Educating Minds for the Age of Innovation

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Major environment, economic and social challenges permeate the world, while simultaneously, rapid technological developments are reshaping human experience. This emerging context accelerates the need for education to innovate solutions to ongoing challenges and ill-defined, anticipated, and unknown problems. Against this backdrop, the purpose of the article is to problematize the latest push in global education policy towards competence-based approaches to education, primarily through the Organisation for Economic Cooperation and Development (OECD). Methodologically, the article relies on document analyses of policy documents and select curriculum frameworks to conceptually address the extent competency-based education policies have the potential to prepare students for the Age of Innovation. The article finds that the recent OECD's Education 2030 policy agenda falls short of providing learning opportunities for students to address current challenges locally and globally. The authors conclude that educating minds for the age of innovation requires students to explore deeply their creative potentials and learn how to innovate – ethically and morally – for continued development of democratic societies.

Keywords: creativity, innovation age, OECD Education 2030, curriculum policy

Introduction

Rapid technological developments in personal devices, smart machines and autonomous vehicles require education systems' transformation to educate future generations for fast approaching reality of artificial intelligence in the emerging digital age. Predictions for the future if the education systems fail include massive numbers of unemployed and underemployed, greater inequality, inadequate solutions to global warming, immigration, and rapid growth of humans on a finite planet, all of which increase the risks of dystopian cultures characterized by overcrowding, dehumanized oppression, and unjust totalitarian regimes (OECD, 2018). The only educational response observed so far internationally has been a shift from content- to competence-based curricula since 2000s (Anderson-Levitt, 2017). The competence-based education approaches rely primarily on set key competences. The European Union defined key competences as a combination of knowledge, skills, and attitudes for personal fulfillment, citizenship, social inclusion, and employment. A sense of initiative and entrepreneurship was noted as an attitude characterized by initiative, independence, and innovation in life as well as work (OJEU, 2018; OJEU, 2006). Massive changes will be needed in teaching and learning philosophies that free students to be creative, innovative, and entrepreneurial with the freedom to act on their ideas and opportunities in which motivation and passion must be the driving forces for change. Recent debates in curriculum theory from sociological and educational perspectives have been promoting powerful knowledge as a way to reenergize national curricula around the world in order to address 'the curriculum crisis' (Young, 2013; Deng, 2015), however not all curriculum scholars are onboard with the idea that a 'curriculum crisis' is present (Lundgren, 2015). Young (2013) identified the lack of powerful knowledge in curricula as a contributing factor to 'curriculum crisis'. Yet, Young's position is limited to a sociological theorization of curricula and 'curriculum crisis' evaporates as soon as one takes a more 'within' education perspective, such as Didaktik education tradition of Continental and Nordic Europe (Tahirsylaj, forthcoming). Student knowledge acquisition will always be important, but must be coupled with the learning of knowledge creation and application by the use of information technologies to innovate the future, primarily due to ongoing and expected changes and challenges in the society affecting the current global world order with implications for education policy.

The issues of modernity, internationalization and globalization are constantly highlighted as sources of dramatic change for education (Lundgren, 2015). In addition, Lundgren had pointed to the third industrial revolution as placing new demands of education with "[…] the transformation

from a labour market structured by industrial production to a labour market structured by service production, circulation of products, reproduction and, above all, the new information technology […]" (Lundgren 2015, p. 796). Education is an interlinked part of the society and developments shaping societies nationally and internationally affect education, however education also contributes to the ongoing debates and developments both at national and global level. Specifically, the new information technologies are often reinforced as a strong influence on shaping the knowledge-based curriculum and knowledge-based societies and economies at large (McEneaney, 2015).

However, we are quickly moving beyond the third industrial revolution, and the world is heading to the fourth industrial revolution or what is referred to here as the Age of Innovation. Klaus Schwab (2017) argues that while three previous revolutions liberated humankind from animal power, brought mass production, and introduced digital capabilities to billions of people respectively, the fourth industrial revolution is creating dramatic shifts again on how people live and work. Ubiquitous, mobile supercomputing, intelligent robots, self-driving cars, neuro-technological brain enhancements, genetic editing are evidence of dramatic changes brought about by the fourth industrial revolution (Schwab, 2017). Further, as a result of technological developments brought about by the fourth industrial revolution, technological devices are starting to be considered as having cognitive skills and decision making powers and thus can make decisions within a few milliseconds (Hayles, 2017). As a result, routine jobs will continue to disappear, while creative pursuits that lead to substantial innovation will be increasingly in demand. Against this backdrop, the paper aims to problematize the latest push in global education policy towards competence-based approaches to education, especially through powerful transnational organizations such as the Organisation for Economic Cooperation and Development (OECD), the UNESCO, and the European Union, not that there is something inherently wrong with the policy, but to point out that such policies strictly rely on social efficiency as a curriculum perspective, which has also given rise to the traditional assembly-line education systems that such policies aim to replace (Tahirsylaj, 2017). To do this, we rely on document analysis of a sample national curriculum frameworks and education policy recommendation reports to conceptually address an overarching research question that pertains to the current dominating educational policies in the Western world primarily, and to what extent those policies have the potential to prepare students for leading productive and meaning lives in the Age of Innovation. "Document analysis is a systematic procedure for reviewing or evaluating documents—both printed and

electronic (computer-based and Internet-transmitted) material" (Bowen, 2009, p. 27). To undertake the research we rely on 'primary documents' (Cohen, Manion, & Morrison, 2011) produced by international organizations such as the OECD and respective governmental authorities in charge of developing national curriculum frameworks. The documents are in the public domain and accessible online. The focus of the paper is K-12 education, and primarily on 'institutional' curricula, defined as connection between schooling and society, embodying a conception of what schooling should be with respect to the society and culture (Deng, 2011; Doyle 1992). In this regard, the paper does not cover the other two types of curricula, namely 'programmatic' defined as translation of institutional curricula into school structures, subjects and courses, and 'classroom' curricula defined as activities of teaching and learning that teachers and students engage in in classroom settings (Deng, 2011).

The paper is divided in three main sections. First, we provide a more elaborate description of lessons learnt from prior education policy implementation internationally and recommendations that were offered as a result, and also provide a brief summary of key competences defined in a small number of national curriculum frameworks. In the second section, we turn to current state of affairs in the global society, and some missing elements in current education systems, and then specifically turn to the OECD Education 2030 Learning Framework as the latest ambitious document to shape education curricula internationally. In the third and final section, we lay out a potential roadmap as to where do we go from here, educationally speaking, so that education systems provide quality education to students in order for them to be able to succeed in the complex and challenging times of the Age of Innovation.

Lessons Learnt From Education Systems Internationally

Major social changes in demographics, migrations, isolationism, and globalization, create 'new crises' to be dealt with by education. Concomitantly, the timing is right for any education system to step back and reflect over where it is, and what steps can be made to offer education opportunities to students that will prepare them for the complexities and challenges of life in the 21st century. There is a need for all education policy makers and education communities to take time to truly redesign the system(s) before embarking on another quick-fix agenda that will not bring about the required, expected and intended changes. Yet, the pressure is always high to make changes happen soon, especially when policy makers insist to see changes occur within the

mandate of a political administration. Another source of pressure for quick fixes in education comes from the results of individual countries in the Programme for International Student Assessment (PISA) and other international large-scale assessments (Grek, 2009), while many internationally active for-profit, not-for-profit, and multi-national organizations lobby for certain education policies.

As a result, efforts have been made to decode the secrets of top performing countries in the educational arena. In 2007, McKinsey & Company issued the report *How the world's best-performing school systems come out on top?* where it was concluded that there are three common broad guiding principles underpinning the success of top-performing countries in international assessments, namely, the quality of education cannot exceed the quality of its teachers; the only way to improve outcomes is to improve instruction; and, for a country to achieve high-outcomes universally high-quality instruction needs to be delivered to every child in the system (Barber & Mourshed, 2007). In a follow-up report, *How the World's Most Improved School Systems Keep Getting Better?* Mourshed, Chijioke, and Barber (2010) focused on how poor performing systems become good and how good performing countries become excellent. After analyzing twenty systems from around the world, all with improving but differing levels of performance, examining how each has achieved significant, sustained, and widespread gains in student outcomes, as measured by international and national assessments, the report concluded that each system no matter where in the continuum can make progress in six years or less. Not surprisingly, the McKinsey recommendations for system improvements are in line with the neoliberal policy agendas for education, focusing on external standardized testing for example, attempting to make education systems operate more as businesses competing in the free market and less as schools for public education.

In 2011, the OECD issued a report in collaboration with the U.S.-based National Center on Education and the Economy (NCEE) titled *Lessons from PISA for the United States*. While the report focuses on recommendations for the US alone, it echoes the overall tone of education policies that OECD promotes internationally, both among OECD member states and other countries that participate in PISA studies for example, for which the OECD is in charge. Again, examining strong performers and successful reformers of education around the world, the report concluded that the US would need to overhaul its education system towards performance improvement. There are striking similarities between the OECD (2011) report and McKinsey (2010) report in that both aim at turning schools into business organizations where efficiency of the organization is one of

the core goals. Other authors have suggested that policies of top performing countries, such as Finland, should only be followed in terms of distributing educational resources more equitably, paying teachers higher salaries, and eschewing high-stakes standardized testing (Tucker, 2011; Darling-Hammond, 2010).

The underpinning rhetoric of policy recommendations highlighted here so far paint a picture of failing school systems and overpromising ones that seem to solve all societal troubles. Still, even at the country level, education policy has shifted from the 'traditional' content-based education, where focus is on broad academic knowledge within disciplines, towards 'competency-based' education, where focus on mastery of a limited number of key competences. Table 1 provides but only a few examples of national education/curriculum frameworks under which they run their education systems.

Table 1. Key competences/capabilities/capacities/skills highlighted in a sample of national educational frameworks

Eight key competences in European Union Framework for Lifelong Learning (OJEU, 2018):	Seven general capabilities in the Australian Curriculum (2010):	Five key competencies in New Zealand's Curriculum Framework (2017):
1) Literacy competence 2) Multilingual competence 3) Mathematical competence and competence in science, technology and engineering 4) Digital competence 5) Personal, social and learning to learn competence 6) Citizenship competence 7) Entrepreneurship competence 8) Cultural awareness and expression competence.	1) Literacy 2) Numeracy 3) Information and communication technology capability 4) Critical and creative thinking 5) Personal and social capability 6) Ethical understanding 7) Intercultural understanding.	1) Thinking 2) Using language, symbols, and texts 3) Managing self 4) Relating to others 5) Participating and contributing
Four key capacities in Scotland's Curriculum for Excellence (2019):	**Five basic skills in Norway's Curriculum Framework (UDIR, 2012):**	**Three 21st century key competencies in Singapore Curriculum Framework (2018):**
1) Successful learners 2) Confident individuals 3) Responsible citizens 4) Effective contributors.	1) Oral skills 2) Reading 3) Writing 4) Digital skills	1) Civic Literacy, Global Awareness and Cross-Cultural Skills

	5) Numeracy	2) Critical and Inventive Thinking 3) Communication, Collaboration and Information Skills

Notes: Some of these frameworks are on second or third revisions. For example, the key competences proposed by the European Union have been lastly revised in 2018 but a slightly different version came into effect for the first time in 2006. The same applies to New Zealand, where the competency-approach to education was first introduced in 2007.

The European Union is not a country in the traditional sense, however its policy recommendation around key competences in 2006 set many countries in motion in Europe and around the world to incorporate competence-based education ideals into their curriculum frameworks. Overall, the frameworks noted above from the European Union, as well as from Australia, New Zealand, Scotland, Norway, and Singapore demonstrate the direction that education has been taking in some of the countries over the last decade. These examples of competency-based curriculum frameworks are primarily offered here to juxtapose them with the OECD Education 2030 Learning Framework and to point out that the direction that OECD is promoting is not new, that it has been tried and tested, and countries still fall short of addressing the societal challenges prevailing in each of them. In Australia, for example, a long debate has preceded the production of the Australia Curriculum, and general capabilities were one of the components emphasized in it, others being the formulations of learning areas and cross-curriculum priorities (Yates, 2018). Still, early analyses in Australia show that even when there is a broad consensus towards a certain curriculum policy at the national level, individual states and certain communities, such as minorities or students with disabilities, might be marginalized or not find themselves in the 'national' curriculum, opting to ignore parts of the national curriculum or redesign the curriculum for their own needs (Reid & Price, 2018).

When considering individual schools within countries, it is possible to identify examples where learning is tailored towards students' needs and capabilities. For example, advocating for personalized learning and claiming that it is possible to have personalized learning for every student, Robinson (2011) refers to the School of One, an innovative school in New York City, which has as its mission to provide personalized, effective and dynamic classroom instruction so that teachers have more time to focus on quality instruction. The School of One is innovative also in its learning environments, where students of different grades sit around different corners of the large areas while teachers can move from one group to another facilitating the learning progress.

It also developed a computer system known as learning algorithm, which generates unique daily schedules and resources for each student and each teacher. It highlights the importance and relevance of smart use of technology in classroom and learning and as such it validates the point that technology cannot replace teachers but it can assist in making teaching and learning experiences much more productive and meaningful for both students and teachers. This example and other similar ones (for example Gerver, 2010) show the potential of improving students' learning and school experiences when teaching and learning are taken seriously and all stakeholders collaborate to improve schools for the benefit of students' learning. To summarize, the approach to education policy promoted by OECD 2030 Learning Framework is not new, as similar approaches has been introduced and implemented already in a number of countries since 2000s, and as such, in case and when individual countries adopt OECD 2030 Agenda it will still not be enough to prepare students' who are capable to deal with ongoing and upcoming challenges both within nations and globally. The next section turns to a brief summary of the present status of education and societies, and a more elaborate and critical analysis of the OECD 2030 Learning Framework.

Where Are We Now Educationally?

The world of work is rapidly changing internationally, as it is observed through the rise of the gig economy in US (Gallup, 2018), and arrival of big inventions — one day we are calling from phone booths, and the next from miniature super-computer-texting-GPS-cellphones pulled from our back pocket (LeVine, 2018). On the other hand, Europe is facing its own issues and the overall sentiment is that the continent is struggling to keep up with this technology-led revolution. European Commission (2017) showed that 44 percent of the adult population in Europe has low levels or no digital skills at all. This evolving global context shows the need for more creative, innovative, and entrepreneurial mindsets in the world of work as well as within educational contexts.

Admittedly, few examples exist when efforts are being made to integrate creativity and innovation in educational opportunities. The current President of the Pennsylvania State University, Dr. Eric Barron, commented on innovation as a core priority in promoting economic vitality and improving the quality of life by driving job creation, and student career success by entrepreneurial discoveries to the marketplace. "We must develop a culture that nurtures and rewards entrepreneurship not

just in STEM, but in the arts, human development, education and more" Barron noted (New York Times, 2018). Further, a team at Penn State in 2013, developed a Massive Open Online Course (MOOC) titled, "Creativity, Innovation, and Change," (CIC) on the Coursera platform. It was designed and presented to a global community with no prerequisites. The course has been utilized by teachers as a supplement in courses ranging from chemistry to art in high schools and colleges around the world. Approximately half the students take the course to improve work skill, and the other half take it to become more innovative personally. Fostering learner community in the CIC MOOC has been one of the strategies to engage students and assist them to successfully complete course requirements (Tahirsylaj, Mann, & Matson, 2018).

Students' minds must be free to create, and therefore it is paramount for education system to educate minds that are free to create in the age of innovation (Tahirsylaj, 2012; Matson, 1996). The traditional education systems continue to rely on century old teaching techniques with some newer elements such as guided discovery in which open-ended projects allow students to explore under the purview of an instructor/mentor. Utilization of the digital forms of seeking knowledge are becoming available worldwide. This is important because in the business world successful businesses are becoming and will be digital businesses (Wertz, 2018). Another digital trend in the early stages at the college level is for universities to recognize the approaching age of perpetual education, another term for lifelong learning that K-12 education needs to instill in students for the age of innovation.

Missing Elements

An examination of OECD's 2030 Learning Framework on the Future of Education and Skills (OECD, 2018), shows the limitations for addressing the missing elements in current education systems pertaining to opportunities for students to develop their creative potential and innovation skills. The document paves the way for an ambitious education agenda for individual countries around the world, as the OECD attempts to address two far-reaching questions for the state of education worldwide, namely *What knowledge, skills, attitudes and values will today's students need to thrive and shape their world?* and *How can instructional systems develop these knowledge, skills, attitudes and values effectively?* (OECD 2018, p. 2, *emphasis added*). The rationale for reconsidering the future of education consists of the need for new solutions to environmental, economic and social challenges. Further, the document calls for broader education goals, focusing on individual and collective well-being by relying on learner agency. Specifically, it lists three categories of 'transformative competencies'

"[…] that together address the growing need for young people to be innovative, responsible and aware: Creating new value; Reconciling tensions and dilemmas; Taking responsibility" (OECD, 2018, p. 5). Defining the creating new value competency, the OECD notes that new sources of growth are urgently needed to achieve stronger, more inclusive and more sustainable development and "To prepare for 2030, people should be able to think creatively, develop new products and services, new jobs, new processes and methods, new ways of thinking and living, new enterprises, new sectors, new business models and new social models" (OECD, 2018, p. 5). Next, 'reconciling tensions and dilemmas' is understood as the competency for individuals to be able to sometimes hold contradictory ideas by for example, balancing equity and freedom, autonomy and community, innovation and continuity, and efficiency and the democratic process. Lastly, 'taking responsibility' is defined as the prerequisite of the other two, since "Dealing with novelty, change, diversity and ambiguity assumes that individuals can think for themselves and work with others" (OECD, 2018, p. 6).

While OECD's 2030 Learning Framework is indeed an ambitious project, its overarching goal, if fully implemented as initially conceptualized by the OECD, will be to make the education experiences similar around the world. This approach defeats the purposes laid out by the OECD since similar educational experiences will produce more conformist thinkers rather than creative and innovative people that are indeed needed in the age of innovation. Ultimately, a rigid definition of competencies to be pursued through education nationally and internationally, irrespective of how well-intended they are, will limit students' opportunities to experience through schooling the very ill-defined, and unknown challenges of the 21st century. In other words, students will not develop the needed skills and competencies for addressing 21st century environmental, economic and social challenges unless they have the opportunity to test solutions, and risk failures and its accompanying learning as they go through the education system. Furthermore, students will need to develop their full potential with the goal to contribute to their communities not only economically, but also socially and culturally, which indeed will require developing skills to 'take responsibility' through schooling and lifelong learning.

Where Do We Go From Here?

In the previous sections, the paper highlighted some of the educational policies that are being pursued among some of the top-performing countries around the world, and showed a few

educational frameworks under which those systems operate. The OECD 2030 Learning Framework, as the latest international policy agenda, is gaining momentum as the OECD has been successful in galvanizing national governments to be engaged in the development process for securing their long-term commitment to its implementation. However, as shown in the elaboration of the OECD 2030 Learning Framework and the guiding competences in select national educational frameworks, the competence-based educational approaches have not delivered on their promise, primarily because education of future generations cannot be narrowed down to its instrumental value only. To address major challenges such as climate change or migration or technological disruptions, the current and future generations need to have the skills to create and innovate new solutions (and jobs) while holding themselves to high ethical and moral standards to ensure a more equitable and humane world. As numerous climate strikers around the world have been proclaiming for years, it is not enough to only create jobs and increase economic output as "As there are no jobs in the dead planet" (ITUC, 2015, p. 9). Therefore, more comprehensive and holistic education policy agendas need to be developed and pursued to properly educate students' minds for the Age of Innovation.

Numerous suggestions for reshaping education systems are found already in the literature. For example, Gardner (2000) called for an education that is built around three key concepts, namely the truth, the beauty and the good and suggested six different educational pathways (see Gardner, 2000, for details on the six pathways). Further, Gardner (2006) proposed a list of what he refers to as *five minds* which will be demanded by workers and citizens in 21st century to be able to solve increasingly complex challenges, including *the disciplined mind* – mastery of content and knowledge within and across disciplines; *the synthesizing mind* – sorting out information within and across disciplines; *the creative mind* – ability to think outside the box and approach problems creatively within and across domains; *the respectful mind* – cultivating respect amidst students and community members at large; and *the ethical mind* – self-consciousness about making ethically right decisions while performing one's job. More recently, authors have been promoting the concepts of creativity and innovation as the grounding drivers for the education systems (Tahirsylaj, 2012; Robinson, 2011; Robinson & Aronica, 2009; Matson, 1996).

With the rise of international assessments such as Programme for International Student Assessment (PISA) and Trends in International Mathematics and Science Study (TIMSS), the voices of concern started to emerge as to why students of individual countries were not performing

as good as their peers elsewhere. Analyzing the data and results from the TIMSS and referring to the US students, Schmidt, Houng and Cogan (2002) claimed that "American students and teachers are greatly disadvantaged by our country's lack of a common, coherent curriculum and the texts, materials, and training that match it" (p. 1). The concern for a lack of a coherent curriculum in the U.S. seems to be voiced repeatedly by numerous researchers in the U.S. literature (Duschl, Schweingruber & Shouse, 2007; Schmidt et al., 2002; Schmidt, 2008; Tahirsylaj, Niebert & Duschl, 2015). This is a fundamental challenge for the K-12 education systems operating under federal state systems, such as US, Germany, or Australia, where the decentralization of power to individual states often means incomparable educational standards across the states, hence holding all students within a country accountable for similarly high educational standards irrespective of their state can potentially lead to more quality education systems.

Again, in the case of the United States, the issue of having a national curriculum is a recurring theme, as is the idea of learning from best examples from around the world in terms of importing education policy. For example, Tucker (2011) noted that the U.S. K-12 education was at its best almost a century ago when it benchmarked against European counterparts, and mentions specifically Scots and Germans. Ironically or fortunately, there are still great lessons to learn from Scots and Germans currently either for the US or any other country. Scotland currently has one of the best curriculum frameworks in the world called *Curriculum for Excellence*. Germany runs its education system based on the didactics (or German term *Didaktik*) theory, which at its core is different from the curriculum theory dominant in English speaking countries. Didaktik theory is a teacher- rather system-centred - its focus and ideal is on the role of the teacher in "forming" rather "instructing" his or her students and to do this, celebrates the individuality of each teacher as an active and reflective curriculum maker and theorist rather than seeing the teacher as an agent of a workplace manual of best practices, that is, a curriculum or a curriculum package (Westbury, 2000). Under curriculum theory, the belief is that the whole system can be measured through inputs and outputs, but the didaktik theory is more flexible and is focused on developing each child's uniqueness and individuality (Tahirsylaj, 2019; Hopmann, 2007). And it is impossible to grow students into unique and individual citizens when they face year after year of uniform and conformist standardized tests. As a comparison, Finland is often viewed with admiration by the international education community, but contrary to the testing-driven education policies promoted around the world by the OECD, in Finland national testing, school ranking lists, and inspection systems do not exist (Finnish National Agency for Education, 2010).

Commenting on the existing visions about education, Eisner (2005) noted that:

> […] among the visions guiding education there are two that are particularly important today. The first is a formalist vision which conceives of curriculum and teaching as rule guided activities that lead to prespecified ends capable of being achieved if the pedagogical and curricular methods employed are appropriate. The aim of educational policy is to create institutions that make the realization of those aims possible. A second vision of education, a Romantic vision, places its emphasis on the realization of distinctive human potentialities. The Romantic vision is more concerned with surprise than with predictability and is more interested in invention than in discovery. It recognizes that human aptitudes differ and that pedagogical virtue consists in increasing, rather than reducing, variance in a class (n.p).

Educational policy makers and stakeholders around the world have to decide which one of the two above presented by Eisner is the vision they want to pursue and instill for education of their children and youth. This is crucial not only for the future of individual countries but to the future of entire world as a whole. Hopefully, their choice will be the second one. To move towards this direction and towards the vision that has larger potential for educating students' minds for the Innovation Age, individual countries can start by taking away the burden of high-stakes testing, thus allowing more time for teachers to do their job in educating students holistically and not preparing them for taking tests. Returning to the fourth Industrial Revolution and the Age of Innovation, one implication it has for education is that the demand for more powerful knowledge-based curricula will only increase. The challenge for education is not only how to prepare students to live and contribute into the changing world, but also to equip them with high ethical and moral values that will make possible continued development of democratic societies. Arguably, there is nothing more important for any individual country than to provide quality education for their students – their future will not only determine the direction and standing of the individual country in the global community but it will shape to a large extent the future of the interconnected world in the Age of Innovation in the 21st century. Making right choices and decisions now will ensure better futures for all – locally and globally.

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