Chapter 10

An Education Towards the Future

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'(…) we will have computerised devices the size of blood cells and in the 2030s they will go non-invasively into our brains and basically put our neocortex on the cloud'

Ray Kurzweil [1]

Abstract

By the 2030s, we will have computerised devices the size of blood cells that will put our neocortex on the cloud. Current 3-year-olds will graduate in 2031. Borders are progressively irrelevant and a global approach is essential. Teachers must prepare their students for a global society of permanent access to varied information and resources: from AI-assisted processing to actions carried out by robots and autonomous vehicles. Four main conditions seem essential: Permanent *updating*: Standards and practices must be constantly revised, exactly like software is and for the same reasons. Collaboration: A multi-faceted approach indispensable to develop high-quality education through combined efforts. Autonomy: Educators see their mission hindered by one reform after another. Governments must allocate the appropriate resources and let professionals do their job. Individualisation: There are endless variations of human brain and capacities. We must serve all that diversity: it is a duty towards each individual and a benefit to humanity. The chapter will illustrate four eras of knowledge through human history. It will analyse the contributions of the International Baccalaureate. And it will outline the approach at San Francisco de Paula, Sevilla International College, inspired by the International Baccalaureate (IB) and Singularity University.

Keywords: educational innovation, entrepreneurship, international education, technology, learning, knowledge

1. Introduction

The statement above may sound shocking; still, it acquires even more relevance if we consider that current 3-year-old students will graduate in 2031 and today's pregnant women will see their children enter university in 2035 or 2036 (what university may have become by then is a part of the conundrum, too).

Teachers today face the challenge of preparing their students for a world that will bear little similarity with anything we have known so far. A society of global, permanent, instant access to the widest variety of information, and resources—from complex AI-assisted, 'mental' processing to physical actions carried out by robots and autonomous vehicles. Sharpening flint arrow-heads when planning to get a steak for lunch is as relevant to us today as many of the current school activities will be to the students in their near future. It is not only to *future* students but also to *our* youngest students, already in our classrooms; those who will have a full-brain-capacity computer before they start their secondary education, given the pace of technological evolution. The world is accelerating at an increasing rate, as Singularity University (SU) shows [2].

The question, then, relies on defining what should be taught, with specific reference to the role of technology. In order to do so it is important to note first that the changing relevance of knowledge has been accompanied by a transformation of the nature and purpose of knowledge itself.

A parallel, related trend is the progressive irrelevance of borders. Humans travel more often, faster and farther, or, instead, they adopt an even more evolved version of travelling, getting in touch with others through a variety of real-time, long-distance communication means. Growing interconnectedness has an impact on traditional power structures, including nation-states. A global approach is increasingly essential in order to facilitate fruitful co-operation. In this respect the International Baccalaureate (IB) [3] makes a unique contribution. Since its role as educational provider is widely renowned, we will limit ourselves to briefly describing how it operates in order to achieve that universality.

Not just *what* to teach but *how* to do it is also relevant. Pedagogy has traditionally been considered an art. Nowadays we are learning more and more about how the brain works. Many of the best practices that educators have employed through ages are being explained by discoveries in neuroscience, thus confirming their intuition. We can no longer plan our activity without taking into consideration what works and what does not in relation to the brain; some examples will be given below.

A final aspect we will ponder combines *who* and *when* about education. For a long time now it has been established that teachers are no longer the central figure in learning. The student's role has arisen and the individual has acquired ownership (and accountability) of their achievements. But it is not just that, as we will see, the IB has included that what happens *outside the classroom* as one of the *essential elements* of learning [4]. This has enormously interesting implications that we will analyse in a specific section.

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That central role of the student has obvious similarities with a ubiquitously praised character, the entrepreneur. In every country the need is felt to have a sufficient number of individuals who combine the creativity, the stamina and the skills needed to give birth to innovative companies and generate wealth. Here again SU provides valuable inspiration. We will describe specific actions that schools can take to stimulate entrepreneurship.

Our last sections will deal with two additional requirements for schools to thrive: continuous professional development and autonomy.

General principles lay foundations, and the devil lies in the detail. We will draw some practical examples from a specific school, San Francisco de Paula-Sevilla International College (SFP-SIC, onwards) [5]. Its involvement with the IB and SU has fostered educational evolution along the lines of a global approach and technology-based innovation.

2. Knowledge as a need: the fourth educational paradigm in history

The human brain has changed little in the last myriad years. Human society, on the contrary, has evolved dramatically, and even more so have human tools. Arguably, this overall process has been enabled by an exponential growth of information and knowledge. Data are information; knowledge is the conscious use of organised information, the result of applying intelligence in order to process of all those data.

According to the accessibility and the amount of knowledge, human history can be divided in four eras—the fourth one having just started.

Knowledge as a privilege: In pre- and ancient history only kings and lords had access to knowledge, whether they were of a secular or a religious nature. We will not take into consideration for this purpose the practical skills that progressively enabled cattle breeding and agriculture, as well as primitive housing or handicrafts. That development was open and widespread; so much more so if compared with worldly administration and the mysteries of health and sickness, leading to the myths about death and an afterlife. The apparatus served the mighty, who received data and controlled knowledge. Accounting records on clay tablets in Mesopotamia appear alongside the Egyptian hieroglyphs of pharaohs and dignitaries on their journey to the underworld.

In the Western world, the Greeks and the Romans created more complex societies. Their systems concerning governance and law enabled an ever increasing participation for citizens, a concept that included just a fraction of humans. In Eastern Asia, China and its examinations for civil service is another example of how knowledge and privileges were two sides of the same coin. From the eighth century onwards, the Arabs promoted learning at the largest scale so far; it was still restricted to the mighty and wealthy, but this latter aspect could be seen as a transition to the following phase. The 400,000 volumes of the Caliphs' library in Muslim Córdoba [6] deeply contrast with the Christian world: the Papal library at the time in Avigon (the sole to own over 2000 volumes) [7], or 300 volumes of two of the greatest Christian booklovers: the Spanish Cardinal Gil de Albornoz (1304–1367) and the French Jean, Duke of Berry (1340–1416).

Knowledge as a luxury: Gutenberg's invention[1] of the printing press with moveable type pieces created a completely new scenario. The Limbourg brothers took 2 years to produce the Very Rich Hours for Jean de Berry; the first printed books, the incunabula, were instead issued by the hundreds; with over 30,000 editions in the second half of the fifteenth century, it can be estimated that 20 million books were published in that period alone [8]. Books became increasingly relevant in commerce. Knowledge became an element of trade for businessmen and entrepreneurs [9]. Erasmus (1466–1536) was in fact the first author ever to live off his books.

Still, the average literacy in Europe was below 10%, with Italy peaking at 15%. In other parts of the world that number would be close to 0%, including Sweden [10]. This means that 90% of the European population had no access to other than practical knowledge. Actually, Michael Faraday (1791–1867) one of the greatest scientists of the nineteenth century, had no formal instruction, and started his adulthood as a book binder; his life would probably have been very different without a very special present he received: a ticket for Davy's lectures at the Royal Institution, the turning point in his career [11].

Education was accessible only to the wealthiest families, who could employ private tutors or send their children to one of the very few schools at the time. Personalised learning was combined with travels that expanded views and experiences, like the Grand Tour that British nobility used to enjoy. Research in the different domains was developed largely by those who could afford employing their time and resources in activities other than earning their living.

It is worth noting that current trends in education underline again these very aspects, which had already been identified by the earliest theorists of pedagogy, very particularly, Johann Heinrich Pestalozzi (1746–1827). In a way we are moving back to the mode of learning that upper classes developed when they did it as a passion.

Knowledge as a right: During the nineteenth century, a joint consequence of the industrial and social revolutions was the progressive development of education. Under the principles of uniformity and universality, educational systems grew; by the late 1880s, a French Minister of Education boasted that he could say what every child was doing in any school, at any moment.

This process went ahead in the twentieth century, resulting in a general rise in literacy levels around the world as well as an increase in university graduates. A professional title, and especially a degree, was a way to improve socioeconomic status and it normally secured a job for life. It could hence be seen as an investment, which is arguably, at least in part, behind the fees increase, especially in the United States: for example, the University of Pennsylvania has almost doubled their fees each decade for the past half century [12].

In spite of that, national educational systems have had two major downsides.

On the one hand, they have been utilised as a means to fulfil political agendas or even to impose a given view of society. At a national scale this has frequently led to political controversies: parties have changed laws and regulations when they have reached power. From a

[1] Or more precisely re-invention, since it had existed in the Eastern world for half a millennium.

global perspective, national (or even regional) approaches are found to favour biased feelings, thus hindering intercultural understanding and co-operation.

On the other hand, every right comes with a duty, and many children have struggled to comply with those uniform regulations established for their achievements. With some well-known exceptions, national systems do not have mechanisms in place to ensure an appropriate degree of individualisation, a research-based practice nor (as we will further elaborate below), a general policy of professional development for educators and school administrators. There ensues a high rate of dropout, particularly among adolescents: the consequence is an unbearable cost in the form of frustration among students, teachers and families and the huge loss of human capital.

Knowledge as a need: In his classical paper, Maslow classified human needs into a hierarchy of five categories: physiological, safety, love, esteem and self-actualisation [13]. He specifically set aside the cognitive needs (pp. 384–385).

More than 70 years have elapsed since Maslow's paper was published. This period has witnessed an unprecedented growth of information and processing capacity. In the mid-sixties, Gordon E. Moore predicted the exponential evolution of microprocessors in price performance, which has been called Moore's Law [14]. Later, in his book *The Singularity is Near*, Ray Kurzweil showed Moore's Law to cover just one phase of an ever-growing calculation power [15].

What Kurzweil calls Law of Accelerating Returns [16] has tremendous implications for human society and thence in the education world. This effect is multiplied by a general increase in life expectancy, which has more than doubled in the period 1913–2015 [17]. Individuals are bound to experience an ever accelerating world and they will need to adapt to it: they will have to learn how to live in a different environment, doing new things which will imply more complex processes. Knowledge, therefore, becomes a basic resource. It is no longer Maslow's cognitive need arisen out of curiosity, but something rather related to safety, if not a truly physiological need, once human beings are augmented through technology.

As already mentioned, these facts have to be taken into account when planning day-to-day teaching activities. And it is a requirement that derives from the main objective of education, i.e. the students; but teachers themselves have the same need. They can now, less than ever, rely on the knowledge they acquired in undergraduate school; they have to adapt and evolve their teaching practice in order to apply new knowledge and cater for their current students' new needs.

3. Education and technology: keys to navigate uncertainty

It is often said that we teachers are very reluctant to change our professional practices. The discussion whether that statement is more or less accurate, or at which extent it might be true or false, goes beyond the scope of this article. We will nonetheless expose some of the reasons that could lead to such a situation, particularly when dealing with technology. An average teacher is

- a single digital immigrant faced by 10–30 digital natives;
- one individual who feels the need to prevent misuse of devices by the rest;
- an adult concerned about students' learning, progress and success in life;
- a university graduate with much experience on methods that have worked well for them, so far;
- a decades-long professional without specific legal requirements to update or get professional development;
- someone who must comply with national regulations on curriculum content.

Of all those factors, the external requirements account for much of the barriers to educational change. They include legal regulations, general examinations and especially their consequences on university admissions. Thence the concern for students' success pointed out above.

And yet, traditional curriculum programmes and pathways continue to lose touch and relevance. Over 10 years ago, the late founder of Apple, Steve Jobs, spoke about that in his world-famous speech at Stanford [18]. More recently, the founder of LinkedIn, Allen Blue, stated that head-hunters do not rely 'so much on degrees but on skills and professional achievements. If they believe that the candidate is prepared enough, it does not matter the degree they show on their profile'; and he adds 'Things have changed, individuals do not need to finish their degrees or get a specific diploma, they may just prove what they can do'. [19]. The 'Big Four' consulting companies (E&Y, PwC, Deloitte and KPMG) agree along the same lines, according to news published some time ago [20]. Of course corporations have a degree of agility and freedom light-years away from the educational world.

That said, we teachers have the responsibility of preparing our students for *their* own future lives. We need to behave like explorers of those new worlds our youth will inhabit, to anticipate their needs and to set the requirements they will have to meet in order to succeed as adults. Doing that means coping with a certain amount of risk. Whether we like it or not, we have to face the challenge of innovating, changing, trying and making mistakes. And we had better learn to enjoy it, as Chesterton said about English weather, 'So we may be perpetually reminded of the indefinite hope that is in doubt itself' [21].

As stated, technology is one of the (exponentially) changing aspects of life. Many professional fields have already been transformed by digitalisation, from flight control to manufacturing. Education has not yet, in spite of the numerous ongoing initiatives; but current students will soon be adults. Isidore of Sevilla was declared patron of the Internet; Heraclitus of Ephesus should have been appointed patron of the new digital world, where you can truly never 'bathe twice in the same river'. We teachers have an unavoidable obligation to get our pupils accustomed to using ever evolving technologies. Technological evolution itself must be factored in. In order to do so we must learn to navigate uncertainty, since only thus will we live up to the expectations placed upon us.

That attitude is much more necessary since we can hardly imagine today how education will be when cognitive augmentation becomes mainstream. When writing these lines augmented

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reality is embryonic, we are slowly starting to have connected wearables; we only have some elementary measurements of body parameters including brain waves. We need to experiment in order to peep into the unknown. Students are not just understanding, but involved, when they see their teachers strive in order to provide them with better, newer, brighter learning opportunities.

Of course we cannot ignore everything we were teaching. History provides us with wonderful examples of human behaviour, languages enable communications and thinking, whilst philosophy empowers it, music and art foster creativity and enjoyment, maths and science explain how the world works and give us the foundations for further progress. We must choose the relevant examples, make them meaningful, work on them in order to reach true understanding and draw conclusions which can then be extrapolated. We must also decide what we have to discard, like flint arrow-heads lost importance at a given point. Employing the state-of-the-art technologies makes sense only if they enable new approaches and benefits for the students.

In this respect we may be reassured about one point: given the pace of change, the mistakes we will undoubtedly make will be soon overcome by the next step, provided the overall direction is right. In order to guarantee that correctness we must go back to basics such as honesty, commitment, alertness. Honesty to recognise one's own strengths and shortcomings and others' pre-eminence, when due; commitment to one's very best rejecting underperformance of any kind, since early childhood, for them to grow in accountability and self-demand; alertness to detect both errors and unexpected opportunities.

These three fundamental requirements have a corollary. More important than any syllabus or method is the set of values that we model and transmit. In this era of uncertainty the ultimate demand we will have on any individual will be an acceptable way of behaving towards neighbours and nature. Only this will ensure a fruitful collaboration in building a better, fairer society. And this is something a school needs to reflect upon, publicly declare and conform to. In that respect, the International Baccalaureate (see below) can be considered one of the best available options.

4. Some examples of technology applied to classroom activities

Twenty years ago, a group of teenagers produced the first example worldwide of virtual reconstruction of an entire roman city: Italica, 7 km north from Sevilla, the native land of emperors Trajan and Adrian [22]. It started as a Comenius co-operation project. It ended up being presented as a public exhibition at the National Archaeology Museum in Madrid (April through June, 2003) [23].

That was the first large-scale tech project developed at SFP-SIC. It took 6 years, considerable funding and an exceptional degree of flexibility in the circumstances of the leading teacher. Students drew the entire topography of the site and cartography of the building using an early version of AutoCAD®; they also produced realistic renders for the surfaces. Such a project

requires someone with very special characteristics, brilliant in their specific achievements but capable of causing a considerable amount of discomfort within an organisation. This has to be taken into account when choosing to embark on this kind of endeavour, alongside the aforementioned willingness to navigate uncertainty.

Some degree of certainty, however, is needed when managing a school. A strategic plan for technological infrastructure is essential in order to lay the foundations and enable further deployment. Consultation with experts was the choice we made in Sevilla a few years (and a couple of triennial plans) ago. Objectives and their requisites are hence defined and taken into account when budgeting upcoming years.

It is also important having someone who oversees development. Teachers are too busy planning their lessons, assessing students, individualising activities and striving to meet parents' requests more often than not showing a personal involvement that goes far beyond mere professional duties. An overall view and clear directions need to be taken care of. In our case, following SU's inspiration, we appointed Mr Mark Polko as an advisor for Exponential Technologies in Education. In collaboration with our advisor for educational innovation, Ms Pauline Bullen, they have summarised a few examples of the last steps made at our school

- *STEaM lab*: a physical laboratory space we have created in school where over the weekend teams of youngster tackle a real life business challenge, e.g. design furniture for the classroom of the future. Prior learning and knowledge gathering from STEaM domains come together in search of a creative solution. The real life relevance is enhanced when learners meet and share thinking with business professionals working in local community.
- *Sensor technology*: forms an essential part of the science curriculum, whether this be to measure muscle strength to several decimal points of precision or to measure the amount of oxygen produced by plants in parts per million, familiarity with technology as a tool in scientific research is simulating in the classroom, laboratory practice professionally.
- *3D printing*: hands on learning with 3D printing allows learning in science to take place in far greater depth: e.g. an anatomical study of the heart might now include an initial laboratory dissection then move to 3D scanning so that the dissected heart can be labelled in the round using 3D software, copied to a digital portfolio providing the option of creating a physical model.
- In the nursery school children as young as 3 or 4 years of age are helped to grasp complex ideas around emotions with the aid of holograms projected by the teacher using a tablet software.

Early findings have shown us that a willingness to experiment with even the most up to date technologies, some still in stages of early adoption and development, has led to greater engagement with the learning process and especially with complex conceptual thinking. We have seen evidence of increasing autonomy in decision making and a freer reign for creative imagination. Trial and error and persistence become an integral part of the learning process.

In this respect technology is enabling a promising process: the generalisation of that personalised learning that used to be available just to the wealthiest (see section 'education as a luxury').

This is a part of the 6D transformation. Peter Diamandis [24] mentions: digitisation, deception, disruption, dematerialisation, demonetisation and democratisation. Adding a powerful AI-assisted system and the dream of really individualised education will be a fact. Imagine the connected brain and then simply stop dreaming: that will change the rules so dramatically that we cannot extrapolate our current concepts and experiences. That is Kurzweil's *Singularity*.

There is still some way to go, of course. In the nearest future, next steps in this evolution at our school will be: (a) definition of a digital curriculum for students and teachers; (b) redesign of learning spaces; (c) increase of interdisciplinary activities based on problem solving; (d) game and app-design, 3D-printing and coding to become mainstream, integrated into subject curricula.

5. Neuroscience in the classroom

Howard Gardner has mentioned in public [25] his original surprise about the success of his seminal book on multiple intelligences [26]: it was acclaimed mainly by educators, not by psychologists. In retrospect it is not that strange; we try to get the best possible results from our students. That means adjusting our practice to the way the brain works. Thence the growing popularity of neuroscience among teachers, in spite of what the business world calls the entry barrier; brain research generally takes place far from schools and we need specific introductions to its findings.

The following examples of neuroscientific practices applied to the classroom have been provided by Ms María del Carmen del Castillo, a graduate in medicine who teaches at SFP-SIC[2]. It is worth noting that her approaches gained her the top appraisal among the student body in her very first year as a teacher, which is a most unusual achievement.

- To explain how the brain works: The brain has developed strategies to ensure survival, its main function, among them, is reward-seeking. Underline some crucial aspects (breakfast, physical exercise, sleep, self-control, and mood). Induce reflection and building of the self through weekly analysis of a given aspect in their lives (being often late, getting bored, having heartbeat when nervous or in love, feeling tone-deaf).
- To combine curiosity and play through competition for fun [27]: Challenging peer presentations with humour causes positive emotional states (unlike stressful situations). Adrenaline and dopamine foster thirst for learning. Happiness improves insight, interconnection of ideas and more creative responses. [28]. There ensues the need to careful monitoring of the students' emotional state.
- To build a theme upon questions posed by students: After a 30-min introduction, they have to upload questions on a shared document, and they cannot repeat them, so the complexity increases. They find the answers co-operatively.

[2]Ms Castillo teaches a course on Applied Anatomy; she is also Advisor for Wellbeing and Customer Relations in the School

- 'The odd question': The brain generates dopamine (thus guaranteeing learning) in front of the unexpected [29]. Examples such as 'Why is it successful, from an evolutionary perspective, privileging a single organ, thus preventing life in case of damage?' 'Can we consciously control our heart as we would any other muscle?'
- Stimulation of creativity: Creativity is increased by training. The effect is greater in the average individual rather than the highly skilled one, and in adolescents rather than adults [30]. Creative questions followed by scientific explanations foster learning. Examples such as 'How could we relate going shopping and applied anatomy?', 'Art and anatomy', 'Beyond dreams', 'Love, a chemical experience in our brain'.
- Training for an exam: Learning how to relax in order to control anxiety: music, some movement, a moment of relaxation, plus a biscuit after 30 min. Contrary to the usual experience when passing a test, fear is avoided and the exam reinforces learning.
- Doing exercise in every lesson: Physical exercise stimulates the hippocampus, key in explicit memory and learning [31]. It improves brain plasticity and strengthens neuronal connections to favour learning [32]. Blood circulation is increased, augmenting the amount of nutrients that reach neurons; neurogenesis is also fostered [33].
- Transdisciplinary topics: Collaboration between subjects of very different nature, like applied anatomy with mathematics or literature. Example: 'rhetorical devices and anatomy'.
- Artistic activities: Music, drama, handicrafts, humour, creativity, involve different brain regions. Example: dramatising the functions of the nervous system when studying the nervous impulse.

As a final remark in this section, it is worth noting that these techniques support the aforementioned requirements of honesty, commitment and alertness in a very explicit way. Honesty is ensured through enhanced co-operation, friendly challenge in public, a sense of community; commitment is increased thanks to enjoyment and purpose; alertness is fostered by the need to make creative contributions to the group.

6. Education for a better world: the International Baccalaureate

It is unlikely that the founders of the IB could imagine the impact they would have half a century later. To begin with, and as its name was meant to indicate, it dealt with the *baccalaureate*, 2 years previous to entering university; furthermore, it was destined to a handful of highly mobile students attending a few international schools around the world. Today the IB offers four programmes, covering the 3–18-year range. They are followed by over a million students, in close to 5000 schools (mainly state schools) established in more than 150 countries.

The uniqueness of the IB arises from three main characteristics

Values: Its holistic approach is intrinsically driven by a deep humanistic approach. This sense of purpose is reflected in the learner profile [34]

- Inquirers
- Knowledgeable

- Thinkers
- Communicators
- Principled
- Open-minded
- Caring
- Risk-takers
- Balanced
- Reflective

Beyond beliefs and personal opinions, which are fully respected by the IB philosophy, there is a genuine emphasis on mutual understanding and peaceful co-operation, as well as on a mindful relationship to the environment. The sentence that 'others, with their differences, can also be right' encompasses much of the IB philosophy and is an urgent need in today's world of fundamentalism, fear and anger. The fact of being a foundation, and hence acting on a non-for-profit basis, allows it to devote all its resources as best serves its aims.

Independence: The IB has no particular link to any organisation, belief or government. Hence it develops its programmes attending only to best practices and research-based advancements.

Co-operative evolution: Through a careful planning, programmes are designed, students are assessed and practices are revised. Educators from all over the world contribute to the best of their knowledge to progress for all.

The IB learner profile is more than an extremely powerful tool to guide any educational review and improvement. It keeps the focus on the main attributes that a well-rounded person needs to develop. A community of such citizens is bound to flourish no matter how much society evolves or technology advances, they will always make the most of what is available.

The global perspective that the IB adopts makes special sense in an interconnected world. Arguably, the most important challenges that society faces today (whether hunger or terrorism) come from a lack of principles and care for the other. The belief that others are wrong whilst we are right paves the way to confrontation and war. Highlighting differences instead of commonalities is a very traditional means of protectionism which is one step away from plain rejection. History is full of examples and the list continues unfortunately to grow.

7. The IB primary years programme (PYP): holistic education 24/7

We have so far dealt with what happens in the classroom. We educators hope that all those things we do will end up having consequences on the world we inhabit, furthermore, *positive* consequences; we hope that students will behave according to those principles and practices we have talked so much about.

Yes, hope we do.

And…?

And little more, actually. We teach our subjects, we test the students on them; unless there is deeper and/or further connection, many schools have almost no clue whether they succeeded beyond the exam. It is often impossible for teachers to know what the student does outside the school, apart from daily homework. (Thank goodness, many would say!)

What students do outside the classroom might seem irrelevant in terms of subject content, only 'might', and not even that as we will see. But it is definitely relevant with regards to values, behaviours and application to real life of what might otherwise be to them nothing but bookish dead content.

As a matter of fact, what a student does at home, on the street and elsewhere *is* learning. Children, adolescents and adults learn through their entire lives admittedly, with varying intensity. A given experience, a single conversation outside formal school setting can be a deterrent or a life-changing stimulus for a student. We just have greater difficulty to measure it. Or rather we had; things have changed now thanks to the Primary Years Programme (PYP) [35].

The PYP has brought many felicities to the educational field. We will mention two which are particularly relevant in the context of this book

Learning is organised in 'Units of inquiry': Students are not *taught* a prescribed curriculum, but fostered in their collaborative research around the broad transdisciplinary theme of study. They have to find and verify sources of information, compare contrasting opinions, defend their own, make choices and come up with a product. They are, in fact, entrepreneurs of their own learning.

The programme is structured around five 'essential elements', only one of which (knowledge) is mainly what we used to call 'content'. Another of those elements is 'action', which stands out as the most innovative part and onto which we would like to focus our attention.

'Action' is the *subsequent* result of the educational process. It is what the student actually *does* because of the insight they have gained through the acquired learnings. There ensues that action has to be assessed through evidence, i.e. the child has to be seen or heard doing something that proves their learning. Seen or heard by whom? The answer is obvious: mainly by their parents (or close adults).

Involving parents in assessment implies, on the one hand, a few challenges. One needs to ensure that they understand what is required; also, busy parents are not always inclined to participation; a mechanism has to be created to facilitate gathering contributions; and they have to be objective, so that children do not get the message that 'making up' reality is acceptable.

But, on the other hand, it has enormous benefits. It makes parents aware of what their child will do at school in the following weeks; it catalyses conversations about it at home and outdoors, enhancing learning; it helps the students create links between what happens in the classroom and the outside world; it makes students realise that what they do and say outside the school has an educational value and it makes families proud that their children are learning 'so much' in line with expectations.

Here are some literal translations of evidences given by parents in Sevilla

- (He) identifies his entire body, right and left. He knows that boys have penis and girls have vulva. He can say what each part of his body is for. He identifies the different members in a family and he recognises that each person has their own family. He is aware of having a roundish face (after the song). He is happy to bear a resemblance to his father. And he knows that eating a lot of lettuce will grow him big as his cousin (X) [3-year-old].
- We have observed how he is aware of what he is learning, once outside the classroom, and he can see it and apply it on a daily basis. When we are all together, he names each member of the family and he knows who constitute it. What his role is, how to contribute and that he can help. Trees that he sees every day and he asks whether they are perennial or deciduous. Rain, how and rubbish, why it is generated and how we dispose of it (4-year-old).
- (He) has gone over responsibility and change, the key concepts of this unit of enquiry, outside the school. He recycles properly all the objects he uses, he is aware that plants need water and how sustainable farming works. He has improved considerably, having become more tolerant in his interactions with his younger brother. He is very much striving to overcome his frustration when he doesn't manage to communicate successfully (5-year-old).
- We have noticed the varied vocabulary he has acquired on a diversity of topics: weather, clothing, seasons, landscapes, geography. His comments on climate have been especially striking, he seems to be the weatherman. And he loves talking about clouds and the colours in the morning sky, the weather in other parts of the world, how people are likely to dress and how animals live in heat and cold. He also loves nature books (6-year-old).
- (He) has started to show interest about TV news during these weeks. He has always enjoyed nature documentaries but now he seems to wonder about other topics. He has astonished us with some very infrequent questions, like who was the narrator of the plot in a novel about which we were talking to him. He has enjoyed doing some school activities, like finding out the biography of the inventor of TV. He felt very motivated to do it well (9-year-old).

All these quotations are taken from individual students assessment reports. It is easy to imagine the tremendous stimulus they are to the students. Not just they have the proof that their learning means something to their parents, but they see that what they do outside the classroom is collected alongside the results they obtain at school. Furthermore, they can find the coherence between those apparently independent worlds.

If we want students to be really engaged, we need to make them value what they learn and do: nothing better than a shared, connected and co-ordinated partnership between parents and teachers. We are all educators, and there is no non-educating time. The sooner we become aware of it, the better: better for our youth, and also for ourselves, since they will be the doctors who cure us, the engineers who design our services and the lawyers who defend us once we retire.

8. Technology-enabled: IB middle years programme on-screen assessment

The Middle Years Programme (MYP) is designed for students in the range 11–16 years old. As it is the case with the PYP, it does not prescribe a syllabus. It is instead defined in terms of skills and competencies that the students have to develop.

In 2015, the IB launched its pilot for an on-screen (not online) assessment. It went mainstream in 2016. This is the first time ever that an on-screen examination has been offered worldwide.

There are a few reasons why this is a high-interest initiative

- The test is specifically designed to assess competencies. The absence of a written curriculum makes it especially versatile and appropriate to serve today's changing needs.
- A global benchmark. Schools carefully analyse the detailed reports provided by the IB on the results. These data include comparisons with the predicted grades and the world averages. They become tools for improvement.
- The MYP is being seen with increasing interest as a means to meet the objectives set by most international measurements, like PISA. A recent study conducted in Spain by an educational research team [36] showed its superiority to the national regulation [37]. Actually, the City Council in Sevilla has unanimously agreed to implement the MYP in five state schools, including some in deprived areas. The venture will start in 2017, being the first of its kind in Europe.
- Students are increasingly accustomed to working on computers. A pen-and-paper exam is becoming alien to them. Also, applying their learning to an unknown situation is at the same time a challenge and a stimulus.

The IB is aware that not everyone yet has broadband connection to the Internet. That is the reason for the exam not being online. It poses some extra organisational requirements, in terms of staff and time to upload the tests.

The main achievement, though, is having designed a cutting-edge assessment, independent from the specific syllabus and hence applicable all over the world. It is a significant step towards an individualised and simultaneously comparable society.

9. The exponential entrepreneurship programme

Among the variety of courses and events that SU organises, the nine-week Global Solutions Programme (GSP) stands out as one of the most unique and sought after professional (and personal) development offers in the world [38]. Around one out of 100 applicants are accepted at the NASA-based campus to work in ideas related to 12 global grand challenges [39]. In words of co-founder Peter Diamandis, ‘the world's biggest problems are also the biggest business opportunities’.

The GSP at SU is focused on promoting entrepreneurship applying digital (exponential) technologies. The challenging goal they present to participants is ‘how will you improve the lives

of a billion people in 10 years'. A few dozen innovative companies have been created out of GSP team projects.

Creativity, as stated above, can be developed. Entrepreneurship is creativity applied to business. And the entire world needs individuals who create wealth and employment whilst making the future look brighter, happier, healthier, in every domain.

Why should we then wait until university in order to foster and grow this thinking mode? An adaptation to teenagers can be done, as shown by the Exponential Entrepreneurship Programme®. This is an initiative of Fundación Goñi y Rey [40] and SFP-SIC in collaboration with the SingularityU Sevilla chapter [41]. The programme had its first edition in the academic year 2015–2016.

In a way, it is a natural extension of the MYP personal project [42]. Students gather in teams, to choose a real-life problem or opportunity related to one of the global grand challenges. They generate a business idea, work up a development plan and outline its potential for investment and incorporation as a company.

There are some lessons learned from that pilot, which have been taken into account when planning the second edition

- Although many students find it challenging at start, most (if not all) become really engaged and come up with interesting ideas which they shape as an entrepreneurship project.
- At the end of the year they feel confident enough about their progress to do public presentations of their prospect businesses in front of potential investors and answer questions [43].
- Alongside the refining of their ideas, an individual insight process takes place whereby team members define their roles. They find which aspect of the business world appeals the most to each one and they start to think seriously about their future.
- Last, but not least, this kind of course is better coached by individuals with previous experience in the innovation and business world. The present case has had the invaluable co-operation of Mr Jaime Aranda and Ms Teresa Suárez, the extremely active founders of a business and innovation association called SevillaUp [44].

In conclusion, we can state without doubt that pre-university students do have the willingness and the capacity to get involved in the business generation process. Success stories (or *Unicorns*, as investors call them) are always difficult to find. But, as Picasso put it, 'may inspiration find you at work'.

10. Teachers and school leaders as lifelong learners

We cannot stress it enough; continuous professional development is as essential as careful planning when aiming to provide quality education which in turn is inseparable from *updated* education. Also, on the one hand, it is a way to model the attitudes we demand from students; on the other hand, it prevents burning out through providing newer and different challenges.

The right mind-set needs to be infused in the organisation. Time has to be devoted. Budget must be allocated. Involvement and lead from senior and middle managers are essential.

Best-practice sharing, lesson observation, collaborative planning are extremely powerful tools. It is well known that one can find deeper differences within a given school than between two different ones. Appropriate, constructive feedback should be combined with improvement objectives.

At SFP-SIC we have designed a complex system of performance-related pay, with clear and objective indicators. We use it as a way to define the important extra aspects to develop, once full compliance with the high-standards requirements has been met. They include research and co-operation projects, external results (when applicable), parents' and students' surveys, line-manager appraisal. For middle managers, indicators are their team's satisfaction results, overall students' performance, homogeneity of group results throughout the department or section, among others. In no case we use indicators that can be altered by the individual who is being assessed, an obvious example would be the marks given to one's own students. Depending on the year it has even reached a 15% supplement to a given teacher's annual salary.

In addition to the in-house courses, a few stand out as really interesting

- The IB offers a high number of workshops, seminars and conferences. Some are specifically directed to teaching the IB programmes (categories 1 and 2). Others, instead, focus on specialised aspects of general good teaching and learning practice (category 3). A yearly calendar is published on the IB website. They are open to general public registration. Online courses are also available [45].
- Especially relevant to the purpose of this chapter is the Future of Learning Institute organised by the Harvard Graduate School of Education [46]. It starts in late July every year.
- SU has 5-day executive programmes [47] that provide a sufficiently deep insight on technological evolution, as well as a unique experience at their NASA-based headquarters in Silicon Valley. An easier alternative, also mind-blowing though shallower, are their Summits, held in different parts of the world. The Singularity University Summit Spain 2015, [48] that SFP-SIC co-organised, was attended by our entire teaching body as well as over 100 students. The voice was spread and other summits around the world have also received teenager participants.
- Learning and the brain is a series of events privately organised in the US [49]. Many of the leading neuroscientists present in each edition, with an approach that is often specifically directed to educators.
- Finally, the Educational Collaborative for International Schools (ECIS) also offers a number of conferences [50]. The annual executive conference is a benchmark for school leaders and administrators, positions that do not always receive the attention and training needed for an entire school to operate successfully.

When planning professional development, very specific attention needs to be paid to school managers. In most cases middle and senior leaders were trained as teachers: they are often

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recruited among the most brilliant ones. But leading adults is a totally different job. Other skills are needed and a completely new set of responsibilities must be faced. An extensive training programme has to be designed and offered to facilitate successful and efficient management.

One cannot overstate the importance of middle managers in a school. Senior leaders may come up with the best ideas: they will fail pitifully if they lack the appropriate collaborators to implement them. Hence, one of the main tasks of a head is to ensure the effective promotion and development of staff.

All this applies to entire countries or regions. A new educational law is meaningless if it is not supported by an intensive training programme. No one would be crazy enough to change the flight-control system without having controllers duly trained: but it is everyday practice dictating a law and waiting for it to have some kind of miraculous effect on its own. Policy makers think they can change classroom practice this way. They cannot. Even more, they *should not*. Education must evolve on a *continuous cycle of reflection and improvement* and not just when a given minister believes it to be appropriate. There, again, the IB is exemplary.

11. Independence, funding: independent funding

All the examples and initiatives above arise, at the very beginning, from the capacity to make the most appropriate choices for the school, which means first and foremost, what suits the students best. Curriculum design, school ethos, human resources policy, organisation and priorities are crucial variables that require deep reflection and careful management.

The degree of independence varies from one system to another and, within a given one, according to the funding entity. The larger the freedom, the deeper the educational accountability and the higher the chances of developing an interesting project, provided, of course, that honesty, commitment and alertness pervade the school operation.

Being a vocational educator implies devoting one's time, energy and imagination to help the world improve. It is a very long-term process, given the turnover rate: a generation takes 20–30 years to blossom—up to 15 of which are often spent at pre-university school. Therefore, one needs to plan things far in advance, as said at the beginning. In trying to do so, one finds nothing more harmful than the short-time reasons behind many of the political moves. Thence the importance of school independence from the political and governmental debates.

There also ensues the need to invest. The process of nurturing the human brain, the most complex structure in known universe, requires resources. It brings far higher benefits to humanity than bombing people, though at longer terms. When considering who wants bombs being dropped the clear answer is: certainly, not those being hit. We need to improve education in order to make a more peaceful world and not just mathematics and language, but ethics and related values.

Again, schools must be able to operate towards those goals. Citizens will eventually manage to free education from short-sighted political-party policies, at least we hope so. In the meanwhile

educators' professional audacity and parents' financial sacrifice will be the only way to guarantee that students receive the stimuli they need for their future to be brighter.

12. Conclusion

Throughout this chapter we have tried to outline the main features that education today needs to have in order to prepare students for the future. We have illustrated them with a few examples, but much more can be done.

At end of the day, in the time when knowledge was a luxury, education involved a preceptor—a full-time, adapted, private teacher, personal trainer. A relatively similar situation might end up being available to all when AI becomes mainstream.

To summarise, four main requirements seem essential to enable a way forward:

- Permanent *updating*: Standards and practices must be constantly revised, exactly like software is and for the exact same reasons. Professional development on neuroscientific progress, technology, management, social change, associated risks. All those aspects are crucial to make educational approach to evolve as society needs. Teaching is an enormously absorbing task. Myriad aspects require one's attention, from the individual student's well-being to planning class activities. Educational administrators need to manage time and resources in order to support agile response to changing times. In a world of lifelong learning those who prepare learners must be the first to stay at the cutting edge.
- Collaboration: All human progress has taken place through further contributions to a shared body of knowledge. The role of each individual is crucial, but since the Greeks we are also aware of the importance of discussion and co-operative advancement. Science showed long ago the power of multi-disciplinary teams. On the one hand, globalisation makes a multi-faceted approach indispensable for individuals to learn about sensitivities and diversity. On the other hand, a high-quality education has increasing complexity and variety: it can only be developed with the combined efforts of educators around the world. Pedagogy is a science, with all the attributes that science has.
- Autonomy: There would be a civil revolt if a government were to dictate the medical treatment of a disease based on their political beliefs; the same if one-fifth of those sent to a hospital died systematically. Nevertheless, educators around the world see their mission hindered by one reform after another, according to the creeds of the party in power; and in some regions an appalling proportion of students drop out of education. Education is to society what medicine is to the individual. A wrong treatment may kill the individual. Poor education may kill the future of an entire society. In so far as it happens long term, it is more difficult to detect; often those who caused it are no longer in power when the irreparable effects become obvious. As representatives of their people, governments do have the right and the obligation to set the minimum requirements for the progress of society which has little to do with the results of a given test; they must allocate the appropriate resources which citizens contribute through taxation; and they must allow professionals the autonomy to do their job.

- Individualisation: Philip of Macedonia made his way into history for having secured the best available education for his child. He called Aristotle and the investment definitely paid off, according to the standards of the time: Alexander 'the Great', the most widely acclaimed emperor ever. Noblemen used to follow his example and enrolled the best preceptors for their offspring. Industrialisation introduced standardised tests, focused on the easiest items to measure. Current knowledge has uncovered the endless variations of human brain and capacities. Each one's contributions are unique, like one's needs. We must strive in order to serve all that diversity: it is a duty towards each individual; it is in benefit of the entire humanity.

Definitely, exciting times to be in education!

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References

[1] Kurzweil R. Telepresence Session. 'Future of Finance' seminar. NY: Singularity University; 2014

[2] www.su.org

[3] http://www.ibo.org/

[4] http://www.ibo.org/programmes/primary-years-programme/curriculum/written-curriculum/

[5] http://colegiosfpaula.com/en

[6] Lyons J. The House of Wisdom. London: Bloomsbury; 2009. p. 148

[7] Manguel A. A History of Reading. New York: Penguin Books; 1997. p. 133

[8] https://global.britannica.com/topic/incunabula, 1 January 2017, 17:40

[9] Burke P. A Social History of Knowledge. Cambridge: Polity Press; 2004. p. 160

[10] https://ourworldindata.org/literacy/#measurement-and-estimation-of-historical-literacy-rates, [Accessed: 30 December 2016]

[11] Antonio Díaz-Hellín J. Faraday. Madrid: Nívola, libros y ediciones, 2001. pp. 46-50

[12] http://www.archives.upenn.edu/histy/features/tuition/main.html [Accessed: 1 January 2017]

[13] Maslow AH. A Theory of Human Motivation. Psychological Review. 1943;50:370-396. Consulted at http://psychclassics.yorku.ca/Maslow/motivation.htm [Accessed: 1 January 2017]

[14] http://www.intel.com/content/www/us/en/silicon-innovations/moores-law-technology.html [Accessed: 1 January 2017]

[15] Kurzweil R. The Singularity is Near. New York: Penguin Books; 2006. p. 67

[16] Kurzweil R. The Singularity is Near. New York: Penguin Books; 2006. p. 35

[17] 72.3& Increase in Europe up to 80.67 years; 127.3% in Africa; 109.4% Overall in the World. https://ourworldindata.org/life-expectancy/ [Accessed: 1 January 2017]

[18] http://news.stanford.edu/2005/06/14/jobs-061505/

[19] Interview in EL PAÍS. Madrid, 9 October 2016. Available from: http://economia.elpais.com/economia/2016/10/09/actualidad/1476037626_750776.html

[20] http://www.elconfidencial.com/alma-corazon-vida/2016-02-11/expediente-academico-no-sirve-nada-google-kpmg-pricewaterhouse-deloitte-ernst-young_1150165/

[21] Chsterton GK. The Glory of Grey, in Alarms and Discursions. London: Methuen & Co; 1910

[22] http://www.iaph.es/revistaph/index.php/revistaph/article/view/1435#.WG_ci1PhDIV

[23] http://www.man.es/man/en/exposicion/exposiciones-temporales/historico/2001-2010/2003.html

[24] http://videos.singularityu.org/2015/05/peter-ds-6-ds-of-exponentials/

[25] Future of Learning Institute. Harvard Graduate School of Education. July 2012

[26] Gardner H. Frames of Mind: The Theory of Multiple Intelligences. New York: Basic Books; 1983

[27] Ms Castillo teaches a course on Applied Anatomy; she is also Advisor for Wellbeing and Customer Relations in the School

[28] Subramaniam K, Kounios J, Parrish TB, Jung-Beeman M. A brain mechanism for facilitation of insight by positive affect. Journal of Cognitive Neuroscience. 2009**;21:**415-32

[29] Smith BL, Holliday WG, Austin HW. Students' comprehension of science textbooks using a question-based reading strategy. Journal of Research in Science Teaching. 2010;**47**:363-379

[30] Stevenson SW, Kleibeuker CKW, De Dreu EAC. Training creative cognition: Adolescence as a flexible period for improving creativity. Frontiers in Human Neuroscience. 2014;**8**:1-16

[31] Gomez-Pinilla F, Hillman C. The influence of exercise on cognitive abilities. Comprehensive Physiology. 2013;**3**:403-428

[32] Vaynman S, Ying Z, Gomez-Pinilla F. Hippocampal BDNF mediates the efficacy of exercise on synaptic plasticity and cognition. European Journal of Neuroscience. 2004;**20**:2580-2590

[33] Van Praag H. Exercise and the brain: Something to chew on. Trends in Neurosciences. 2009;**32**(5):283-290. http://doi.org/10.1016/j.tins.2008.12.007

[34] http://www.ibo.org/benefits/learner-profile/. [Accessed: 2 January 2017]

[35] http://www.ibo.org/programmes/primary-years-programme/

[36] http://www.gipes-uam.com/index_en.htm

[37] http://www.proyectosib-gipes.com/4proyectomyp.htm

[38] https://su.org/programs/global-solutions-program/

[39] https://su.org/about/global-grand-challenges/

[40] http://fundaciongyr.es/en/

[41] http://singularityusevilla.org/en/

[42] http://www.ibo.org/programmes/middle-years-programme/curriculum/myp-projects/

[43] http://singularityusevilla.org/presentacion-de-los-proyectos-de-exponential-entrepreneurship-programme_ev96.html

[44] http://sevillaup.com/

[45] http://www.ibo.org/professional-development/

[46] https://www.gse.harvard.edu/ppe/program/future-learning-institute-project-zero

[47] https://su.org/programs/executive-program/

[48] http://singularitysummitspain.org/en/

[49] https://www.learningandthebrain.com/

[50] https://www.ecis.org/events/conferences

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