A Mobile School in the Digital Era

Learning Environment Ecosystem Strategies for Challenging Locations and Extreme Poverty Contexts

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Abstract

This paper reflects on a major contemporary challenge concerning the delivery of educational services and school facilities in complex non-traditional contexts largely afflicted by poverty, like remote rural and troubled city areas, disaster areas, nomad cultures, or crisis contexts and refugee camps. Extreme poverty is to be found in many developing regions of the world but also in some developed countries. Education empowers individuals, families and communities, addresses the intergenerational transmission of poverty, creates access to economic opportunities and promotes the achieving of a range of sustainable development priorities. In 2000, as part of the Millennium Development Goals, UN and UNESCO set itself the target of ensuring that every primary-age child in the world would be in school by 2015.

However, alarming statistics today illustrate a persistent worldwide lack of opportunities to quality primary education, a huge wasted potential of human capital. In 2014, 57 million primary-age children are reported to be still out of school, another 250 million children are not learning the basics by fourth grade due to poor quality of schools, and 175 million youth are unable to read a single sentence. 200 million young children lack early learning opportunities, at the age most critical to brain development. 28.5 million out-of-school children are marginalized in complex, conflict-afflicted parts of the world, in crisis contexts, war zones, refugee camps, predominantly in the poorest countries and regions. Furthermore, research finds that stressful events and poverty in early childhood affect and alter the development of the brain. However, interventions and strong early childhood programs from the first 1000 days can help disadvantaged children to overcome effects of adversities and poverty on brain development.

While investing in human capital through education is a powerful instrument in addressing the intergenerational transmission of poverty, conventional models of schooling have not proved to be able to scale up rapidly enough to serve unprivileged children in a reasonable timeframe. However, digital technologies open up new perspectives to improving educational access, equity and quality. Mobile technology promotes learning independent of time, place and distance - even independent of teachers. This calls for new strategies and school formats, and challenges aid providers, governments, schooling designers and architects to create more relevant educational ecosystems in challenging and poverty afflicted contexts. As an illustrative case, this paper refers to a disruptive re-locatable ‘mobile’ school format, my project InnoSchool Learning Lab, presented at Venice Biennale 2014 ‘Time Space Existence’ exhibition.

Keywords: UNESCO MDG Goals, UN Sustainable Development Goals, extreme poverty, childhood poverty and brain development, early childhood development, learning environments, educational ecosystems, educational facilities, educational technology, pre-primary education, primary education.

Education empowers individuals, families and communities, addresses the intergenerational transmission of poverty, creates access to economic opportunities and promotes the achieving of sustainable development priorities.

Mobile technology promotes learning independent of time, place and distance – even independent of teachers. This calls for new strategies and school formats, and challenges aid providers, governments, schooling designers and architects to design and provide more relevant educational ecosystems in challenging and poverty afflicted contexts.

Introduction: The global learning crisis

In 2000, as part of the Millennium Development Goals, UNESCO, The World Bank, and a large international community set itself the ambitious target of education for all, and of ensuring that every primary-age child in the world would be in school by 2015.

Education is a powerful instrument and a strong catalyst for lasting development: it empowers individuals, families and communities, addresses the intergenerational transmission of poverty, and creates access to economic opportunities. It is widely accepted that literacy not only changes lives, it saves them: there is undeniable evidence of the links between education and reducing hunger, preventing disease, escaping poverty, promoting commitment for a healthy environment and achieving a range of sustainable development priorities. In 2000, as part of the Millennium Development Goals, UN, UNESCO, The World Bank, and a large international community set itself the ambitious target of education for all, and of ensuring that every primary-age child in the world would be in school by 2015 (Save the Children, 2013).

In 2014, still 57 million primary-age children are reported to be out of school, and 28 countries might not be able to fill the gap even by 2030. Most often out-of-school children are to be found in remote rural and underprivileged city areas, or in nomad cultures, in disaster locations, catastrophe areas, in poverty afflicted settings in developing or even in some developed countries.

Despite significant progress, the Millennium Development Goals will not be met, and the deadline is proposed to be extended to 2030. Alarming statistics reflect a huge wasted potential of human capital owing to lack of opportunities to quality education. In 2014, 57 million primary-age children are reported to be still out of school, and 28 countries might not be able to fill the gap even by 2030 (UNESCO, 2014). Most often out-of-school children are to be found in remote rural and underprivileged city areas, or in nomad cultures, in disaster locations, catastrophe areas, in poverty afflicted settings in developing or even in some developed countries. 43% of these children, 15 million girls and 10 million boys, are unlikely ever to set foot in a classroom. Today, another 250 million children have not learned the basics by fourth grade, whether in school or not, due to quality deficits of schools, and 175 million youth are unable to read a single sentence. An estimated 200 million young children lack early learning opportunities at the age most critical for brain development, and are at high risk of not achieving their full potential. By 2014, the number of illiterate adults remains at 774 million.

The coverage challenge

28.5 million out-of-school children are reported to be in complex, conflict-affected settings, in crisis contexts, war zones, refugee camps, predominantly in the poorest countries and regions, practically ignored by the international community.

A ‘hidden crisis’ of education delivery in conflict-afflicted countries has been revealed by UNESCO GMR (2011). New analyses show that the international community is not reaching children in crisis contexts, one of the principal reasons for the slowdown in progress towards the goal of universal primary education. 28.5 million out-of-school children are reported to be in complex, conflict-affected settings, in crisis contexts, war zones, refugee camps, predominantly in the poorest countries and regions, practically ignored by the international community. These children already make up the larger proportion of all primary-age out-of-school children, their number having increased from 42% of the global total in 2008 to 50% in 2011 (Save the Children, 2013).

The teacher shortage challenge

By the extended deadline in 2030, the total demand for primary teacher recruitments would rise to 27.3 million; of these, 23.9 million teachers are needed to compensate for attrition, with about 3.4 million additional new posts in need. In some countries, 10 primary teachers leave the profession for every 7 hired.

The learning crisis is fuelled by too few classrooms and a chronic shortage and attrition of teachers. To achieve universal primary education by the deadline in 2015, 4 million primary teacher recruitments would be needed: 2.6 million teachers in replacements for attrition, and 1.4 million to ensure quality by securing that there are not more than 40 students for every teacher. By the extended deadline in 2030, the total demand for primary teacher recruitments would rise to 27.3 million; of these, 23.9 million teachers are needed to compensate for attrition, with about 3.4 million additional new posts in need. In some countries, 10 primary teachers leave the profession for every 7 hired (UNESCO/ UIS, 2012). Trained teachers may be difficult to recruit in remote and adverse settings; in some areas the percentage of lower primary school teachers who are trained may be as low as 1% (UNESCO EFA GMR, 2014). Rushing to fill the gap, many countries are hiring teachers with little or no training (UNESCO/ UIS, GMR, 2014).

Besides the persisting teacher shortage there is a serious quality deficit problem, hitting the poorest and most marginalized children the hardest.

Where schools are available, a huge variability exists in the quality of education provided. More than 250 million children are not able to read a sentence or count by fourth grade, whether in school or not.

150 million children aged 5 -14 are involved in child labor and cannot attend school during daytime when schools work.

At the bottom is the shame of humankind: at least 21 million people -more than ever in history- are trapped in modern-day slavery; 26% or 5.5 million of these are children. The joint Nobel Peace Prize 2014 was awarded to Kailash Satyarthi for his courageous work helping children out of slavery.

The joint Nobel Peace Prize 2014 was also awarded to Malala Yousafzai for her brave fight for all children's right to education, including the rights of girls.

Knowledge is a valuable resource, increasingly determining who has access to power and profit. The hindrance of knowledge and limits to its access also represents power.

The quality deficit challenge

Besides the persisting teacher shortage there is a serious quality deficit problem, hitting the poorest and most marginalized children the hardest (Global Partnership of Education GPE, 2014). Where schools are available, a huge variability exists in the quality of education provided. More than 250 million children are not able to read a sentence or count by fourth grade, whether in school or not. In some areas, the quality of schools might be seriously compromised as a result of substantial teacher absenteeism, or even teachers being drunk, sleeping on the job, getting children to do their domestic chores for them, teachers keeping schools closed for weeks at a time, or reducing teaching activity to a minimum in terms of both time and effort (Walford, G., 2014, and Probe Team, 1999). Referring to their report, the Probe Team even claims that "this pattern is not confined to a minority of irresponsible teachers – it has become a way of life in the profession". Quality deficits may also be due to unqualified teaching personnel consisting of staff with forged degree certificates, high pupil-teacher ratio, poor classroom facilities, and lack of learning materials.

The hidden child labor challenge

Children around the world are engaged in paid and unpaid forms of work that might not be harmful as such, but if the children are too young to work or are involved in exhausting or stressful work that might compromise their physical, mental, social or educational development, they are classified as child laborers. Forms of 'hidden' child labor are not only found in sweatshops but also in households, in family businesses, and on farms especially where there is livestock. 15% of the age group, around 150 million children aged 5 -14 in developing countries are involved in child labor and cannot attend school during daytime when schools work. In the least developed nations, nearly one in four children is engaged in work that is potentially harmful to health or development (UNICEF, 2014). And at the bottom is the shame of humankind: at least 21 million people -more than ever in history- are trapped in modern-day slavery around the world. Of these, 1.5 million are to be found in developed economies and in the European Union (UN Estimate of Forced Labor, and ILO, 2012). The joint Nobel Peace Prize 2014 was awarded to Kailash Satyarthi for his courageous work helping children out of slavery.

The affordability challenge

The number of children living in extreme poverty is reported to be 400 million globally, and poverty exists also in developed nations. Recent numbers reveal that 19 million children in the European Union are living in poverty (World Bank Group, 2013).16.4 million children in the United States live in poverty, with an increase of 3.3 million between 2007-2011 (University of New Hampshire, 2012). The WBG has endorsed two global goals: ending extreme poverty by 2030, and fostering income growth of the bottom 40 percent of the population in developing countries (World Bank Group, 2013).

In some less economically developed countries the governmental education budget may rely heavily on international aid. Many of these countries have corruption so strongly embedded in the society that a great deal of the funding does not reach the schools, or when it does, it may be misused (Walford, G., 2014). Schools cost, and monthly school fees may prevent underprivileged families from enrolling their children; even lack of a school uniform is sometimes an obstacle to education. Some families cannot send all of their children to school and must choose which child to send, often a boy. Besides affordability problems, a gender bias, gender-based violence and hostile attitudes towards girls' education still persist in unstable contexts. The joint Nobel Peace Prize 2014 was awarded to Malala Yousafzai for her brave fight for all children's right

400 million children globally are living in extreme poverty, also in developed nations. 19 million children in the European Union and 16 million children in the US are living in poverty.

Environmental experiences in childhood affect the development of the brain by epigenetic fine-tuning of genes, by switching some genes on and others off, and in so doing set a trajectory for life.

There is an important link between poverty and biology. Stressful life and poverty in early childhood affects the brain structure. Wolfe, B. (2013) claims: "We are watching how poverty gets under the skin".

Multiple studies have shown that strong early childhood programs can help disadvantaged children to overcome the grave effects of adversities and poverty on brain development.

Studies highlight the need to integrate strategies aimed at tackling nutrition and cognitive development problems within the first 1000 days of childhood. Initiatives need to help children not only to survive but thrive.

However, a huge imbalance exists in the allocation of international humanitarian funds. Only 1.4 % of the total humanitarian aid is allocated to education, instead of including basic education as an integral component of any humanitarian response.

to education, including the rights of girls. Child marriages are serious hurdles to girls' education (UN, UNESCO, UNHCR reports, 2014). In the global information society, we are witnessing the emergence of knowledge as a valuable resource, increasingly determining who has access to power and profit (UNESCO, 2005). The hindrance of knowledge and limits to its access also represents power (White, D. S. et al, 2011).

Problem of problems: Poverty affects brain development

Children in poverty suffer not only from loss of opportunity but from poor development of their nervous system (Lipina, S. et al, 2009). "*A third of the world's children are at risk of not being able to actualize their potential"* (World Economic Forum, 2014). The new field of developmental neuroscience reshapes our understanding of the early years of human life, and of the impact of adversities in childhood. An international network of researchers has demonstrated that an individual's genetic makeup is programmed to adapt during the formative early years of life to environmental stimuli, both positive and negative (CIFAR, 2012). Studies show how profoundly environmental experiences in childhood affect the development of the brain by epigenetic fine-tuning of genes, by switching some genes on and others off, and in so doing set a trajectory for life. Stressful life events and poverty in early childhood are associated with a higher risk of poor cognitive outcomes and school performance, and can have profound impacts on later physical and emotional health. There is shown to be an important link between poverty and biology. Wolfe, B. (2013) claims: *"We are watching how poverty gets under the skin".* According to Wolfe, a longitudinal analysis of hundreds of infants' brain scans up to four years of age revealed that at birth the brains looked very similar, but a separation in brain growth between children living in poverty and more affluent children increases over time, which implicates the postnatal environment. Luby, J. (2013) studied underprivileged six to twelve year old children and reports that exposure to poverty during early childhood affects the brain structure; it is associated with smaller cortical gray matter, smaller white matter, smaller hippocampal and amygdala volumes in the brain.

Multiple longitudinal studies have shown that strong early childhood programs can help disadvantaged children to overcome the grave effects of adversities and poverty on brain development. The growth of brain's grey matter peaks during specific times in childhood, indicating periods when the environment can strongly influence brain development (Nelson, C. and Sheridan, M., 2012). According to Nobel Prize Laureate James Heckman, timing, quantity and quality of intervention are crucial for the development of cognitive abilities (Gertler, P. and Heckman, J., 2014). Intervention strategies targeting high-risk families should start as early as birth, and *"exposure to early life adversity should not be considered less toxic than exposure to lead, alcohol, or cocaine, and as such it merits similar attention from public health authorities" (*Nelson, C., 2013). Research clearly suggests that intervention in the first 1000 days of life is vital to fulfilling childhood potential (Black, M. et al., 2014).

International humanitarian aid providers ignoring education

There is a large consensus today about education being the most powerful tool in the efforts in eradicating the intergenerational transmission of poverty and misery, and in empowering individuals, families, communities, society and economy. Black, M. and Dewey, K. (2014) highlight the need to *integrate* global strategies aimed at tackling nutrition and cognitive development problems within the first 1000 days of childhood, and suggest combining intervention strategies which focus on both nutrition and early learning. The integrative strategies are

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Conventional efforts need to be supplemented by a new generation of strategies and solutions.

Interventions might also overlook a key age group and not recognize the value of early education. The rate of return on investments in early childhood education compared to any other education age group, yields the highest return, by far.

Neuroscientific disciplines have the potential to inform the design of interventions. There is an obvious need for greater synergy between advances in neuroscience and the formulation of policies to improve the quality of schooling and early childhood interventions.

seen vital for long-term success of the UN Millennium Development goals. To realize the potential of children and contribute to sustainable human progress, initiatives need to *help children not only to survive but thrive*.

However, a huge imbalance exists in the allocation of international humanitarian funds. Only 1.4 % of the total humanitarian aid is allocated to education, instead of including and financing basic education as an integral component of any humanitarian response. The private sector contributes the equivalent of only 5% of aid to education, and 57% of this private sector aid to education comes from only 5 private corporations worldwide (UNESCO, 2012). A decline by 10% since 2010 in the already insufficient overall aid for basic education further jeopardizes the education for all goals and a sustainable alleviation of poverty.

Discussion

The prevailing worldwide lack of opportunities to quality education means a huge wasted potential of human capital. The current stagnant numbers of out-of-school children implicate that conventional ideas and models of schooling are not scaling up rapidly enough to serve the hardest-to-reach and marginalized generations of children in a reasonable timeframe. Many existing programs, interventions and efforts to deliver education services in underprivileged settings are important and valuable, but are often unlikely to produce breakthrough impact. Well-meaning projects are not always well-informed, and might rely on conservative industrial age school formats, instruction-centered teaching methods, unrealistic hopes for a stable availability of qualified teachers and images of brick-and-mortar school facilities.

Investing in human capital through education is a powerful instrument in addressing the intergenerational transmission of poverty (World Economic Forum (2014). However, interventions often overlook a key age group. The renowned 'Heckman Curve' illustrates the rate of return on investments in human capital at different ages, and demonstrates that investing in early childhood education compared to any other education age group yields the highest return, by far (Heckman, J., 'Heckman Curve'). Education, however, has a longer payoff horizon than workforce training, primary school has a longer payback horizon than higher education, and recognition of the high return on early education investments calls for highly well-informed policy makers. As policy-making cycles tend to be relatively short-term, and good education requires long-term investments, there are often conflicting interests (World Economic Forum, 2014). Neuroscientific disciplines have the potential to inform the design of interventions. There is an obvious need for greater synergy between advances in neuroscience and the formulation of policies to improve schooling and early childhood interventions (Shonkoff, P. et al,2010). The value of early childhood education is highlighted in the WB 2020 strategies: *Invest early, Invest smartly, Invest for all* (The World Bank Group, 2011).Some experts suggest that global action in this issue is already overdue (Lake, A., 2011).

"At no point in history has education been so essential to the well-being of society…Countries need to benefit from the best of modern ideas, methods and technology. The labor market demands workers who have technical attributes, higher order skills, knowledge and ability to adapt to a fast-changing and competitive world. It means that the educational crisis and massive waste of human capital is not remedying by improved access to and quality of mere basic skills and 20th century competences. The complexities of emerging global challenges call for a more aspirational educational agenda to secure workforce with 21st century skills" (World Economic Forum, 2014).

To meet these challenges, there is a need of new ways of thinking and new ways of doing, and this demands fresh approaches, creative ideas and innovative solutions. Consequently, UNICEF has declared 2014 as the 'Year of Innovation for Equity', to focus the world's attention on showcasing and developing innovative solutions to the pressing challenges.

The most common notion of schooling often sentimentally refers to the one we familiarized with in childhood, in another century: the one-size-fits-all factory model, manifested in the brick-and-mortar format; the one with those long corridors and rows of rooms with rows of children making lots of efforts to "learn the same things at the same time in the same way from the same person in the same place for many hours every day".

Countries are increasingly seeking to develop knowledge-based and innovation-driven economies in which not only basic skills and content acquisition but deeper learning and higher order skills, digital literacy, and capacities for creativity and innovation play a central role.

The core question when we export education is: are we preparing the world's most disadvantaged learners for the future or the past?

Nearly 25 years of efforts by the international community have yielded some progress, but much is still left to do; old challenges have combined with new problems, and many children have fallen even further behind (UNICEF, 2014). To meet these challenges and to reach those children who are hardest to reach, there is a need of new ways of thinking and new ways of doing, and this demands fresh approaches, creative ideas and innovative solutions. Consequently, UNICEF has declared 2014 as the 'Year of Innovation for Equity', to focus the world's attention on showcasing and developing innovative solutions to these pressing challenges. In addressing the magnitude of the coverage problems, quality deficits, delivery, availability and affordability challenges and many more, conventional efforts to secure education for all ought to be supplemented by a new generation of strategies and solutions.

Technology changes the game in learning, but is it changing the idea of schooling?

Education has always been resistant to change and apt to maintain status quo. Particularly in the education industry people are often attached to longstanding habits and strongly defended interests that constantly slow innovation in the field (World Economic Forum, 2014). The most common notion of schooling often sentimentally refers to the one we familiarized with in childhood, in another century: the one-size-fits-all factory model, manifested in the brick-and-mortar format; the one with those long corridors and rows of rooms with rows of children making lots of efforts to *"learn the same things at the same time in the same way from the same person in the same place for many hours every day"* (Nair, P. & Fielding, R., 2009).

Today, a reframing of forms, needs, tools and places of learning is irreversibly in process. Digital technology today has the potential to advance learning ecosystems in which learning adapts to each child instead of each child trying to adapt to school. Technology affords intelligent tools for individualized, personalized, self-directed and self-paced learning. It has the power to improve learning efficiency, foster critical thinking, promote creative problem solving and innovating, and develop abilities for media-literacy, collaboration and socio-digital interaction. It calls for a diversification of school formats into disruptive learning ecosystems, as well as for a revised understanding of key skills required to thrive in the modern world, and for more visionary approaches, able to build on technological innovations that are at our fingertips.

The explosion of mobile digital technologies opens up new perspectives to improving educational opportunities, equity and quality. Mobile technology modifies habits of minds; it promotes a new disruptive culture of education and enables services that did not exist before. It has the potential to provide more effective, affordable and scalable educational services to areas where opportunities have been scarce or even absent (World Bank Group, 2011).

Countries are increasingly seeking to develop knowledge-based and innovation-driven economies in which not only basic skills and content acquisition but deeper learning and higher order skills, digital literacy, and capacities for creativity and innovation play a central role (World Economic Forum, 2014). Developed economies are striving and competing to create better and better education for their children. It does not seem a sustainable solution to settle for less and be content securing mere basic skills, last century capacities and school systems derived from the industrial era when we deliver schooling in already marginalized locations and fragile contexts. It can even expand the digital divide. The core question when we export education is: are we preparing the world's most disadvantaged learners for the future or the past?

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One of the most powerful programs demonstrating all children's, also the most marginalized children's huge potential is the renowned Hole-in-the-Wall project in the slums of New Delhi, India.

Children in groups are able to teach themselves to be computer literate and English literate, and learn to search the Internet for answers to big questions in a few months' time, even without direct input from a teacher or with only minimal guidance.

The project has grown into a chain of 300 Hole-in-the-Wall stations, serving more than 300 000 children in remote locations all over India.

The 'School in the Cloud', project has grown into over 100 Self-Organized Learning Environments where children in small groups can search for answers to 'big' questions

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One of the most powerful programs demonstrating all children's, also the most marginalized children's huge potential is the renowned Hole-in-the-Wall project in the slums of New Delhi, India. In 1999, Sugata Mitra launched a ground-breaking experiment that involved carving a hole in a wall in the slum and placing a computer with an Internet connection in the wall. Through the hole, a freely accessible computer and a mouse were put up for free use for the slum children. The children had barely been to school, and did not know English, they had never seen a computer, and they had no idea of what the Internet was. In just a month's time, children without prior knowledge learned to use the computer on their own. The experiment was successfully repeated multiple times in diverse remote and underserved locations in India (Mitra, S., 2010).

According to Mitra, (2010), these experiments have clearly shown that provided the learners are given free and public access to a suitable computer plus engaging and motivating content, in an environment that stimulates curiosity, children in groups are able to teach themselves to be computer literate and English literate, teach themselves the use of e-mail, chat and search engines, improve their English pronunciation on their own, and learn to search the Internet for answers to big questions in a few months' time, even without direct input from a teacher or with only minimal guidance. Furthermore, Mitra claims that children are also able to improve their mathematics and science skills, answer examination questions several years ahead of time, change their social interaction skills and value systems, and form independent opinions and detect indoctrination. Groups of children can learn to navigate the Internet to achieve educational objectives on their own (Mitra, S., 2010). The experiment inspired the Oscar winning film 'Slumdog Millionaire'. Mitra (2007) coined the name Minimally Invasive Education MIE for the approach. The project has grown into a chain of 300 Hole-in-the-Wall stations, serving more than 300 000 children in remote locations all over India, and spreading into more countries. In 2013, Sugata Mitra won the first-ever 1 million dollar TED Prize, and gave his celebrated TED Talk featuring the Hole-in-the-Wall project (Mitra, S., 2013).

Mitra has recently taken technology a step further by introducing his 'School in the Cloud', a *physical-virtual* learning lab. For this project he has recruited British grandmothers, many of them retired teachers, as remote online mentors for children through a 'Granny Cloud' (Mitra, S. 2014). The Skype sessions operate with a life-size image of the granny projected on the wall in the school, interacting with children in real time, while the class is present on a large screen in the granny's home or office in the UK. The idea has grown into over 100 Self-Organized Learning Environments (SOLE's) where children in small groups can search for answers to 'big' questions: a kind of learning activated by questions, not answers. The SOLEs were originally initiated to provide educational support for children in remote, marginalized settings in rural and urban areas in India, but have evolved into morning- and after-school learning labs in both India and the UK. They are not yet schools, but well on the way: Mitra (2014) claims that if research connected to the project confirms his hypothesis*, "then it's the end of schooling as we know it"*. In his TED Talk, Mitra cited Arthur S. Clarke who suggested that *"every teacher that can be replaced by a computer should be"* (Mitra, S., 2013).

While our novel digital learning tools allow us to dwell in the virtual universe independent of time, distance and even teachers, the physical dimension of the learning environment ecosystem sometimes seems to receive too little attention.

If we overlook the power of the place, we will miss a potent tool, capable of supporting the processes of learning. When neglected, it has the power to even hamper or compromise our endeavors.

Toyo Ito suggests: "From old times, architecture has served as a means to adjust ourselves to the natural environment… The contemporary architecture needs to function, in addition, as a means to adjust ourselves to the information environment… It must function as the extended form of skin in relation both to nature and information at once. Architecture today must be a media suit…architecture as a media-suit is the externalized brain".

Architecture should become an answer to multiple novel concerns, many of which we could not imagine a few years ago. This calls for not only those fantastically shaped architectural objects but for well-informed design that embraces research evidence, effective-proven strategies and technological innovations, and promotes engaging, joyful and playful learning and development.

Conclusion

Potential landscapes featuring disruptive technology-enabled learning ecosystems are evolving and fusing into emerging and even more promising sceneries. Radio, television, film and computers in turn have been heralded as disruptive technologies, but have been gradually incorporated into standard conventional schooling. The learning landscape has experienced major shifts since the 1989 promise 'The future is multi-media' to the 1999 promise of 'The future is the Web', to the 2009 promise of 'The future is smart mobile', to the 2012 promise of 'The future is pervasive tech' (Wheeler, S. 2014). The modern economy embraces the perpetual stream of innovations that open up new vistas and enrich older ones, at times having breakthrough and lasting impact. There is enormous momentum for the schooling system to update itself intact with the fast-changing society and the digital, mobile and soon pervasive technology, as well as keeping teacher training up to date with the emerging new learning paradigms, as learning 2.0 is yet emerging while learning 3.0 is already knocking at the door.

While our novel digital learning tools allow us to dwell in the virtual universe independent of time, distance and even teachers, the physical dimension of the learning environment ecosystem sometimes seems to receive too little attention. However, in our digital euphoria, we still continue to be embodied human beings, still part of our immediate environment, tied to a place. As the reframing of forms, needs and tools of learning advances, the places of learning also need attention. If we overlook the power of the place, we will miss a potent tool, capable of supporting the processes of learning. When neglected, it has the power to even hamper or compromise our endeavors.

Pritzker Prize Laureate Toyo Ito suggests: "*From old times, architecture has served as a means to adjust ourselves to the natural environment… The contemporary architecture needs to function, in addition, as a means to adjust ourselves to the information environment… It must function as the extended form of skin in relation both to nature and information at once. Architecture today must be a media suit…architecture as a media-suit is the externalized brain"* (Ito, T. 2013). From primeval times, the existence of man has been dependent on his ability to respond to environmental stimuli and adjust to the challenges of the natural environment. In interaction with nature, man has created an extended form of skin manifesting as architecture. In our times, while we are nonetheless tied to the deeper qualities of our natural origin, we need to adjust to a new layer, the information environment. Our novel understanding of the ability of the human brain to alter its neural connections and genetic make-up in response to environmental conditions and experiences challenges conventional design paradigms. Being projected into natural, artificial and virtual dimensions at the same time, the well-being of man is ever more reliant on a well-informed environmental/ architectural design. In our time, architecture needs to function as a media suit and the externalized brain, but at the heart of the design there still needs to be the primeval human being inhabiting the space.

The novel disruptive physical / digital learning environment ecosystems call for fresh approaches and strategies. Architecture should become a consequence of and answer to the multiple novel concerns and constituents, many of which may not have existed before, many of which we could not imagine a few years ago. This calls for not only fantastically shaped architectural objects but *well-informed design* that embraces research evidence, effective-proven strategies and technology innovations, advances opportunities, equity and efficacy, promotes collaboration and well-being, and engaging, joyful, playful learning.

Case InnoSchool Learning Lab

There is enormous momentum for the schooling system to update itself intact with the fast-changing society and the digital, mobile technology.

If we wish to contribute to global efforts in addressing the challenges of poverty and misery by delivering learning services in marginalized settings and fragile contexts, transformational innovations will be needed.

These may afford new potential to overcome the widening digital divide, bridge the knowledge divide, and sustain marginalized generations to be able to take account of opportunities in the fast-evolving society and play a more productive part in the innovation-driven economy.

Contemporary architecture needs to function as a means to adjust ourselves to the information environment.
A disruptive physical / digital learning environment ecosystem calls for fresh architectural approaches and strategies.

"Architecture influences, shapes and renews pedagogy. The space is not simply background, it is a key player: organizing a space means organizing a metaphor of knowledge, an image of how we know and learn"

If we wish to contribute to global efforts in addressing the challenges of poverty by delivering learning services in marginalized settings and fragile contexts, transformational innovations will be needed. These may afford new potential to overcome the widening digital divide, bridge the knowledge divide, and sustain marginalized generations to be able to take account of opportunities in the fast-evolving society and play a more productive part in the innovation-driven economy.

The challenges presented in this article are part of a larger field of issues reviewed in my doctoral thesis-in-process, "Learning Environment Ecosystem Strategies for Challenging Locations and Poverty Afflicted Contexts". The study investigates the multiple challenges facing the delivery of high quality primary, pre-primary and early education services for marginalized children and educational programs for underprivileged women in complex and non-traditional settings, in order to find implications to inform future physical/digital learning environment ecosystem providers. The study also highlights research evidence that illustrates the power of the places of learning, and claims that *"architecture influences, shapes and renews pedagogy. The space is no longer simply background, but a key player: organizing a space means organizing a metaphor of knowledge, an image of how we know and learn"* (Rinaldi, C. 2010).

As an illustrative case, the study refers to a disruptive learning environment solution, my project *InnoSchool Learning Lab*, presented during 7.6.2014 - 23.11.2014 at the Venice Biennale 2014 'Time Space Existence' –exhibition. This scalable and cost-effective, re-locatable, 'mobile' solar-powered architectural / digital all-in-one Learning Lab 'package' is a disruptive 21st century 'school' format in micro-scale, for 1-6 and 6-12 year old children. The paperless and teacherless lab utilizes today's advances in research and in digital technology. The system involves a parenting program platform for marginalized women, who benefit from programs that improve childcare-, literacy and life skills, and build computer skills to support underserved women to connect and participate in the modern society and economy.

At the heart of the Learning Lab is the innovation InnoSchool *'Smart Early Learning System'*, awarded in 2013 by the Finnish Foundation for Inventions (Keksintösäätiö), drawing on research evidence yielded in my long-term R&D project, *'Leonardo's Children'.* The organization of the educational space reflects an image of how we know and learn, and supports multiple dimensions of learning. The awarded evidence-based and effective-proven early learning strategies are being digitized and gamified into an interactive platform, the *'Leonardo Code'.* The preset digital multistrategy educational platform is embedded in the physical environment of the InnoSchool Learning Lab through touch-screen technology: tablets, screens and interactive whiteboards, and more. The Leonardo Code supports a playful and joyful self-directed, personalized playlist, as well as collaborative inquiry and socio-digital interaction, and utilizes game dynamics that hook children on learning.

The all-in-one *InnoSchool Learning Labs* will *roll out* to provide high quality primary, pre-primary and early education for the hardest-to-reach children in underserved settings. The service is run by marginalized local women, themselves involved in learning processes. InnoSchool Learning Labs have the potential to address wicked and unsolved educational challenges not only in 'poor' developing countries but also respond to multiple newly recognized and educational and social challenges in many 'affluent', developed nations. So - **Let's roll !**

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