva will look for the entire unit in which the requested product is located, not just the product itself. The Kiva will then carry the entire unit to an employee, who will retrieve the product and ship it to the customer.

Autonomous vehicles are one of the greatest promises for AI and smart machines. In fact, they already exist. In the West Angelas iron ore mines located in a desert in Western Australia, Rio Tinto owns self-driving trucks. These **autonomous trucks** haul heavy loads at no risk, as this is a very predictive location where no human wants to venture.

Figure 3.2 | Autonomous trucks. Photo: Rio Tinto / Christian Sprogoe.

Self-driving truck company Otto will be responsible for the commercial distribution of American Budweiser beer. Their trucks will have a driver whose job will be to manage the truck and drive it in areas where the road is not yet adapted. On the highway, he will simply activate autopilot.

► In certain very repetitive jobs, such as managing a warehouse, driving a truck in the desert or distributing goods, humans can be advantageously replaced by smart machines.

24 | AI applications

AI is already used in a number of surprising situations. Some machines can do the jobs that humans used to do. Such is the case of **Narrative Science**, which can read an Excel spreadsheet, interpret the data and write a text. Thus, in addition to writing a corporate report, it can turn data into a valuable asset that allows for better decision-making.

Figure 3.3 | Narrative Science [https://narrativescience.com].

Pefin is an AI-based financial advisor. According to their advertising, their AI will guide you in making smart financial decisions at one-twentieth the cost of a human advisor.

► What will happen in a world where machines can perform tasks that until now were reserved for humans?

25 | Humans with machines

Ericsson recently conducted a survey that asked people involved in technology about their willingness to interact with AI. The results showed that 40% of respondents would accept an AI advisor at work, and interestingly, 20% would accept an AI tool as the leader of a country.

In many activities, it is very likely that humans will be replaced by machines. Even China, which has based its growth on cheap labour, is now considering replacing humans with robots.

Race Against the Machine, by Erik Brynjolfsson and Andrew McAfee, published in 2011, is the first book to raise this issue. The two authors, both economists at Massachusetts Institute of Technology (MIT), have analysed the situation and towards the end of the book point out that the predictable outcome of this revolution would be very different if we competed *with* machines instead of *against* them.

► The great challenge we face is how to multiply human capacity by the capacity of machines. Humans × (by) machines. Either machines go as far as they can

go and humans do the rest, or humans go as far as they can go and machines do the rest.

26 | Multiplied humans

In another thought-provoking book, *The Second Machine Age*, published by the same authors in 2016, they address the prosperity that could be created if we were to fully understand this opportunity to multiply humans by machines.

They discuss an interesting idea, which they call *the second half*. They describe the tale of a king who was grateful that an inventor had created the game of chess and offered him any prize he would like. He wanted one single grain of rice to be placed on the first square of the board, then two on the second, four on the third, and so on, duplicating the number of grains with each square. For only one half of the board, you would need 549,000 tonnes of rice. To complete the 64 squares, you would need all the rice on Earth.

Exactly the same thing happens with technology. According to **Moore's law**, established in 1965, the number of transistors in a microprocessor doubles every two years and its price is halved. This has been true for the last few decades. But what will happen over the next few decades? If this law remains true, what capacity will robots have in twenty years' time? It is hard to say. But there is an alternative: multiplying humans by machines.

A good example of this is Ford's exoskeletons to carry out repetitive and difficult tasks (chapter 2, "Radical is normal"). Human employees can identify a problem, proceed in an unscheduled way to solve it and *comprehend* the situation. Humans have the advantage of understanding their surroundings. In this case, the exoskeleton "simply" helps them to multiply their strength.

► The idea is not to create a future reserved for technology experts, but rather a future that is more agile, more dynamic and also more accelerated regarding the answers we will have to give to the problems raised.

27 | Augmentation

Preceyes is a Dutch company that has created a robotic assistant for complex eye surgery. The dexterity of a human hand is multiplied by the precision of a robot. That is, human abilities (which we can measure in millimetres) are enhanced by robotics (and can be then measured in micrometres).

Figure 3.4 | Preceyes [www.preceyes.nl].

The most suitable term for this collaboration is ***augmentation***. The alternative we humans have to automation is to enhance our capabilities. That surgical robot boosts the ophthalmologist's capabilities, but could it replace humans? This will not be possible for decades to come, because doctors have an immense body of knowledge and experience. But augmentation is a powerful development.

We must not rule out the possibility of **merging humans and machines**, which some authors have called *the great singularity*. There are already some instances of this, such as the bionic arm developed at Johns Hopkins University. Scientists identified the areas of the brain that are activated when a person thinks about moving their arm or hand, then they defined and understood the nerve signals that are generated, and finally translated these signals into movement.

► And one last note on machines. The great topic under debate is the evolution of machines (towards intelligence) and a better understanding of ourselves as human beings. These are two revolutionary ideas that will result in a very different social paradigm.

28 | Extended sensoria

Another promising idea is that of extended sensoria, that is, human senses that are enhanced by a built-in device that increases their potential.

Neil Harbisson's story is very well-known. This young man suffers from a rare condition called achromatopsia. He cannot distinguish colours; he sees everything in black and white. But Harbisson has a light sensor built into his

skull. A camera reads the colour in front of his eyes and turns it into vibrations using a subcranial implant. That is, colour is translated into sound. Thanks to the vibrations, he knows what colour it is as he can "hear the colour".

Harbisson claims that this is not a device, but an extension of himself. He is the first person to be recognized worldwide as a cyborg. Even in his passport photograph he is wearing his device, which is normally forbidden. He has an extended sense.

But Neil did not settle for that and has since modified his device to increase its sensory capabilities. He is now running infrared and ultraviolet tests.

Figure 3.5 | Neil Harbisson [www.youtube.com/watch?v=ygRNoieAnzI (VIDEO)].

29 | Learning instinct

As author Richie Norton said, "Anything that can be done by a machine, will be done by a machine". British science fiction author Arthur C. Clarke also stated that "Any teacher that can be replaced by a machine should be".

As George Monbiot wrote in *The Guardian* (15 February 2017), "schools are teaching our children to be redundant". That is, we are teaching them things they will not need. And he added that "a regime of cramming and testing is crushing young people's instinct to learn and destroying their future".

► "In the future, if you want a job, you must be as unlike a machine as possible: creative, critical and socially skilled. So why are children being taught to behave like machines?" (George Monbiot).

30 | Bold, adaptive and human

While the conclusion of the first chapter was “Be adaptive” and the conclusion of the second chapter was “Be bold”, the conclusion of this third chapter is “Be human”.

- What education do we need to provide for young people? One that can educate people to be bold and to adapt quickly to technology so that they can be multiplied by machines and give something of value back to society. By no means does this mean that we should all be scientists. This new educational approach can also be applied to a masseur, an elderly carer or a soccer player.

PART II
Humans need a new education: we must experiment, collaborate and integrate

4 |
WHAT IS A HUMAN BEING?

Curiosity, critical spirit, creativity, social empathy, the ability to improvise... These are traits that define us as humans. Every one of us has a talent, something about us that naturally stands out. The main purpose of education is to discover that talent and maximize it to its full potential.

31 | Humans and machines

The world is progressing very quickly for many reasons (chapter 1, "A different world"), but one change that will shape the coming decades is the introduction of AI to all areas of life.

When experts are asked what the future holds for us, many of them admit: "I don't know, but whatever it is, it will be related to AI".

This leads us to think of an educational model that takes into account the fact that smart machines will become a reality and humans will have to learn to team up with them and be multiplied by them, as we mentioned before when discussing augmentation (chapter 3, "Human × machines"). In the future, a proportion of the work we do now will be automated by machines and the rest will be done by humans who have enhanced capabilities, thanks to machines.

► We must now ask ourselves: "What is a human being?", as in how can we make the most of our human traits in such a technified society. Machines will replace humans in completing repetitive or routine tasks. Therefore, there is no need to educate or train people to do a job that can be done by a machine.

32 | Curiosity

What makes humans different from machines? How can we compete against machines? There are many things that set humans apart from machines, but one of them stands out from the rest: curiosity.

Curiosity is the human need to observe and ask questions. As we have already mentioned, in a future where smart machines will play a key role, machines will provide many answers by logically analysing large amounts of data.

33 | What is the question?

Machine learning is based on algorithms. An **algorithm** is a set of well-defined instructions in sequence that allows a machine to perform a given action.

After processing large amounts of data, machines can provide an answer to a problem. But what truly matters is not the answer, it is the question, and to be even more precise, the quality of the question. Here, humans have the advantage. Human curiosity, the desire to ask questions, is a transcendental and characteristic trait of the human species.

34 | Thinking is tiring

Many books address why some people do not like school. One such example that is especially compelling is *Why Don't Students Like School?*, by Daniel T. Willingham, an American cognitive scientist who has pieced together a very interesting observation.

Willingham argues that the human brain has evolved to avoid having to think. If we were thinking all the time, we would need to eat constantly, and because thinking consumes so much energy, we can barely think at night. The human brain has evolved to store experiences so that we do not have to think all day. That is, the purpose of our memory is to store knowledge. Yes, thinking is literally tiring, as it requires a lot of energy.

► In a world where machines perform a wide variety of tasks and where thinking is tiring and arduous, we must take advantage of such a genuinely human trait as asking questions. Curiosity makes us want to learn.

35 | Why things happen

The world is a very complex place, so we need many structured answers to avoid asking the same questions all the time. For example, let's say the Earth is round. We accept this fact because we have been taught it and because we cannot prove it over and over again.

However, much of the information we receive today comes from an elite that we should not trust blindly. There are many things that we simply assume because they are part of our educational heritage. The more knowledge we gather, the less we question the information we receive (which in practice it is

not possible) and the easier it becomes for someone to pull the wool over our eyes.

Therefore, there must be a balance between asking questions—because this is how we learn—and just accepting the status quo.

The problem comes when knowledge becomes dogma and thus part of the system, and it seems they are manipulating you to make you believe what they want.

► Curiosity is not just a tool to acquire knowledge, it is also the way we learn to do things, and this knowledge becomes engraved in our memory as an experience.

► We have to prepare ourselves for a world where, no matter how curious we are, there are things we must accept as dogma. To what extent are there things that we should simply *believe*, and other things that we should not just believe, but *understand*? It is very different to be told that the Earth is round and simply believe it, than to carry out an experiment or have some kind of experience that proves that this is indeed the case.

Figure 4.1 | The Earth [https://visibleearth.nasa.gov]. Photo: Reto Stockli, Alan Nelson and Fritz Hasler.

Another attribute that makes us human is our ability to **be critical**. That is, questioning things and doubting well-established answers.

Curiosity is the attentive and inquisitive observation of a situation, while **criticism** is the mechanism to ask questions.

In regard to these two concepts, educational models can vary greatly depending on the culture. Latin cultures are more masterful (teachers pass on their knowledge to pupils), while English-speaking cultures are more critical (or, at least, they were) and encourage students to ask questions and raise doubts for themselves.

For instance, was it really **Columbus** who discovered America in 1492 or was it the Native Americans who discovered Columbus lost at sea? It would be possible to design a history curriculum based on all the information available online and ask meaningful questions, such as: "Was **Napoleon** good or bad?".

Teachers could ask thought-provoking questions and students would have to research them. The answers could go both ways. In Napoleon's case, one could say that he was good because he created the law (the Napoleonic Code or administrative law, still in force) and bad because he started a war that involved half of the world and millions of people died. This would allow for a very productive debate.

► In this new fast-approaching society, we need critical people who question things. This can be done in many ways and does not have to be boring.

Figure 4.2 | *The First Disembarkation of Christopher Columbus in America*, by Dióscoro Puebla, and *Napoleon Crossing the Alps*, by Jacques-Louis David [https://wikipedia.org].

37 | Creativity

The third major ability that young people should develop is creativity. They must be able to observe their surroundings with a critical spirit and come up with alternative ideas.

► Curious people observe their surroundings, critical people ask questions, and creative people provide the answers. We need to be creative about real events and situations.

When it comes to creativity, there are many interesting stories, such as that from **Dominic Wilcox**, who came up with a toothbrush with a built-in toothpaste dispenser (and this is just one of his many crazy ideas). Wilcox combines art, design and technology to create surprising and provocative objects.

Figure 4.3 | Dominic Wilcox [http://dominicwilcox.com].

Another example is the **World Peace Game**, which presents young people with real, global problems related to peace, for which they have to find a solution. Their website states how "it is a hands-on political simulation that gives players the opportunity to explore the connectedness of the global community through the lens of the economic, social, and environmental crises and the imminent threat of war. The aim of the game is to extricate each country from dangerous circumstances and achieve global prosperity with the least amount of military intervention".

Figure 4.4 | World Peace Game [http://worldpeacegame.org].

And yet another example that shows that creativity is also found in the "little things": a 15-year-old American realized that if the Federal Government switched from Times New Roman to Garamond (a thinner typeface) in its written documents, they would save 400 million dollars in ink every year.

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Figure 4.5 | Times New Roman and Garamond typefaces.

- Creativity is essential. The mental algorithms that take place in creative processes are very difficult to reproduce.
  It would be very stimulating to have an education that is aimed at turning things around and seeing them from a different point of view. Everyone has different levels of creativity. We are all creative, but some people have not been trained enough or have not had the opportunity to really exercise this skill.

Transcendence is a human trait that surpasses an object's functionality. Throughout human history, all cultures—especially in Greece and China—have summarized transcendence into three concepts: beauty, goodness and truth.

Beauty is the aesthetic satisfaction of seeing and appreciating something, be it a painting or music. **Goodness** is human empathy, a trait that machines will struggle to incorporate because they essentially follow functional instructions. **Truth**, now in crisis, is being honest and sincere.

These three elements make it possible to understand the advantage that humans have over machines. What is it? Humans can work towards goodness, understand beauty and value truth. It is as if we had some physical senses to understand the importance of these values, which are what give humans the satisfaction of being human.

In addition to these three components, one could add a fourth: justice.

► We must take advantage of the fact that humans can recognize beauty, goodness, truth and justice, and educate ourselves in these values through creativity, curiosity and critical spirit, and then multiply our capacities by machines. What is a human being? Exactly this!

5 |
EXPERIMENTING

How can we make education innovative? Through projects in which students are faced with a challenge they need to solve. Conducting an experiment means looking for different components and then integrating and disintegrating them. Lastly, you have to build the object using your own hands and "bring it to life" with a simple programme.

39 | Project-based education

For some years now, the discussion regarding innovation in education has been centred around the idea of **project-based education**. It is already a reality in some schools.

This is an old idea with many modern applications: instead of working on a subject, pupils work on a project. A typical example is building a house. It is a comprehensive project that requires a wide variety of skills: you must be able to draw, know the materials, have basic knowledge of electricity, oversee legal issues... In short, a bit of everything.

Project-based education has now become quite sophisticated. Let's take a look at some interesting examples.

40 | Tangible projects

One of the most interesting schools providing project-based education is **Brightworks**, a learning community in San Francisco.

Students have to develop projects that are tangible or very straightforward to realize. These projects are not based on a series of presentations, but on achieving tangible results. Why? An essential human attribute is the close **relationship between our hands and our brain**. But this is a skill that must be developed.

Brightworks has a complete workshop, a machine room with circular saws, drills... When new students are admitted around the age of 8, the first thing they do is make their own chair. If they do not build a chair, they cannot sit down. In their first attempt, they usually assemble a heavy piece that is difficult to move

around, but their subsequent attempts become lighter, stronger and much more comfortable.

"We use real tools, real materials, and real problems to encourage students' love of learning, curiosity about the world, ability to engage, tenacity to think big and persistence to do amazing things", they say on their website.

Figure 5.1 | Brightworks [www.sfbrightworks.org].

► It is amazing how the human brain is shaped by project-based education. Thanks to our curiosity, our memory responds very well to the experiences gained through experiments. It is the perfect mechanism: you do something and you remember what you have done all your life.

41 | Educational projects

Another interesting school is **High Tech High**. It is a charter school, which means it receives public funding but is privately managed, and their entire educational curriculum is project-based. For example, their Marvelisk project consists of building an obelisk. This requires knowledge from many different disciplines such as chemistry (forging), history (hieroglyphics), physics (lifting large structures) and mathematics (angles).

Figure 5.2 | High Tech High [www.hightechhigh.org].

► Students show great interest in learning when it is based on hands-on practice!

Another example is **Project H Design**, which stands out for its characteristic way of teaching in communities, not necessarily in schools. This project teaches young people to design an object based on the "three Hs": heart, hands and hammers. In other words, understanding the reasoning, senses, feelings, meaning and tools.

Also worth mentioning is **KitCaixa Jóvenes Emprendedores**, an initiative for young people that Infonomia carried out in collaboration with EduCaixa. Attendees had to detect a problem in their surroundings (a problem at home, on the street or at school) and they had to work in groups to come up with a solution. This project proves the creative capacity that young people have and how stimulating it is to work on projects.

42 | Digital tools

You cannot experiment without tools. If you want to build a chair, you need wood and tools.

The first digital tool that can be used in schools is the **digital content** available online. For example, the conventional model of the solar system shows the planets orbiting the Sun, but this is not exactly the case. In a **DjSadhu** YouTube video, we can see how the solar system actually moves: the planets orbit the Sun but the Sun also moves through the galaxy. So, the planets move in spirals in relation to the centre of the galaxy. This video already exists and is

truly fascinating. Young people are captivated by these images and it is a resource that can be used immediately.

Figure 5.3 | Solar System 2.0 & Science Friction [http://www.djsadhu.com/research/solar-system-2-0-science-friction (VIDEO)].

► The content currently available online is a great treasure, but it is rarely used. Maybe it is because teachers do not have time to find creative ways to use them. This is the first time in history that we have had these kinds of resources and we should try to make the most of them.

43 | Teaching resources

There are countless educational resources online. For example, you can find hundreds of videos from the American public broadcaster **Public Broadcasting Service** (PBS). Teachers can also make their own videos using **Edpuzzle**, a simple YouTube video editor that allows teachers to create useful material without needing to know about computers and IT.

But language can be a big obstacle to accessing these tools. Currently, not knowing English not only prevents you from being connected to a global world, it also denies you access to a remarkable amount of information. So, **English** is important from a cosmopolitan point of view, but also when it comes to effectively using these tools.

44 | Learning to programme

The second key idea in experimentation is **programming**. As we will discuss in the following chapter, we currently have very simple programming tools that allow people with basic training to do very interesting things.

We are no longer talking about taking a piece of wood, sawing it and making a chair, which is a more hands-on activity, but rather about the possibility of making an object work, bringing it to life so it can do things. This is a brand-new phenomenon. It is a true revolution: with just some basic programming, young people can experiment and have an object perform an action.

► It is truly empowering for young people. It is a really powerful experience building a robot with some cardboard then using Arduino (a microcontroller that can be used for many different applications) to get it to move, light up its eyes and make sounds.

Learning to programme is essential for young people. As Douglas Rushkoff says, in the future you can either "programme or be programmed". Knowing how to programme does not mean being a computer wizard, but you must understand what algorithms and routines are and follow some basic guidelines on what to do. Washing the dishes is also an algorithm: you take the dish, turn on the water, put soap on the sponge, clean the dish, rinse it and place it on the drying rack.

Young people must learn to programme. If someone is learning to dance, they are learning to programme, as is someone that is learning to play soccer, or any kind of skill.

The term *programme* may sound scary, and maybe we should use another verb. But it is important to know that if this new generation wants to experiment, they must understand that they can build a physical prototype and animate it, activate it, "bring it to life", which requires a solid understanding of routines, among other things.

45 | Programming club

Many young people who study computer science would be willing to help children who are learning to programme. Schools are eagerly looking for people who can teach kids to programme and often they do not realize that older, more

advanced students could do it too. Unfortunately, for now we do not have the means to make these connections.

Another option is learning to programme in groups. There are programming clubs that meet on a regular basis and help each other to programme. For example, **Code Club** is a global network made up of volunteers and teachers, with over 13,000 clubs in 160 countries and more than 180,000 kids between the ages of 9 and 13. Also worth mentioning is **Vailets HackLab**, a Catalan community that holds programming, robotics and tinkering workshops, as well as talks and classes, "with the aim of promoting the development of children's different intelligences through technology".

Figure 5.4 | Code Club [www.codeclubworld.org].

46 | The ABCs of programming

Programming is not as difficult as it might first appear. A child can learn to programme in a very simple way. One of the most attractive options for kids is **Cubetto**, a project developed by Primo Toys. It consists of a wooden cube (Cubetto) that is screenless, friendly and ready to play; the blocks a board (or interface), where the programming blocks are placed, and an instruction manual. There are seven types of blocks with different shapes and colours, which symbolize seven basic actions: forward, left, right, function, backward, negation and randomization. All you have to do is place the blocks on the board and "tell" Cubetto where to go. Then you press the blue button and the program is executed.

Cubetto also includes maps, educational stories and challenges for children to enjoy their programming experience. With that alone, children are able to

establish a relationship between what is placed on the board and what the robot does.

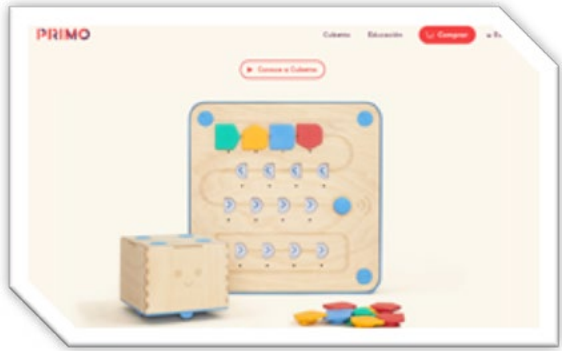

Figure 5.5 | Cubetto [https://www.primotoys.com].

Another simple option is **Tynker**, a comprehensive system that teaches children the basics of programming and designing games, creating applications and carrying out amazing projects.

47 | What is a programme?

Young people do not have to be programmers, but they do need to know the basics of programming. We are one step away from creating software that makes software. The best programmes are made by machines, but it is important that young people understand what programmes are.

A lack of knowledge about routines, procedures or algorithms will prove to be a major disadvantage for the young people of new generations. It would be like not knowing how to use a pen now.

► Programming is the result of massive intellectual humanitarian growth that cannot be ignored.

48 | Let's build it!

A step beyond experimentation is the need to build. We come up with an idea for a project, we carry out some tests and then we have to turn that idea into reality; we have to build it.

There are a lot of tools we can use to physically build an object. Lego, for example, with its diverse, interconnectable, plastic blocks, is one of the most attractive options. In addition, this Danish brand has several teaching programmes.

However, the next step—and the most recent one—is 3D printing. There are millions of downloadable files that allow you to build countless objects.

► Designing a pilot project, developing an object, manufacturing it and bringing it to life with a chip is an extremely powerful and rewarding learning experience.

► It is impossible not to imagine a new education that does not respond to the idea of experimenting and making objects with our own hands.

6 | COLLABORATING

When carrying out a project, the likelihood you know everything you need to know is pretty slim. You need other people to help you. We must learn to work in groups and develop collaborative skills, but personal effort is just as important. Collaboration is an extension of our abilities as individuals.

49 | Empathy and collaboration

Unlike machines, humans are capable of **empathy** and socialization. These are very human—almost mammalian—traits with deeply rooted physiological components. Humans need other humans. We need to have contact with other people. It may seem a disadvantage from an engineering point of view, but the need to socialize is also a virtue.

► We must teach young people to take full advantage of our most human traits, such as socialization. We are not really made to live alone.

However, we promote a social and educational model that puts **competition** before **collaboration**. It is hard to get people to collaborate with each other. We work together when we have no other choice or when we think we will gain from it, but philanthropic collaboration is not a very common virtue. So, we are faced with a dilemma: to collaborate or to compete. Collaboration might not be easy but it is necessary and, therefore, it is a skill that should be taught in schools.

50 | Working in a group or alone?

Many people think that the best way to work in school is in groups, but this is only partly true. **Susan Cain**, author of *The Power of Introverts*, confessed in a very insightful TED talk that as a young girl she often liked to stay at home and read books. One summer she went to summer camp with a bag full of books that she could discuss with the other kids, but she soon realized that it was not that kind of camp, and she admits that she had a terrible time.

Cain had spent her whole life believing that being introverted and calm was wrong, and that you had to be extroverted and outgoing. When people say that now, she replies that introverted people have made great contributions to humanity. Why is that? Because developing certain ideas requires concentration and individual work and effort. Collaboration can come later.

Figure 6.1 | Susan Cain
[www.ted.com/talks/susan_cain_the_power_of_introverts (VIDEO)].

51 | Creativity and innovation

In one of her articles, Renee Hopkins compares creativity and innovation. She states that creativity is an individual quality that requires introspection, while innovation is more collaborative. Inventors are people that lock themselves up at home and immerse themselves in a creative activity and create the perfect object. But for this invention to have a large-scale impact, people often need to collaborate.

► Young people must understand why we need to combine introspection and extraversion, personal concentration—the ability to think deeply—and collaboration among a group of people—the ability to think broadly.

This will make it possible to develop great ideas. We have spent years believing that collaboration is good per se. We just collaborate and that is the end of it, but we are mistaken. Collaboration should be a tool that makes the most out of each person's concentration. Unfortunately, though, this is the worst time in history to encourage concentration. The overwhelming amount of stimuli around us, especially digital stimuli, makes it very hard to focus.

52 | Shakespeare's tablet

In his book *Hamlet's BlackBerry: Building a Good Life in the Digital Age*, William Powers reflects on how obsessive connectivity affects our brains and our lives. He reminds readers that Shakespeare briefly featured in *Hamlet* a note-taking device consisting of a sheet of treated skin on which you could write, and later erase your notes with a sponge. Back then, that was a tablet.

Taking notes, answering messages and keeping an eye on your surroundings consumes a lot of energy. This is the so-called "always on" phenomenon. A few years ago it was shown that being connected all the time, responding instantly to everything that surrounds us and being in a constant state of stimulation causes a major lack of concentration. This is known as *working interruptus* syndrome, because you cannot work if you are always alert to external stimuli.

► Being constantly alert to environmental stimuli actually leads to a significant decrease in our ability to focus.

53 | Meditation

Learning to focus—let's not forget that this chapter is about collaboration—is very important and indeed necessary. If we do not learn to focus, we will not be able to contribute hardly anything interesting to the group. Collaboration per se is not very useful. In a soccer game, kicking the ball is not enough. You have to know how to do many other things and you have to be good at them. You must be able to multiply the values and abilities of everyone involved... And to ensure that the result of that multiplication is not zero, everyone must bring something to the table.

► Meditation is an incredibly useful skill that can teach us how to focus.

Meditation can be very effective in a school environment. Robert W. Coleman Elementary School in Baltimore has proved it. By replacing punishment with meditation, they have lowered the number of disputes and increased their students' interest and happiness. It is the equivalent of the traditional "thinking corner" or telling a kid to calm down, which in fact does not actually teach them how they must think or calm down.

► By meditating, children become more aware of themselves and their actions and it helps them to collaborate more effectively with their classmates.

54 | Me/we

The key element in this chapter about collaboration is the relationship between *me* and *we*. There is no *we* without *me*.

Paradoxically, the whole idea of collaboration must lead to concentration and **self-esteem**. If you do not build strong self-esteem, it will be hard to contribute to the effectiveness of the team

The ultimate goal is happiness. By combining personal spirit and collaboration, we can achieve great happiness.

55 | What is happiness?

According to Mihály Csíkszentmihályi, the flow psychologist, if somebody wants to be happy, they must first find the balance between anxiety and boredom. That is, you should not try to do things that go beyond your breadth of knowledge because you would feel distressed, but you should also avoid doing things that are too easy because you would get bored.

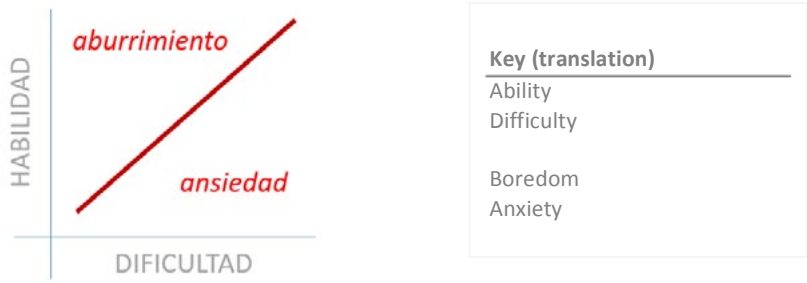

Figure 6.2 | Happiness is balancing anxiety and boredom.

Schools should help students to identify their ability level. They have to know how far they can go and take on challenges that allow them to make the most of their abilities. This will maintain Csíkszentmihályi's flow: a state of mind of full attention and total involvement with the task at hand.

► Schools' ultimate goal should be to help young people discover what interests them most based on their capabilities. They should not pursue goals that are beyond their abilities and interests. Many students become bored and others become anxious because education so far has not done a great job at managing this focus.

56 | Social values

In his excellent book *In Defense of a Liberal Education*, Fareed Zakaria passionately advocates a more liberal education, especially when it comes to humanities.

We will hardly be able to create a balanced society if we cannot give children a good reason as to why it is important to study humanities. If they are all engineers, they will be able to solve all kinds of problems, but will they be able to live in a harmonious community?

This idea is connected to the notion of collaboration. The only society with real durability is one where people understand that they coexist alongside others who must also be respected, and that they must be able to discuss and argue their positions and not simply impose them.

► Educating young people to collaborate is not just about efficiency, but also social conservation. A society made up of people who do not fully understand why societies are necessary, and who do not know how to enjoy beauty and social values, is likely to fall apart. An overly technified society is one formed by individualistic people who usually cause their community to fail.

57 | Political model

The generation now in school will have to completely reinvent our political model, since our system does not work. The current concept of democracy is in complete crisis.

There is a new model known as **deliberative democracy**, which advocates deliberating over our vote rather than just blindly voting. This means that we must teach children to be able to discuss, debate, defend their ideas and accept the ideas of others.

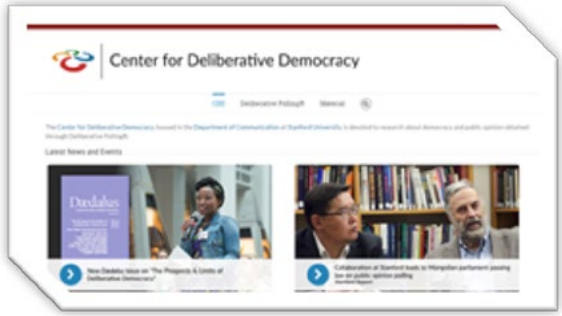

Figure 6.3 | Centre for Deliberative Democracy [http://cdd.stanford.edu].

Returning to an example from chapter 4, do we need to *know* who Napoleon was or be able to *discuss* him? At school, you could talk about Napoleon for days: how European geography has changed over the last two centuries, what wars are and how they are waged today, what the law is, what a code is... But how can young people finish secondary school and not know what criminal codes and constitutions are?

58 | Making sense of our actions

Fareed Zakaria, the author we mentioned before, argues that the future of humanity is *being human*—as was discussed in chapter 4—and taking advantage of our most human attributes.

It is only worth doing something if it makes sense and if it means something. As ***Wired*** magazine recommended on their cover, we should "build something meaningful". Our personal contribution to society needs to have great value. The proposals that only generate economic value can be very interesting, but they do not contribute to the happiness of individuals or to the effectiveness of society.

Figure 6.4 | *Wired* [www.wired.co.uk]

► Among other reasons, we must teach children how to collaborate because social models will change. The concept of family, how we live and even where we live, will all change.

7 |
INTEGRATING

Integrating is like sewing. It is about creating something useful by joining different pieces together, darning the right elements, not just physically, but also intellectually. We must possess the critical ability to determine the value of each piece and the best way to connect them, and this requires knowing how to "think with your hands".

59 | Mix and match

Education has traditionally given students pieces of knowledge. We had—and still have—an educational model based on the idea of presenting information that is broken down into different topics, and so the different elements are provided individually. However, the real world is very different from that: we need to mix and match very diverse pieces of knowledge.

The next generation will have to deal with their problems not by starting from scratch, but rather by taking advantage of everything they can get from their surroundings. They will find a tutorial on YouTube, a piece of software here, an expert there... And they will learn to combine them all.

► In the coming years, education must develop some essential skills: intellectual modesty and the ability to combine different elements.

60 | Innovating is integrating

MIT makes a list every year of **35 innovators under 35** who have done something interesting. There are usually some Spaniards among them. When you have a look at what they do, it is often difficult to understand. They are integrators: an engineer borrows a concept from neuroscience and applies it to construction; a geologist adapts a police conflict management model for earthquake detection... You can find some very interesting ideas.

Figure 7.1 |35 Innovators Under 35 [www.technologyreview.com/lists/innovators-under-35/2017/].

Over the coming years, we will see a wave of knowledge resulting from the creative combination of different pieces of knowledge from very diverse disciplines.

► We must teach young people to be integrators. We must show them how to arrange different elements in order and make them work. And to do this, we now have the best tools ever available.

61 | Agile and lean

Although at first they may not seem to be connected to the idea of integration, **agile and lean** methodologies are very instructive. *Lean* refers to a set of principles that allows us to discard tasks that do not add value to our work, while *agile* refers to sequential and early stages that add value and flexibility and allow us to modify the final product.

The **waterfall model** is the conventional model used until now to carry out projects. In this model you define the requirements, design the elements and finally implement them... It is a long process and until you reach the end you cannot know if the prototype works or not. The value is placed at the end of the timeline and the risk is cumulative: if it does not work in the end, you have lost all your work.

Education works in a similar way. We are educating young people but we have to wait until they finish their studies to see if it was worth it or not. Why is it that we cannot assess the value of education throughout the process? What is

stopping a high school student from teaching computer science to primary school children? Do we really need to wait until they have a title to be useful?

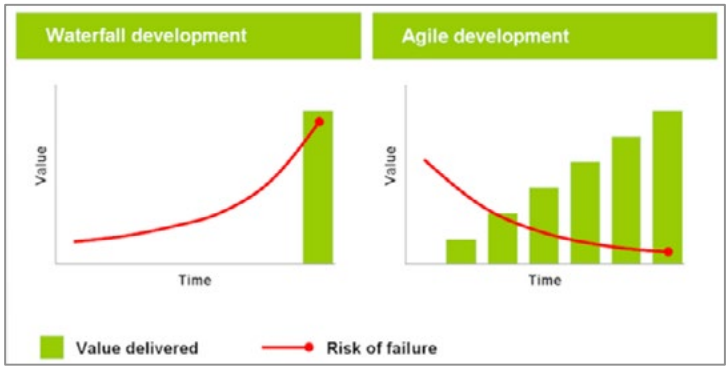

Figure 7.2 | Waterfall and agile development models.

However, the integration model is different. It is an **agile development model**, a very specific software methodology. The main idea is that every stage must be useful. If you know how to use Word, you do not have to be a computer engineer to teach someone else how to use it. This reduces the risk we mentioned earlier, because even if they are unsuccessful in their final assessments, at least they will have learned something during the course.

► I think education should be mainly about providing tools that can be used immediately. And that means integrating all the elements that are offered to students so that they can implement them right away.

62 | "What is the point" indicator

The key indicator for education is the so-called "what is the point" indicator. What do young people usually ask? Increasingly, in this environment with so many stimuli, they always ask "What is the point?".

For example, they might ask what is the point of learning Ohm's law, in which case teachers have to tell them that all electrical appliances follow this law very strictly. (Ohm's law links current intensity [I], voltage [V] and resistance [R] like this: $I = V/R$).

Students are given pieces of knowledge just in case, hoping that the accumulation of information will prove useful at some point. Instead, the

integration model serves other purposes since each stage is valuable on its own. For example, building a house from the roof down is very different from starting with the pool. When the swimming pool is built, we will be able to bathe. The construction of the house will come later.

► It is essential to provide young people with knowledge that is progressively useful, not just useful when it is over, which in the end represents a huge loss of opportunities for society. Kids should be taught things that are of immediate value.

63 | Elements of integration

Integration is a very interesting concept. It basically means merging three elements: hardware, software and humans.

hardware (physical)	+	software (logical)	+	humans (know-how)	=	INTEGRATION

Figure 7.3 | Elements of integration.

For instance, let's imagine a project that aims to use dance to solve problems. We would need to find videos, a venue and an expert on the topic. When you need information about something, you need to find a source: books, websites or people. But you need to learn how to do it. **Integrating** a person's subtle and tacit **knowledge** requires some training, where empathy plays a key role.

► Young people must be integrators, but their ability to obtain the knowledge they need from other people in the first place will depend in great measure on their social skills and their attitude.

64 | Thinking with your hands

Another basic concept is **tinkering**, that is, thinking with your hands. Integration is about working with your hands, touching things and DIY-ing.

The tinker generation touches the different elements and plays with them. It is no longer acceptable for someone to say: "I am not a handyperson". What is that supposed to mean? Is it because you physically are not, or because your education did not teach you how to use your hands, one of the main and most useful tools we possess?

► We have to move towards an education that makes it impossible to say "I am not a handyperson".

65 | Integrative workshops

A good example of "thinking with your hands" are the **Repair Cafés**, which are located in several cities around the world. They are free meeting places where every month you can take a broken object and repair it with the assistance of an expert. It is an amazing idea. It would be great if schools put on one of these workshops once a month, where handy parents (surely there are many) could go and help. People could take their broken lamp, glasses or toaster and repair them together. The culture that is created by integrating and tinkering is simply sensational.

Figure 7.4 | Repair Café [https://repaircafe.org].

Another example of integrative positivism is the "plant hospital" that the Botanical Garden of Barcelona held once a month. It was a free plant consultation service where you could bring diseased plants (or a photo of them) and a botanist or expert gardener would examine it and offer advice on how to revitalize it.

66 | What is an entrepreneur?

Right now, entrepreneurship seems to be the greatest opportunity. But what is an entrepreneur? Generally speaking, an entrepreneur is someone who detects a problem, integrates the knowledge of several people to solve it and pushes the idea forward.

Training people using the integration model is closely related to teaching people to be entrepreneurs. We think that an entrepreneur is someone who has a magical idea and does everything on their own, but an entrepreneur is essentially an integrator. **Entrepreneurs** coordinate a team, seek financing and seduce people. They gather knowledge and bring the different pieces together and are people with great social empathy. They are like orchestra conductors who know how to harmoniously combine all the different melodies.

► Integrators know how to assemble the pieces of a complicated project and successfully carry it out. Being an integrator makes it easier to be an entrepreneur. If you are not an integrator, you will not be an entrepreneur, because you are not able to do anything on your own.

67 | The key to success

With experimentation, collaboration and integration, what is the goal we pursue in educating young people? What guarantees their success? We have already briefly discussed happiness (chapter 6, "Collaborating"), but we need to be more specific now. There is an acronym that sums up the idea of happiness: GRIT. That is, guts—or growth—, resilience, instinct and tenacity. Interestingly, the noun *grit* bears the same meaning as the acronym: tenacity, firmness and courage.

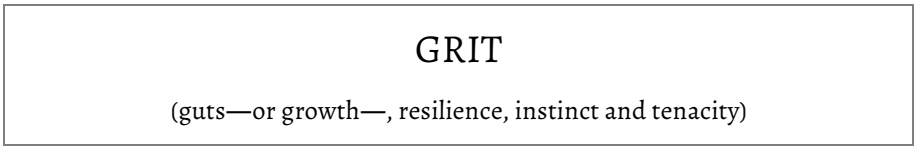

Figure 7.5 | GRIT: the key to success.

According to research, regardless of socioeconomic background, level of education, time invested... the most important factor in success is **persistence**.

What makes a person successful in their education? Persistence. Experimenting, collaborating and integrating, not giving up, facing the same problem over and over again and using all five senses. This is what makes the difference.

68 | The secret of education

Ralph Waldo Emerson, a distinguished American educator, said that "The secret of education lies in respecting the pupil".

Respecting the pupil means listening to them, supporting them and treating them as human beings. Ultimately, showing **respect** for students and proving to them that you are interested in what they are saying or that you like their questions is more meaningful and has a greater psychological effect than simply transmitting information.

PART III
The agents of this new education: parents, mentors, tutors, spaces and educators

8 |
EVERYONE'S TASK

All agents involved in education must be involved in schools. Parents who share their knowledge help as a tool to understanding how the real world works. Tutors and mentors are a source of support and advice for students. Local businesses can provide knowledge and resources.

69 | Persistence circle

We have known for a long time that the education of young people cannot be left to teachers alone. Now, in an increasingly complex society, we have learned that the key to learning is **persistence** (Chapter 7, "Integrating").

If success is not dependent on someone's background or even their education, but rather their persistence, their environment and the people that surround them, it is essential to try to find out how the will to persist, to make an effort and to be consistent, is transmitted.

70 | Parents as teachers

Parents can play an important role when it comes to learning how to be persistent, as they may have a totally different view from their child.

In addition to the psychological component that links them to their child, parents can be involved in their education from a **professional perspective**. It could be very interesting to involve parents and institutions in schools and give them a platform where they can tell children about their jobs.

► Having parents share their knowledge and experiences could be extremely beneficial for children, but it is not done enough. What kids do at home and what they do at school are somewhat disconnected.

71 | Parental involvement

The **DonorsChoose** project shows how parents can get involved in schools. On this website, teachers state what they need at their school and what their budget cannot cover. They might post something along the lines of: "I need these books or that microscope, it costs this much and we cannot afford it". Parents can make a donation for their children's class or for other classes. It is as simple as hosting a crowdfunding site, a market of multitudes, to obtain the resources needed.

Figure 8.1 | DonorsChoose [www.donorschoose.org].

Perhaps this is asking too much of parents, but it is equally true that sometimes we do not take into consideration that they might **want to help**; if not with money, then perhaps with their time.

The scarcity of parental involvement in education is an important matter that remains unresolved.

72 | Mentors

Guides or **mentors** are also significant agents in education. At school there are usually some tutors who follow their pupils' journey and help them, but in this case we are talking about people who are not professionally linked with the school or the pupil, but can still pass on some of their knowledge or experiences.

Three good examples are **Big Brothers Big Sisters**, the New York Academy of Sciences and **Citizen Schools**.

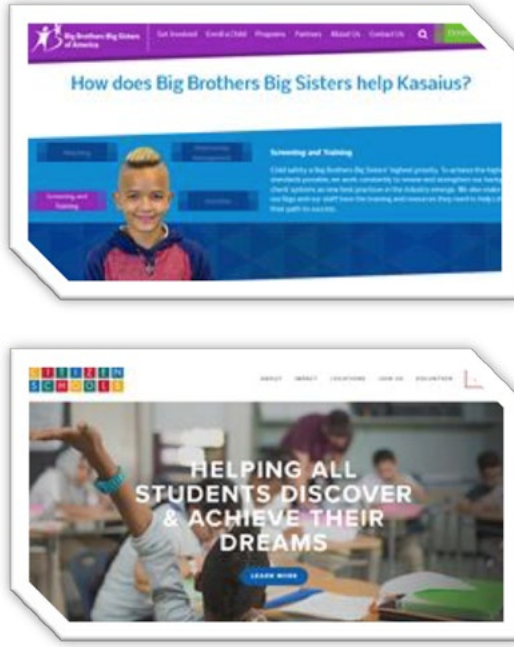

Figure 8.2 | Big Brothers Big Sisters and Citizen Schools [www.bbbs.org] [www.citizenschools.org].

These projects are all made up of volunteers who help children that may be more vulnerable to bullying or harassment because of their vocation. Unfortunately, being passionate about maths in high school does not always make you the most popular student.

These platforms allow university students to accompany and help younger students. They have already gone through the same experiences and are pursuing their technical or scientific vocation, so they might tell them: "I know what you are going through, do not worry about it too much, you will be fine and you can achieve whatever you set your mind to".

These **mentors** are people just like us, but a few years older. This idea will probably be appealing to many young people and adults who could offer a different perspective that would be very helpful to younger students.

73 | The power of companies

Another major agent in education—especially in universities—are companies. This idea is based on the fact that we really learn something when we work on it. Metaphorically speaking, when you start your first job, you feel like you have a general idea of the grammar they speak, but often you cannot yet form a whole sentence.

In such a complex and accelerated world such as ours (chapter 1, "A different world"), we can acquire real knowledge by working in **companies**. Companies play a strong educational role. The dual, German model is perhaps the most significant example (see below).

74 | In-company learning

The dual model used in Germany, Austria and Switzerland is based on deciding, after secondary school, whether or not to pursue an academic career. Many people opt for vocational training, which offers high-quality training that includes working in a company alongside school-based study. Interestingly, this option creates precisely the type of professional we said was necessary: someone skilled in the use of tools and who knows how to multiply their human abilities by machines. For instance, this training can provide a hands-on engineer with both theoretical and practical knowledge. The dual model is one of the keys to the success of the German economy.

► We need people that are skilful, expert, handy and clever, with the capacity to tinker, to do and to execute. In this sense, I think in-company learning is essential.

In a future where machines will do the majority of routine work, our society cannot be divided into those who have a higher education and have mastered symbols and abstractions and those who do repetitive work, because machines will eventually replace them.

► We must distinguish training from education, and it is here that companies can play a very interesting role.

Stratasys is the global leader in sophisticated 3D printing, offering completely free 3D printing courses online. Where could you learn more about 3D than in a company that specializes in 3D?

Figure 8.3 | Stratasys [www.stratasys.com/industries/education/educators/curriculum].

If you want to learn the basics of everyday computing, you could go to an **Apple** store, for example. You can take a course, naturally, but shops that specialize in technology will also teach you how to master the basics.

Figure 8.4 | Apple [www.apple.com/everyone-can-code/].

When the economy is built around companies with very specific know-how, that is, when what makes companies stand out is their knowledge, companies will become the place where students can go to learn. They will provide the knowledge that makes students stand out. We must start to consider this option for primary and secondary school as well.

76 | African talent

Andela is an African project that works in a very interesting way: they look for the most skilled people in software and programming all over the continent. Their work is based on the premise that there are many young people in Africa. If you just took 1% of the young population, it would still be thousands of people.

Andela carefully selects African students that are skilled in IT and trains them up; sometimes they even go on to work for the world's leading corporations.

In other words, they are creating new opportunities for young people: it does not matter in which country they live, they can still work for a major multinational. This trend will start to become more and more common because it will be possible to do these jobs remotely. People will not go to work where they live, but rather they will be able to work on international projects from all over the world.

77 | Online tutors

Another educational agent to consider are online tutors. In English-speaking countries, it is becoming increasingly common to work with a tutor located somewhere else on the planet, especially in India. A young English student can do a maths lesson with an Indian teacher via Skype at a very reasonable price.

Thus, new professionals that we had not previously considered are now part of the education system. These people, who are not physically at the school and not even in the same country, create a virtual, remote connection with their students.

78 | Flipped classroom

Flipped classrooms were developed and popularized by **Khan Academy**, whose CEO is Sal Khan, an India-born graduate from MIT and Harvard who also worked at Wall Street. He said he came up with the idea while using some videos to help his cousins in school.

Now, this academy offers an enormous collection of courses on a wide range of topics, especially technology, but also humanities. Absolutely everything is explained through videos.

Again, this new educational agent is different from schools and parents in that it is not physically close to the students; someone somewhere uploads a video to the Internet and students watch it.

Figure 8.5 | Khan Academy [www.khanacademy.org]

With all these well-designed materials available online, the traditional concept of classrooms can change a great deal. In flipped classrooms, young people learn mainly from home by studying these materials. The idea is that they watch the video prior to going to school, and then they can work with their classmates and check what they have learned.

Given that students have spent some time studying at home before arriving to class, teachers can quickly see if students have understood everything and where they need to focus their attention. In any case, it will not be the teacher who identifies where this attention needs to be placed, but rather a classmate or a student from a higher course.

This educational model is really amazing. The new educational agent are **classmates** or slightly older students, since they are all together in mixed classes. This is not currently possible with our traditional educational model, where you have to prove your intelligence by doing some exercises on the blackboard.

This new model allows students to study and prepare coursework at home and then ask questions in class. Students go to class having already worked on the topic of the day. From a cognitive point of view, having previously studied a topic creates a very different experience than to going straight to class not knowing anything about it and having someone explain everything to you from scratch. This is how you flip a classroom: the lesson takes place at home, while questions and more social activities are done at school.

9 |
THE SPACES

The concept of *classrooms* is in crisis. Spaces are now arranged based on the goals pursued, not the other way around. We must thoroughly rethink the architecture of learning, or perhaps it would be enough to make the most out of a city's existing cultural infrastructures and boost the idea of schools without schools.

79 | Space or subject?

When it comes to innovation in education, there is a lot of literature about pedagogical models, but not much has been written about the physical models of schools and what they should look like. However, there have been some interesting experiments.

In recent years, there has been a lot of talk about a small revolution made by a group of Jesuits in Catalonia. They have taken down walls and joined two classrooms, they have employed three teachers instead of two and they have rearranged the timetables.

► The physical change to classrooms is very significant. We have to leave behind the idea that classrooms should be spaces with twenty people sat staring at a blackboard. It makes no sense: it does not capture the students' attention and it is not a productive way to transmit knowledge.

In several experiments in Sweden, the *subject* has taken over the *space*. Students are no longer gathered in a classroom all day, but rather they move around depending on what they are studying. Maths is taught in one space with one group of classmates, while art is taught elsewhere, possibly with other classmates. What prevails is not the space (there may not even be any classrooms), but rather the subject and the students' abilities, vocation and interest.

A good example is Swedish schools **Kunskapsskolan**. Students are divided into base groups that change during the day. They meet in the morning and afternoon with their base group and during the day the groups change depending on the subject and each student's goals and motivations.

Figure 9.1 | Kunskapsskolan [www.kunskapsskolan.se].

Space is very decisive. If young people spend their whole day in an enclosed space, they will end up producing toxic behaviour that comes from spending too much time within the same four walls.

The book *The Third Teacher*, a collaborative project by Cannon Design, VS Furniture and Bruce Mau Design, offers many examples of small changes that can be made in a space to improve perception and concentration. Wheeled chairs are one of the most notable changes. Simply being able to move a little stimulates our brain, which makes it easier to stay focused.

Another example is **Green School**, located in Bali, Indonesia, which is a great metaphor for nature and creativity. A school that wants to convey a message about nature should ideally be surrounded by nature. And a school that wants to transmit artistic ideas must have plenty of natural light and open spaces.

Figure 9.2 | Green School, in Bali, Indonesia [www.greenschool.org].

► A school with no walls, no classrooms, arranged by groups and where its main theme is well reflected. At High Tech High (chapter 5, "Experimenting") machines are everywhere, because they want to visibly demonstrate their technological vocation.

81 | Architecture for education

We must take more time to consider the physical design of learning spaces. We do not yet have an architecture for education; there are no clear guidelines as to how an educational centre should be built. That is why schools are sometimes designed around questionable ideas. Schools must physically contribute to stimulating learning.

► It is essential that there are architects who specialize in the requirements of creative spaces.

82 | Space or time?

We must stop thinking of education as a *space*, and think about it more in terms of *time*. We should not think about schools as closed spaces where children spend their day inside, but rather we should give time the importance it deserves: when do I want to learn?

Learning has to be organized in a time-sensitive way. There are many moments during the day when we could learn, not just the time spent in school.

83 | Out of school

Some education theorists argue that the future of schools is for schools not to exist; we will learn outside of the classroom. What does that mean? It means that we have enough infrastructures in our surroundings to learn. It might seem a little drastic, but we do in fact have art museums, science museums, zoos, parks, gardens... We should consider that maybe there is more knowledge outside schools than inside them.

We have seen some interesting learning experiences carried out in buses, such as the **Door Step School** in Mumbai, India, which is a school that travels to the children, not the other way around. This is the only way they have access to

lessons. **NewTechKids** is a Dutch project based in Amsterdam "dedicated to igniting the problem-solving capabilities and innovative spirit of children". EducaThyssen's **Big Valise** is conceived as an educational project and also as a collective work of art. It aims to research and share experiences regarding how art is taught, taking the works from the Thyssen museum as its starting point.

Figure 9.3 | NewTechKids [http://newtechkids.com/en].

Some time ago, Infonomia took part in a project to place a complete 3D lab inside a bus and drive it around. The project might not have had the success it was hoping for, but it proved that there are things that cannot be done inside a school, no matter how much money you have, because they need to be portable.

► Objects that go from school to school. Travelling knowledge materialized in objects.

84 | Online electives

With so many online programmes aimed at secondary school education, electives suddenly multiply. For example, a high school might consider teaching Italian as an elective. Previously you had to request a teacher (and cross your fingers that they accept your request), but now you simply have to implement an online programme. Just because they do not have a physical classroom and a physical teacher, does it mean that schools should not offer a series of subjects that students might find interesting? This will soon revolutionize education.

► We are not using online programmes to their full potential to expand schools beyond their walls. The idea is to look *outside* for the knowledge we will never find *inside*. For now, it is completely untapped potential.

85 | Learning at home

Just like with flipped classrooms (chapter 8, "Everyone's task"), this is another revolution. When children study from home using online materials, they will need introversion (chapter 6, "Collaborating") to focus their attention to learn something, either alone or with a small group of friends. Therefore, at home they will increasingly work on their concentration.

In addition, we have a wide variety of materials available online. For example, **Bitsbox** is a code academy for kids from 6 to 12 years old and every month they send you a project to learn to programme at home. It makes for a fun learning experience.

There will be more and more materials like this aimed at improving the learning experience at home... And I dare say also outside of home, that is, children may do some tasks at school and others in another location in small groups. In the morning they will go to school where they will socialize and be given challenges, etc. and then, in the afternoon, in small groups at someone's home, they will do more intense work that requires higher concentration and greater understanding. This is where they will really learn.

86 | Knowledge coach

The coming revolution in materials and technology that will give us access to knowledge remotely will make it possible to study at home. Previously we had no choice but to go to school to learn. Now it is almost the other way around: home is where we can learn the most.

However, I believe that there will be a new professional to help us achieve it: a **knowledge coach**, who, for example, will spend a few weeks at a time coordinating small groups that are deeply immersed in a project that interests them.

87 | Credit market

When obtaining diplomas through online programmes becomes even more a reality all around the world, education will experience a great change, especially in universities but maybe even as early as secondary education.

There is currently a wide variety of massive open online courses (best known as MOOCs), many of which are free, but if you want to obtain a diploma you must take a conventional exam.

You can now obtain a degree or postgraduate degree online from some universities. However, this will soon become a widespread possibility leading to a transformation in the world of education. Universities are already close. This is the so-called **credit market**. When there is a university credit market, a first-year student will be able to do, for instance, 60% of their studies at their university and 40% in online programmes based on their specific interests. When it becomes possible to get a degree certified by another university, the revolution will be even greater.

This credit market now applies to university courses and will eventually be applied to secondary schools, too. Let's have a look at an example. If a student is interested in Egyptian art, their teacher will recommend them to take a specific online programme, either alone or in a group, and either where they live or with other students from around the world.

It is interesting to observe not just what universities do, but also what online learning companies do, such as **Coursera** and **Udacity**, among many others. They understand that this is a business and so offer very specific courses aimed at providing skills. Nowadays, these studies are common after university and are very career-oriented. They are almost occupational courses.

Figure 9.4 | Coursera and Udacity [www.coursera.org] [https://eu.udacity.com].

88 | Customized Education

The current trend is moving towards a highly customized education. It is like we are spiralling back in time. The only people who had the chance to study during the 18th and 19th centuries were those with money, and it was always a customized education.

Before Bismarck's education model in Germany, which still prevails today, those who were lucky enough to receive an education had a tutor. Now, this spiral is returning to where it started with the idea that in order to learn, you need a tutor. The difference is that instead of just one student doing it, now there are millions. This is how history repeats itself. Now we are doing the same thing, but in a new and innovative way.

► Where is education headed? We are moving towards a customized education thanks to online systems targeted at millions of people. This is known as *mass customization*, which is a very popular concept in e-commerce.

89 | Street education

The aim is to create new structures in the streets to transmit knowledge. I think we all wish that any business, product or service also had an educational element to it. For instance, if you are a bank, why not create a museum of money? We have seen some progress, but there is still a long way to go.

One example would be the Erste Financial Life Park (FLIP), the first museum devoted to financial education in Vienna, which focuses on improving children's and young people's financial skills. Also worth mentioning is the **Interactive Museum of Economics** (MIDE), in Mexico, which teaches visitors how the economy works.

Figure 9.5 | Interactive Museum of Economics (MIDE) [www.mide.org.mx/mide].

Although it is not essential to set up a museum to properly explain an industrial process, Aigües de Barcelona runs the Agbar Water Museum in Cornellà de Llobregat, Barcelona, which allows visitors to discover a rich industrial heritage, visit water facilities from the early 20th century and appreciate the values associated with water culture, respect for the environment and sustainability. Half the visitors finish the tour with a vocation to be engineers.

► Streets cannot remain disconnected from the education of all citizens.

90 | Flow of knowledge

Knowledge is a flow, not a stock item.

Museums are seen as an accumulation of knowledge, just like bookshops and libraries. This accumulation of knowledge is useless in a liquid age like ours. That is why it is necessary to turn knowledge into a **flow**, which will allow us to use it in multiple ways.

91 | Educational cities

Cities must find a way to spread the knowledge of all citizens and make it flow. This suggestive approach favours the development of autonomous citizens capable of contributing to our collective benefit.

Instead of having individualistic citizens with their own personal knowledge, which can lead them to compete against each other, knowledge flows to the benefit of all.

Cities must find mechanisms to train and educate their citizens. As such, it is a matter of knowledge and not so much of spaces.

For example, **Smartify** is an app that allows you to scan a piece of art from a museum and then interprets it and adds music. Let's imagine what it would mean for a city to have its museums valued as a source of knowledge, not as a catalogue or a repository!

► Cities treasure a large volume of knowledge that is not leveraged, resulting in a significant loss of resources and capabilities.

10 | EDUCATORS

Teachers' main responsibility is to discover and develop their students' talents. Teachers must determine the best learning method for each of their students; they are coaches who help students find their way. To do that, we need vocational, creative and committed teachers.

92 | Teachers' enthusiasm

The book *Teach Like Your Hair's On Fire*, by **Rafe Esquith**, made a great impression on me when I read it.

The author, who has been awarded the prize for America's Best Teacher several times, is a public school teacher in a deprived neighbourhood of Los Angeles. He is passionate about helping kids succeed.

Every morning his classes begin half an hour earlier in order to better plan for the day. He is completely **involved** with his students and the school, which is located in a neighbourhood with limited resources and many immigrants. Every year he has new students who do not speak English, but who finish the year performing a play by Shakespeare.

On top of being heavily involved in the school, his methods are very creative; for instance, he uses baseball scores to teach maths. His book is full of examples of how to do things differently and creatively to attract children's interest and attention.

Figure 10.1 | Rafe Esquith [www.npr.org/templates/story/story.php?storyId=6939776 (INTERVIEW)].

93 | Teaching vocation

Being a teacher is very vocational. Teachers must have a strong disposition to *cultivate* children, in the sense of *educare*. It is almost a matter of sculpting and shaping the human beings of the future. Teachers are very lucky to be able to do this, but it comes with great responsibility. It is a self-sacrificing and very vocational activity.

In the future, educators will be able to get involved in the more human side of education. We will not need so many teachers, because an important part of the acquisition of knowledge will be done using software. Teachers will therefore be able to focus on the more psychological side of education.

► The role of educators is to *educare*, get to the roots, shape their pupils, discover their talent and stimulate it.

94 | Detecting talent

What should be teachers' main goal? They should be trained to detect their young students' talent and help them develop it.

Unfortunately, we take too long to understand what we like, what we can do and how we learn. Identifying how we learn is essential, but we are never taught it. Do you learn by reading? By listening? By doing? By explaining? These are all very different methods!

In my case, I came to the conclusion that one of the best ways I learn is by explaining something to an audience. When I have to prepare a topic to present in public, I come to realize whether I understand it or not. However, there are people who learn differently.

► Happiness is making the most out of your abilities (chapter 6, "Collaborating"). It is the balance equation between what you expect from yourself and your abilities. Do not demand more or less of yourself. Make the most of your capabilities and you will achieve Csíkszentmihályi's flow.
This is why we must help children to discover their individual talents.

95 | Teachers' commitment

Much has been said about the Knowledge Is Power Program (better known as **KIPP**), a network of American schools whose educational curriculum depends heavily on their teachers' commitment. These schools are located in deprived neighbourhoods, have very long schedules (so that children are not on the streets) and demand great commitment and dedication from teachers, who must have a great vocation. It is essential to have teachers who are willing to work hard to educate young people!

Figure 10.2 | KIPP [www.kipp.org]

96 | Entrepreneurial teachers

Educators who have a special ability to structure and transmit knowledge effectively do not need to be in front of a classroom with twenty students. Such is the case of David Calle, manager of the online academy **Unicoos**. He used to work as an engineer but when he lost his job he decided to explain maths online and now he has thousands of followers. This is another possibility. If you can transmit knowledge, structure it and explain it, you should not limit yourself to a classroom.

Figure 10.3 | Unicoos [www.unicoos.com].

There should be a greater vocation to transmit knowledge. Not all teachers can be that fantastic combination of experts on both the subject and on child or youth psychology; they may be good at just one of these requirements. If you are brilliant at explaining maths, you can explain maths online, and if you excel at motivating people, you can focus on that. Both types of teachers can be present at the same school: a content-based teacher and a psychologist teacher.

In the **E3 project**, which Infonomia carried out for Fundación Telefónica, we observed that there were many teachers who came up with interesting ways to present a subject, such as a workshop or a game, but they did not turn it into a project that other people could use too. This new experience stayed in that school and was not shared with anyone else, because it was very difficult to turn into a package that others could also replicate.

There are many interesting examples of this, which is why we need a platform to collect these experiences of explaining something in a different way so that later others can make use of it too.

► There are few entrepreneurs in the education business who go the extra mile to turn their fantastic idea or superb practice into a project that can be used in many other schools.

Gever Tulley and Julie Spiegler, founders of Tinkering School and Brightworks (chapter 5, "Experimenting"), wrote ***50 Dangerous Things***, which has become a source of inspiration for many people. The book offers children simple instructions on how to do fifty dangerous things and get involved in fun and challenging tasks.

Figure 10.4 | 50 Dangerous Things.

97 | Interns and resident teachers

We should apply the dual education system (Chapter 8, "Everyone's task") to teachers as well, just like what happens with doctors who, after their medical studies, spend some time in a hospital. They would be teachers in residency.

Studying at university is not enough. Education has a very important psychological element; it is not just about transmitting content. Teachers may cease to be knowledge transmitters and become psychologists who educate people, but there is still the tacit knowledge that we must learn from other people. That is why having **teachers in residency** is so important, but unfortunately this programme does not yet exist. This way, you would not become a teacher until you had spent a year in a school being mentored by an expert.

98 | Microschools

Some schools have revolutionary teaching models, like **AltSchool** in San Francisco, created by Max Ventilla, who had previously worked at Google. AltSchool prepares students for the future with a series of customized learning experiences in microschooling communities. They are small schools coordinated with one another in such a way that they become a **learning community** instead of warehouses of kids.

A microschool is a small learning community with 20-80 students which adapts to the needs of teachers, parents and students. AltSchool fosters a great sense of community while benefiting from the resources and innovations from the network of associated schools.

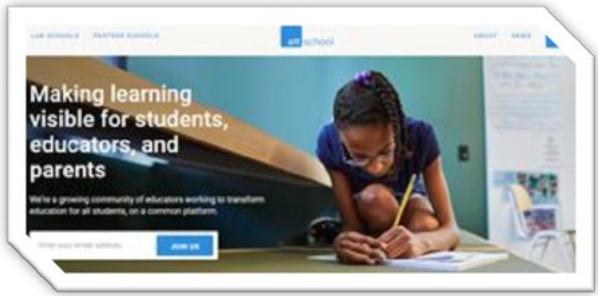

Figure 10.5 | AltSchool [https://www.altschool.com].

Many of these microschool teachers have a strong entrepreneurial spirit. They take the opportunity to come up with new ways of teaching and stimulating young people. This educational model offers a customized education for students. Each student is taught different content each week based on what they have learned during the previous weeks, and teachers have some unusual responsibilities; for example, there is one person in charge of assessing parents' satisfaction and another for that of teachers.

► Schools are not just places where teachers explain things. Schools play other equally important roles in the transmission of knowledge that must be performed by well qualified people. As we have seen, in the near future students will get most of the explanations and content from online tools and technologies.

99 | Educational experiments

The strategy from the automobile industry could also be applied to education. New developments (brakes, paint, safety features...) are usually tested in high-end, expensive cars that are aimed at a very small portion of the population, and eventually they trickle down and are added to the standard models.

► We should experiment more in education, but we should not experiment in all schools; only in certain schools that carry out a more scientific analysis of what works and what does not.

I believe the great mistake of educational authorities is this excessive trend to implement the same things everywhere. The idea that this approach makes

education equal for everyone is outdated. A school that is developing something different and experimenting with new ideas is not widening the inequality gap between themselves and other schools. You cannot experiment everywhere. We must experiment in specific fields and then share what we learned from that experience with other schools.

► Instead of having a law that outlines what needs to be covered in schools, what we really need is to be able to experiment more.

100 | The future of education

What should teachers do? What are their main responsibilities? According to Ralph Waldo Emerson, it was "respecting the pupil".

The future of education is to freely shape humans and mould them into fully-grown adults. It is not a matter of simply transmitting knowledge, which machines will probably do in a few years' time anyway. Whether education succeeds or fails will depend on the students' happiness. If they are happy, it will be because someone helped them to discover what they like and what they are good at, which will be their main focus; they have put their effort into what they are skilled and passionate about. This help can only come from someone whose role is to accompany them in their journey, encourage them and respect them.

► It is clear that education must change in the coming years given that we find ourselves saturated with technology and an increasing number of social problems. To do this, we must educate people in a different way, emphasizing those essentially human traits.

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It is a new education. A radically human education in a world of machines.

In this new, global world, information is always at our disposal and machine translation has become a reality. Humans live alongside smart machines that are capable of doing more and more tasks that were previously considered distinctly human. In this new scenario, bold ideas are quickly transformed into everyday services or objects.

This future is almost upon us, so it makes no sense to teach young people how to do tasks that can be done by machines. Humans are very different from machines in many ways. Our essence as a species lies in the empowerment of human characteristics: curiosity, creativity, imagination, critical spirit, empathy, collaboration, sensitivity, the ability to conceive ideas, to manufacture, to build with our own hands... These are probably the most distinguished human skills and abilities.

In this changing and diverse scenario, education faces a great challenge: to discover each individual's talent and encourage them to develop it to the fullest by deploying their own skills. This new education is based on such basic concepts as experimentation, collaboration and integration, that is, our remarkable ability to create something new by combining the most diverse components.

We are committed to transforming education and adapting it to new contexts. In fact, we now have the opportunity to be one step ahead of the future. But we have to do it together, in new educational spaces structured according to the goals we pursue, and with a new team of committed educators, who are well-trained and specialized in discovering and enhancing the most useful and effective ways of learning for each individual.