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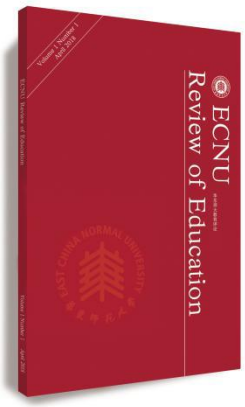

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Educating Learners for Their Future, Not Our Past[1]

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Abstract
Purpose—This paper aims to examine the educational demands in the digital age from tomorrow's teachers and policy-makers, and to encourage and incentivize all actors to develop the innovative learning environments that we need for tomorrow's schools.
Design/Approach/Methods—As a conceptual paper, this article has consulted and analyzed a wide range of updated data and literature to consolidate the argumentation on tomorrow's educational demands.
Findings—The paper mainly provides possible answers on how to educate students for their future, rather than our past. The heart of future education is to help students develop a reliable compass and tools, transformative competency, and to navigate through an increasingly complex, volatile, and uncertain world. To fulfill this core mission, a new set of curriculum design principles, changing school system, renewed teacher culture, and an alternative assessment program are highly advocated.
Originality/Value—Based on the latest observations and reflections, the paper broadens our visions on tomorrow's education and future schools.

Keywords
Transformative competencies; learning compass; school system; professional development

A Changing World

How should countries equip people to understand, engage with and shape a changing world? The backdrop to the 21st century remains our endangered environment. Rising population, resource depletion and climate change place a responsibility on us all to develop the planet sustainably, with an eye to the needs of future generations. At the same time, new challenges have arisen, shaped by the interaction of technology and globalization.

The first challenge is economic. Industries, organisations and professions have been disaggregated and automated. For niche suppliers to hollowed-out corporates, or for dynamic internet businesses, the rewards are high. But for others, the gig economy means the scourge of vulnerable work: zero-hour contracts without benefits, insurance or pension. Entrepreneurial economies have unleashed new growth, but at the price of widening inequality.

The second challenge is social. Across the world, people are on the move. Many work internationally by choice. Others are forced to travel by war and poverty. How

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diverse can communities become before trust corrodes, social capital weakens, and civil society is undermined? We are born with what political scientist Robert Putnam (2007) calls *bonding social capital*, a sense of belonging to our family or other people with shared experiences, cultural norms, common purposes, or pursuits. But it requires deliberation and continuous effort to create the kind of *bridging social capital* through which we can share experiences, ideas and innovation and build a shared understanding among groups with diverse experiences and interests, thus increasing our radius of trust to strangers and institutions. Societies that nurture bridging social capital and pluralism have always been more creative, as they can draw on and bring to bear the best talent from anywhere, build on multiple perspectives and nurture creativity and innovation.

Sustainability is the third challenge. The goal declared by the Brundtland Commission (1987) some 30 years ago—calling for development that meets the needs of the present without compromising the ability of future generations to meet their own needs—is more relevant today than ever, in the face of environmental degradation, climate change, overconsumption, and population growth. Already, many of our best minds are focused on building sustainable cities, developing green technologies, redesigning systems, and rethinking individual lifestyles. For the young, the challenges encapsulated in the 2015 Sustainable Development Goals are often urgent, personal, and inspiring.

While sustainability aims to put the world into balance, resilience looks for ways to cope in an imbalanced world, recognizing that the world exists in constant disequilibrium. These days, we no longer know exactly how things will unfold, often we are surprised and need to learn from the extraordinary, and sometimes we make mistakes along the way. And it will often be the mistakes and failures, when properly understood, that create the context for learning and growth. Strengthening cognitive, emotional and social resilience and adaptability is perhaps the most significant challenge for modern education, as it affects virtually every part of the education system. That starts with understanding that resilience is not a personality trait but a process, that can be learned and developed. In the 21st century, education is a key tool to help people, organizations, and systems to persist, perhaps even thrive, amid unforeseeable disruptions. At the collective level, education can provide communities and institutions with the flexibility, intelligence, and responsiveness they need to persist in social and economic changes.

This is the age of accelerations, a speeding-up of human experience through the compound impact of disruptive forces on every aspect of our lives. It is also a time of political contestation. The priority of the wider international community is still to reconcile the needs and interests of individuals, communities and nations within an equitable framework based on open borders, free markets and a sustainable future.

So education is a key differentiator for how the next decades will play out for individuals, nations and the planet. Every economic age has its core asset. In the agricultural age that asset was land, in the industrial age it was capital, and for our times it is the knowledge, skills and character qualities of people. Some say that the

accelerating digitalisation will leave no work for the majority of people, and at times it seems as we are living in the first time that technology destroys jobs faster than it creates them. I am skeptical. When I was in high school, I had to write an essay about *The Weavers*, a play written by the German playwright Gerhart Hauptmann in 1892, that portrays a group of Silesian weavers who staged an uprising during the 1840s against the industrial revolution. It is true that the industrial revolution eliminated the traditional tasks carried out by those weavers, but it did not stop their employment. In fact, once people were equipped with the new knowledge, skills, and mindset of the industrial age, there were more and higher-paying jobs in the weaving industry than ever before, and the changes allowed more people than ever before to have more and better clothes.

Prior to the industrial revolution, neither education nor technology mattered much for the vast majority of people. But when technology raced ahead of education during that period, vast numbers of people were left behind, causing unimaginable social pain (Goldin & Katz, 2007). It took a century for the policy to respond with the gradual push to provide every child with access to schooling. But eventually education got ahead of technology again. It is not clear to what extent that analogy holds for our times where technology is racing ahead ever faster, but the least we should do is to imagine the type of education that will help people take advantage of our times.

In the face of challenges as great as any that have gone before, human beings need not be passive or inert. We have agency, the ability to anticipate what could happen next and to take action. Being a purposeful, responsible, and capable agent means casting yourself into a future which is necessarily uncertain and so involves taking risks.

Transformative Competencies

In these times, we can no longer teach people for a lifetime. In these times, education needs to provide people with a reliable compass and the navigation tools to find their own way through an increasingly complex and volatile world. As future jobs will pair computer intelligence with the human knowledge, skills, character qualities, and values, it will be our capacity for innovation, our awareness, our ethical judgement, and our sense of responsibility that will equip us to harness machines to shape the world for the better. This is the main conclusion OECD countries working on a new framework for curriculum design, referred to as "Education 2030", have drawn. Not surprisingly then, schools increasingly recognize the need for fostering ethics, character, and citizenship and aim to develop a range of social and emotional skills, such as empathy, compassion, mindfulness, purposefulness, responsibility, collaboration, and self-regulation.

In their Education 2030 framework for curriculum design, OECD countries have

put "creating new value, dealing with tensions and dilemmas" and "developing responsibility" at the center. Creating new value, as a transformative competency, connotes processes of creating, making, bringing into being, and formulating; and outcomes that are innovative, fresh and original, contributing something of intrinsic positive worth. It suggests entrepreneurialism in the broader sense of being ready to venture, to try, without anxiety about failure. The constructs that underpin the competence are imagination, inquisitiveness, persistence, collaboration, and self-discipline. Young people's agency to shape the future will partly hinge on their capacity to create new value.

In a structurally imbalanced world, the imperative of reconciling diverse perspectives and interests, in local settings with sometimes global implications, will require young people to become adept in handling tensions, dilemmas, and trade-offs. Striking the balance, in specific circumstances, between competing demands—of equity and freedom, autonomy and community, innovation and continuity, and efficiency and democratic process—will rarely lead to an either-or choice or even a single solution. Individuals will need to think in a more integrated way that avoids premature conclusions and attends to interconnections. The constructs that underpin the competence include empathy, adaptability, and trust.

The third transformative competency is a prerequisite of the other two. Dealing with novelty, change, diversity, and ambiguity assumes that individuals can "think for themselves" with a robust moral compass. Equally, creativity and problem-solving require the capacity to consider the future consequences of one's actions, to evaluate risk and reward and to accept accountability for the products of one's work. This suggests a sense of responsibility, and moral and intellectual maturity, with which people can reflect upon and evaluate their actions in the light of their experiences and personal and societal goals; what they have been taught and told; and what is right or wrong. The perception and assessment of what is right or wrong, good or bad in a specific situation is about ethics. It implies asking questions related to norms, values, meanings, and limits. Central to this competency is the concept of self-regulation in the spheres of personal, interpersonal and social responsibility, drawing on constructs of self-control, self-efficacy, responsibility, problem-solving, and adaptability.

Knowledge

The transformative competencies discussed above build on knowledge, skills, and values. It was long ago conceded that we can know only a small proportion of what there is to know. Whatever it is that we want to know, Google or Weibo can now tell us in an instant. Nevertheless, the OECD learning framework claims a central role for knowledge itself. What knowledge remains essential for fulfilled and productive human lives? Several types of knowledge seem to be relevant:

Interdisciplinary knowledge, the capacity to see real-life problems, phenomena,

and issues through multiple disciplinary lenses (different disciplines) has become increasingly important. It is rooted in deep disciplinary knowledge. Teachers increasingly underline the importance of epistemic knowledge, the capacity to understand the distinctive nature of the thinking processes and beliefs specific to each discipline. Epistemic knowledge can be stimulated by questions such as "What am I learning in this subject and why?", "What can I use the knowledge for in real life?" and "How do professionals from this disciplinary field think?" Procedural knowledge develops through understanding how something is done or made—the series of steps or actions taken to accomplish a goal. Some procedural knowledge is domain-specific, some transferable across domains. It typically develops through practical problem-solving.

Skills

Cognitive skills are a set of thinking strategies that enable the use of language, numbers, reasoning, and acquired knowledge. They comprise verbal and non-verbal skills, higher-order thinking skills, effective use of executive functions (especially working memory), and problem-solving. Meta-cognitive skills, in particular, include the ability to recognize one's knowledge, skills, attitudes, and values.

Social and emotional skills are a set of individual capacities that can be manifested in consistent patterns of thought, feelings, and behaviors. They can help balance and ground personalities and strengthen character.

Physical and practical skills are a set of abilities to use physical tools, operations and functions. They include manual skills, life skills, professional skills, and the ability to mobilize capacities.

Attitudes and Values

Attitudes can be formed and changed, and generally considered much less enduring and stable than other personality attributes such as traits or temperament. Attitudes are considered separate from and more malleable than personality tendencies and values. In addition to an evaluative aspect (either positive or negative), an attitude may entail a tendency to behave in a particular way towards a given object. Values are guiding principles by which particular beliefs, behaviors, and actions are judged to be good or desirable. Values develop through a process of exploration and experimentation, where young people make sense of their experiences and refine what they believe. Values transcend specific actions and contexts, have a normative prescriptive quality about what ought to be done or thought in different situations, and may be used to guide individuals' attitudes, judgments, and actions. Having good academic and social skills doesn't seem to prevent people from using those skills to destroy, rather than advance, their societies. It comes down to the heart of education: teaching the values that can give students

a reliable compass and the tools to navigate with confidence through our world.

Of course, values are a difficult territory for schools. To make one's way through it, one has to strike a balance between strengthening common values in societies, such as respect, empathy, and tolerance, that cannot be compromised, and appreciating the diversity of our societies and the plurality of values that diversity engenders. Leaning too far in either direction is risky: enforcing an artificial uniformity of values is detrimental to people's capacity to acknowledge different perspectives; and overemphasising diversity can lead to cultural relativism that questions the legitimacy of any core values. But avoiding this issue in discussions about the curriculum just means that it becomes another problem put on the shoulders of classroom teachers without adequate support.

Trying to limit education to the delivery of academic knowledge also carries the risk that education ends up dumbing people down to compete with computers, rather than focusing on core human traits that will enable education to stay ahead of technological and social developments. This is about the true, the realm of human knowledge and learning; the beautiful, the realm of creativity, aesthetics, and design; the good, the realm of ethics; the just and well-ordered, the realm of political and civic life; and the sustainable, the realm of natural and physical health.

Singapore was the first country I came across that placed values explicitly at the center of its curriculum framework, putting the primary emphasis of schooling on respect, responsibility, resilience, integrity, care, and harmony. These values are meant to shape students' character qualities, such as self and social awareness, relationship management, self-management, and responsible decision-making. In fact, character qualities are expressed as 'values in action' by this framework. As a whole, the Singaporean curriculum framework is designed to nurture a confident person, a self-directed learner, a concerned citizen, and an active contributor. Schools in Singapore use the framework to design curricular and co-curricular programmes that will help students develop the requisite competencies. In addition, every student is expected to participate in "Values-in-Action" programmes that help to build a sense of social responsibility. Still, even in Singapore much of this remains an aspiration that is at best partially reflected in how students learn and teachers teach.

Learning as a Navigational Compass

The ability to develop competencies is itself something to be learned, using a sequenced process of reflection, anticipation, and action. Reflective practice is the ability to take a critical stance when deciding, choosing, and acting, by stepping back from what is known or assumed and looking at a situation from other, different perspectives. Anticipation mobilizes cognitive skills, such as analytical or critical thinking, to foresee what may be needed in the future or how actions taken today might have consequences for the future. Both reflective practice and anticipation

contribute to the willingness to take responsible actions, in the belief that it is within the power of all of us to shape and change the course of events. This is a model that suggests how agency is built. It proposes that through anticipation, action and reflection we assemble the competences that enable us to engage with the world incisively, sensitively, and responsibly. This means the mobilization of knowledge, skills, attitudes, and values, through a process of reflective practice, anticipation, and action, in order to build inter-related competencies that equip us to engage.

Curriculum Design Principles

These things are easy to say, hard to do. There seems to be a strong alliance standing in the way of change: Parents who worry that their children will not pass an exam may not trust any approach that promises to achieve more with less. Teachers and their unions may worry that adding social and emotional learning to their tasks will mean that the world will assess them no longer just for what they teach but also for who they are. School administrators and policy-makers may feel they will lose familiar tools to manage schools and school systems when the metric for success shifts from easily quantifiable content knowledge to trust in human qualities that may not reveal themselves in full until well after graduation. Developing convincing answers to this will require a new approach towards the design of modern curricula.

Many countries have responded to reconciling expanding knowledge with the limited time that is available for learning by adding ever more subjects areas at ever more limited depth. But often, this has led to an overloaded curriculum and to learning systems that are a "mile-wide but an inch-deep", while the PISA outcomes suggest a negative cross-country relationship between hours of learning and learning outcomes. However, some countries have looked to broaden the learning experience by integrating new subjects, topics, and themes into traditional curriculum areas, often under the flag of an interdisciplinary approach. Yet other countries have reduced the amount of learning materials to provide more space for depth.

What is needed is a careful balancing act between a "negotiated" and a designed curriculum. Public confidence and the engagement of the profession is not just a function of the inclusiveness of the process of curriculum development, but also of the resulting quality of the curriculum and instructional system, and the social value of its learning outcomes. Finding the right balance is not easy. To give an example, the question many pose in this technology-rich world is whether today's students should learn coding, and I have been intrigued by many interesting examples for doing this in schools all around the world. But I still remain doubtful. The risk is that we will again teach students today's techniques to solve tomorrow's problems and, by the time they graduate, those may show little enduring relevance. The bigger question is how we can strengthen a deep understanding and engagement with the underlying concepts of the digital society without being distracted by today's digital tools.

Curriculum design principles are important that address both overload and time lags. They can also ensure that curriculum changes benefit all the learners, not just a few; and that changes are not made piecemeal but as part of a broader plan for an integrated learning experience. At least the following design principles are relevant:

- **Learner centrality**. Curriculum should be constructed around learners, to ensure they are fully motivated and to take account of what they have already learned.
- **Authenticity**. Learners should be able to link what they are learning to the real world and feel that it is purposeful.
- **Rigor**—that is, building what is being taught around a high level of cognitive demand; focus, in terms of aiming at deep conceptual understanding by prioritizing depth over breadth of content; and coherence, in terms of sequencing the instructional system based on a scientific understanding of learning progressions and human development.
- **Inter-connectedness.** Learners should be given opportunities to discover how a topic or concept can link to other topics or concepts within and across disciplines. The challenge is to remain true to the disciplines, while aiming at interdisciplinary learning and the capacity of students to see problems through multiple lenses.
- **Flexibility**. Curriculum should not be static and predetermined but adaptable and dynamic, enabling schools and teachers to take account both of changes in the external environment and the needs of individual learners.
- **Alignment**. Curriculum should be well-aligned with teaching and assessment practices.
- **Transferability**. Higher priority should be placed on knowledge, skills, attitudes, and values that can be learned in one context and transferred to others.
- **Inter-disciplinarity**. Topics should combine concepts and content from multiple disciplines.
- **Choice.** Students should be offered a diverse range of topic and project options, with support to make informed personal choices.
- **Engagement**. Teachers and other stakeholders should be involved early in the development of curriculum, to harness their ideas and build their support for implementation.

The Changing Face of a Successful School System

So how do we foster motivated, engaged learners who are prepared to conquer the unforeseen challenges of tomorrow, not to speak of those today?

In traditional school systems, teachers have often been dispatched to the classroom with prescribed instructions about what to teach in their subject. A different model has emerged in top-performing school systems, with teachers being given the tools and the support to find their own more individual path. There are clear goals for what students should be able to do, but there is an expectation of more professional independence for how teachers achieve this.

The past was about received wisdom, the future is about user-generated wisdom. The past was divided—with teachers and content divided by subjects and students separated by expectations of their future prospects. The past could also be isolated—

with schools designed to keep students inside, and the rest of the world out, with a lack of engagement with families and a reluctance to partner with other schools. The future needs to be integrated—with an emphasis on the integration of subjects and the integration of students. It needs to be connected—so that learning is connected to real-world contexts and contemporary issues and open to the rich resources in the community. Instruction in the past was subject-based, while instruction in the future needs to be more project based, building experiences that help students think across the boundaries of disciplines and domains of knowledge. The past was hierarchical, and the future is more collaborative, recognizing both teachers and students as resources and co-creators.

In the past, different students were taught in similar ways. Now the challenge is to embrace diversity with differentiated approaches to teaching. The past was curriculum-centered, the future is learner-centered. The goals of the past were standardization and compliance, with students educated in age cohorts, following the same standard curriculum, all assessed at the same time. The future is about personalizing educational experiences, building instruction from student passions and capacities, helping students to personalize their learning and assessment in ways that foster engagement and talents and it's about encouraging students to be ingenious. As well as countering educational disadvantages, this can help capitalize on the strengths of the most talented students.

In the past, schools were technological islands, with technology often limited to supporting existing practices, and students outpacing schools in their adoption and consumption of technology. The schools of the future will use the potential of technologies to liberate learning from past conventions and connect learners in new and powerful ways, with new sources of knowledge, innovative applications, and one another. The future will be about participating.

We need to deeply understand that learning is not a place but an activity. School systems need to recognize that individuals learn differently, and differently at different stages of their lives. They need to foster new approaches that allow people to learn in ways that are most conducive to their progress.

The focus of policy needs to be on the outcomes of a school system, rather than on arguments about how education is provided. This means shifting from looking inwards at the bureaucratic structure towards looking outwards to the next teacher, the next school, and the next education system. Powerful learning environments are constantly creating synergies and finding new ways to enhance professional, social and cultural capital with others. They do that with families and communities, with higher education, with businesses, and especially with other schools and learning environments. This is about creating innovative partnerships (OECD, 2017).

Instead of an emphasis on the role of school management, top-performing education systems are stronger on the idea of leadership at every level of the system, and the need for school leaders to support and develop the quality of teaching and distributed leadership. This includes coordinating the curriculum and teaching programs, monitoring and evaluating teacher practice, promoting teacher

professional development, and supporting collaborative work cultures. The past was about quality control; the future is about quality assurance. It is time to explore the implications of all this for learners, educators, and educational leaders.

What does It Mean for Teachers?

High and Growing Expectations on Teachers

The expectations for teachers are high and rising each day. We expect them to have a deep and broad understanding of what they teach and whom they teach, because what teachers know and care about makes such a difference to student learning. But we expect much more than what we put into the job descriptions of teachers. We expect teachers to be passionate, compassionate and thoughtful; to make learning central and encourage students' engagement and responsibility; to respond effectively to students of different needs, backgrounds and languages, and to promote tolerance and social cohesion; to provide continual assessments of students and feedback; and to ensure that students feel valued and included and that learning is collaborative. We expect teachers themselves to collaborate and work in teams, and with other schools and parents, to set common goals, and plan and monitor the attainment of goals.

Teachers of today's "connected" learners are also confronted with challenging issues around the digital world, from information overload to plagiarism, and from protecting children from online risks such as fraud, violations of privacy or online bullying to setting an adequate and appropriate media diet. They are expected to help educate children to become critical consumers of internet services and electronic media, and to make informed choices and avoid harmful behaviors.

But there is more to this. Successful learners generally had a teacher who was a mentor and took a real interest in their life and aspirations, who helped them understand who they are, discover what their passions are and where they can capitalize on their specific strength; who taught them how to love to learn and build effective learning strategies as the foundation for lifelong learning; and who helped them find out where they can make a difference to social progress. Those aspects of teacher quality are difficult to compare and quantify, but designing a work organization and support culture that nurtures these qualities among teachers will give public policy a powerful handle on successful learning.

Digital Technology in Support for Teachers

Some suggest that digital technologies may make teachers redundant. But the heart of teaching has always been relational and teaching seems to be one of the most enduring social activities. So there will be more, not less, demand for people who are able to build and support lifelong learners.

Still, like for many other professions, digital technologies are likely to take over many of the tasks now carried out by teachers. Even if the work of teachers will never be digitalized or outsourced to other places, routine administrative and instructional job tasks in their present form are already being outsourced by technology. Digital technology now allows us to find entirely new responses to what people learn, how people learn, where people learn and when they learn and to enrich, amplify, and extend the reach of excellent teachers and teaching.

Digital technologies are also creating opportunities that will amplify great teaching, even if great digital technology can never replace poor teaching. Technology enables teachers and students to access specialized materials well beyond textbooks, in multiple formats and in ways that can bridge time and space. It offers innovative platforms for collaboration in knowledge creation, where teachers can share and enrich teaching materials.

Perhaps most importantly, technology can support new ways of teaching that focus on learners as active participants. There are many examples where technology enhances experiential learning, fosters project-based and inquiry-based teaching methods, facilitates hands-on activities and co-operative learning, and delivers formative real-time assessments. There are also interesting examples where technology supports learning with remote and virtual labs, interactive, non-linear courseware based on state-of-the-art instructional design, sophisticated software for experimentation and simulation, social media, and educational games. These are precisely the learning environments that are needed to develop 21st century skills. One teacher can now educate and inspire millions of learners and communicate their ideas with the whole world.

Perhaps the most distinguishing feature of technology is that it not only serves individual learners and educators, but builds an ecosystem around learning that is predicated on collaboration. Technology can build communities of learners that make learning more social and more fun, recognizing that collaborative learning is a powerful tool to enhance goal orientation, motivation, persistence, and the development of effective learning strategies. Similarly, technology can not only build communities of teachers to share and enrich teaching resources and practices but also to collaborate on professional growth and the institutionalization of professional practice. It can help system-leaders and governments to develop and share best practice around curriculum design, policy and practice.

Building Trust and a Culture of Sharing

Big data can also support the redesign of education. Imagine the power of an education system that could meaningfully share all of its collective expertise and experience. But throwing education data into the public space does not in itself change the ways in which students learn, teachers teach, and schools operate. That is

the discouraging insight many administrative accountability systems provide. People might have data, but they might not do anything with it to change education practice.

Turning digital exhaust into digital fuel and using data as a catalyst to change education practice requires us to get out of the "read-only" mode of our education systems, in which information is presented in a way that cannot be altered. This is about combining transparency with collaboration. The way in which educational institutions often work is that there are experts sitting somewhere in the administration who determine the content, rules and regulations affecting hundreds of thousands of students and teachers, with few people being able to figure out how those decisions were made, and are thus bound to follow them blindly, or ignore them.

If we could make the data available behind such decision-making, and could enable educational innovators to experiment and create a maker culture in education, then we could use big data to help create big trust. The power of "collaborative consumption" is striking, where online markets are created in which people share their cars and even their apartments with total strangers. Collaborative consumption has made people micro-entrepreneurs—and its driving engine is building trust between strangers. In the business world, trustworthy strangers are connected in all sorts of marketplaces. The reason of why this works is that behind these systems are powerful reputational metrics that help people know their counterparts and build trust.

It is worth considering the use of technology in Shanghai, the top education system in the PISA 2012 results. Teachers are very judicious and selective in deploying technology in classrooms. But they embrace technology when it comes to professional practice. When I visited Shanghai in 2013, I saw teachers using a digital platform to share lesson plans. That in itself is not unusual. What made it different was the combination of the platform with reputational metrics. So the more that other teachers downloaded lessons, or criticised or improved lessons, the greater the reputation of the teacher who had shared them. At the end of the school year, the principal would not just ask how well the teacher had taught his or her students, but what contribution they had made to improve the teaching profession and the wider education system.

Shanghai's approach to curate crowd-sourcing of educational practice is not just a good example for identifying and sharing the best practice among teachers, but it is also so much more powerful than performance-related pay as an approach to professional growth and development. In this way, Shanghai created a giant open-source community of teachers and unlocked the creative skills and initiative of its teachers, simply by tapping into the desire of people to contribute, collaborate, and be recognized for it. Because technology has enabled us to act on our imaginations in ways that we could never before, value is less and less created vertically through command and control but increasingly is created horizontally, with which we connect and work.

When Shanghai parents are surveyed about the quality of schooling, many rate the quality of the school system as poor but the quality of the school of their children as good, irrespective of the outcomes in absolute terms. We trust the schools of our children because they are the ones we know, and we trust the teachers in these schools because we know them, while we have less trust in strangers. But the digital age allows us to create much more enriching and valuable social capital. What reputational metrics such as those used in Shanghai do is give those strangers faces and identities, and because so many other people are doing the same, we learn whom we can trust.

The Importance of Teachers' Ownership of their Profession

The heart of this debate on teaching is not technology, but ownership. We need to do more to create a teaching profession that owns its professional practice. I meet many people who say we cannot give teachers and educational leaders greater autonomy because they lack the capacity and expertise to deliver. That, of course, often holds some truth. But a response that simply perpetuates an industrial model of teaching will continue to disengage teachers, like someone who heats up pre-cooked hamburgers will never become a master chef.

In contrast, when teachers feel a sense of ownership over their classrooms, when students feel a sense of ownership over their learning, that is when productive learning takes place. So the answer is to strengthen trust, transparency, professional autonomy, and the collaborative culture of the profession all at the same time.

When teachers assume ownership, it is difficult to ask more of them than they ask of themselves. In 2011, the Ministry of Education in the Netherlands developed teacher-led professional standards. Initially, there were concerns in the government that leaving this to the profession could sacrifice the necessary rigor and set off a drive towards the lowest common denominator. But the opposite was the case. No government in the Netherlands would have ever been able to impose such demanding standards for the profession as the profession had developed itself.

There are many things we can learn from such experience. First of all, involving teachers in the development of professional standards is a great way to build professional knowledge. Indeed, for teaching standards to be relevant and owned by the profession, it is essential that teachers play a lead role in developing and taking responsibility for them. The participation of teachers in designing methods for teacher appraisal is essential to the effectiveness of any appraisal system (OECD, 2013). Inviting teachers to participate is a way of recognizing their professionalism, the importance of their skills and experience, and the extent of their responsibilities. Teachers will be more open to being appraised if they are consulted in the process. Thus appraisal-system designers need to work with teacher professional organizations and outstanding teachers from across the system. In the end, teachers, like other professionals, have a genuine interest in guarding the standards and reputation of their profession.

But the most essential reason why teachers' ownership of the profession is a must-have rather than an optional extra lies in the pace of change in the school system. Even the most effective attempts to translate a government-established curriculum into classroom practice will drag out over a decade, because it takes so much time to communicate the goals and methods through the different layers of the system and to build them into traditional methods of teacher education. Such a slow process is no longer good enough because it inevitably leads to a widening gap between what students need to learn and what teachers teach.

The only way to shorten the pipeline is to professionalize teaching, that is, to provide teachers not only with a deep understanding of the curriculum as a *product*, but equally with the *process* of curriculum and instructional design and the pedagogies to enact and enable the ideas behind the curriculum. Subject-matter knowledge will be less and less the core and more and more the context of good teaching.

Schools face a tough challenge in responding to changes in what will be valuable for young people in the future. The traditional content-based curriculum needs to be replaced by fast-moving flows of knowledge creation. Much of today's curricula are designed to equip learners for a static world that no longer exists. Those types of curricula could be delivered with an industrial approach. They did not require advanced professional insights around instructional design on the part of teachers. That is no longer good enough. As the prescriptive approach weakens, the position of the classroom practitioners needs strengthening. While governments can establish directions and curriculum goals, teachers themselves need to take charge of the instructional system.

However, increased professional autonomy also implies challenging idiosyncratic practice. It means moving away from every teacher having their own approach to the common use of practices agreed as effective, making teaching not just an art but also a science. That is what the example of teacher collaboration in Shanghai was really about. Paradoxically, the highly standardized industrial work organization of teaching has often left teachers alone in the classroom. Zero per cent school autonomy has meant a hundred per cent teacher isolation behind closed classroom doors. So the challenge is moving from every teacher choosing his or her own approach towards practices agreed by the profession as effective. We should not take freedom as an argument to be idiosyncratic. If you were a pilot, and you would announce to your passengers you were taught to land against the wind but, this time, you want to try to land with the wind, they would feel very anxious.

Encouraging Partnerships Outside of Education

When other sectors see flat-lining productivity they look to innovation. That is happening in education too. Comparisons point to levels of innovation in education

that are pretty much in line with those in other sectors (OECD, 2014). The central question is perhaps not the volume of innovation, but its relevance and quality and the speed from idea to impact. Innovation is happening, but too little of it is focused at the heart of learning; and when it does, it spreads too slowly.

Even where good knowledge exists, many educational practitioners just do not believe that the problems they face can be solved by science and research. Too many teachers believe that good teaching is an individual art based on inspiration and talent, and not a set of competences you can acquire during your career. Yet, it would be a mistake to just blame teachers for that. This problem goes often back to policy, because there is a real lack of incentives and resources to codify professional knowledge and know-how. Because education has not been able to build a professional body of practice nor even a common scientific language in ways other professions have, practice remains tacit; not articulated, invisible, isolated, and difficult to transfer. Investing in better knowledge must become a priority and it promises to deliver huge rewards.

It is also important to create a more level playing field for educational innovation. Without knowing more about the size, market, and innovation intensity of the education industry, it will be hard to build a business sector that can generate and disseminate innovation.

Governments can help to put ideas into practice, to strengthen professional autonomy and a collaborative culture where great ideas are refined and shared. Governments can also help with funding and can build incentives and signals that strengthen the visibility and demand for what works. But governments alone can only do so much. Silicon Valley works because governments created the conditions for innovation, not because governments do the innovation. Similarly, governments can not do the innovations in the classroom. However, they can help by opening up systems, so that there is an innovation-friendly climate where transformative ideas can bloom. That means encouraging innovation within the system and making it open to creative ideas from outside. More of that needs to be happening.

Education also needs to better identify key agents of change and champion them and to find more effective approaches for scaling and disseminating innovations. That is also about finding better ways to recognize, reward, and give exposure to success, to do whatever is possible to make it easier for innovators to take risks and encourage the emergence of new ideas. One of the most devastating findings from our first TALIS survey of teachers was that three-quarters of teachers in the industrialized world consider their workplace an environment that was essentially hostile to innovation (OECD, 2009). Nothing will change if we can not change that perception.

Redesigning Assessment

The way that students are tested has a big influence on policies and practices too,

because it signals the priorities for curriculum and instruction. Tests will always focus our thinking about what is important, and they should. Not just students but also teachers and school administrators will pay attention to what is tested and adapt the curriculum and teaching accordingly.

Some pertain that assessments are limited as they only capture selected dimensions of learning outcomes. That is obviously true, but it is also true for any form of measurement, including observation. Ask police investigators about divergences among the testimonies of witnesses, or consider teacher biases about gender or social background and you will see how limited and subjective observation can be. The question is rather how we can get the assessment piece right and ensure that assessments form one of multiple perspectives on student learning outcomes that can help teachers and policy-makers keep their finger at the pulse of educational progress. Successful reforms of curriculum and instructional systems will therefore hinge on redesigning assessment systems in tandem.

The trouble is that many assessment systems are poorly aligned with the skills required by young people. One can answer large parts of today's school tests in seconds with the help of a smartphone. If our children are to be smarter than our smartphones, then tests need to look beyond whether students can reproduce information to see whether they can extrapolate from what they know and use their knowledge creatively in novel situations and engage with divergent thinking.

At present, most tests would not allow students to connect with the internet, for fear students might look up the answers to the questions. The challenge for future assessments is whether they can encourage them to go online to connect with the world's most advanced knowledge without jeopardizing the validity and reliability of results.

Similarly, one of the worst offences in test taking is to consult with your neighbor. However, as innovation is now rarely the product of individuals working in isolation but more likely to be an outcome of how we share and link knowledge, future tests should not disqualify students for collaborating with other test-takers, but encourage them to do so.

We should also work harder to bridge the gap between summative and formative assessments, which has traditionally divided educators and policy-makers into opposing camps. Summative assessment usually means testing students at the end of a course unit, while formative assessment is a more diagnostic approach, carried out while students are studying and intended to show what needs to be improved while work is in progress, rather than delivering a final verdict.

We need to find more creative ways to combine elements of both approaches to testing, as it is now possible to create coherent multi-layered, real-time assessment systems that extend from students to classrooms, to schools, to regional, national and even international levels. Good tests should provide a window into students' thinking and understanding and the strategies a student uses to solve a problem. Digital assessments such as PISA now make that possible, in that they do not just capture the

degree of correctness of students' responses, but also the paths students have taken to their solutions.

Not least, tests need to become better at feeding results back to learners and educators in real time, so that data become a powerful instrument to improve learning. Teachers can then understand what the assessment reveals about students' thinking. They will then no longer see testing as separate from instruction, taking away valuable time from learning, but rather see it as an instrument that adds to learning. Not least, school administrators, policymakers, and teachers can use this information to create better opportunities for student learning.

The Importance of Looking Outward

If I can add one more aspect to the demands on responsive and responsible leaders, it is the need to look outward. It is not surprising that a strong and consistent effort to carry out international benchmarking and to incorporate the results of that benchmarking into policy and practice is a common characteristic of the highest-performing education systems.

Finland was benchmarking itself against the performance and practices of other education systems in the run-up to its own dramatic emergence as one of the world's top performers. Japan launched its long-running status as one of the world's leading performers when its government officals, during the Meiji Restoration, visited the capitals of the industrializing West and decided to bring to Japan the best that the rest of the world had to offer. It has been doing so ever since.

When Deng Xiaoping took the helm in China and began its rise on the world's industrial stage, he directed China's education institutions to form partnerships with the best educational institutions in the world and to bring back to China the best of their policies and practices. In the latter half of the 20th century, Singapore did exactly what Japan had done a century earlier, but with even greater focus and discipline.

Contrasting this outward-looking attitude with that of those countries which prefer to cast doubt over PISA when test results show that their education system has been outperformed and that consider it humiliating to make comparisons with what is happening in other countries, this is likely to be a key differentiator between which countries make progress. The division will be between those education systems that feel threatened by alternative ways of thinking and those that are open to the world and ready to learn from the world's best experiences.

Note

1 The Chinese version of this article was published on *Global Education* (Vol. 47 No. 2, pp. 3–18, 2018).

Note on Contributor

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