

EDUCATION IN AN ERA OF ARTIFICIAL INTELLIGENCE

INTRODUCTION

In the advance of the ‘machine age’ demand for educated labor as a resource (factor of production) in industrial production steadily mounted. With advances in manufacturing technology and increasing requirements for industrial and consumer skilled services youth education became all about ‘completing school’ as access to a steady ‘job’. The conventional wisdom (post WW-II) held education (at ever higher skill levels) would increase the certainty of steady employment¹, and that dynamic industrial capitalism would create a sufficient range of wage jobs and pay levels. Economic ‘growth’ (despite intervals of economic disruption), abetted by a spectrum of worker skills emerging from education institutions, sustained periods of near full employment.

To be considered is: Will in a further-evolving industrial period with its distinctly new forms of technology for productive processes and alternative means for employing knowledge-labor (viz., robot/AI workers) yet continue to yield—even for well-educated—ample selection of jobs, and periods of steady full employment²? Will increasingly intensive technical and knowledge-based education for a future generation of workers inevitably yield growth and employment stability³? What is a future function for public education in the era of extensive application of robot/AI intelligent labor for productive processes? Is a future educated workforce destined to ‘race against the machine’ with constant, higher order, education (knowledge/competence flows) for one’s prospect to secure, or hold, a job? Will a ‘life-long-learning’ lifestyle enable workers to earn incomes for maintaining their well-being? How would such workers gain compensation and/or capture the benefits for their prime-level knowledge from their employers? Is it conceivable within the man’s diverse range of humanistic mental abilities to pursue, with intensity, a ‘lifelong learning’ social paradigm? How would education institutions in their instruction regimen prepare themselves for lifelong innovation⁴? And, with workers cycling in-and-out between jobs and school enrolment how should EUROSTAT measure unemployment/under-employment?

EDUCATION IN ERA OF ‘JOB ECONOMY’

Aims for public education had remained relatively unchanged during Western social transformation to democratic civil government. *Basic* education was viewed as the *conditio sine quo non* in sustaining a suitably educated society for conducting the affairs of the state’s constitutional ideals for a democratic society⁵. *Higher* education was viewed as means for engagement in more intensive intellectual, social, and political spheres. Even with formation of regular employment professions, those in their pursuit were thought to engage in social motivated activities. (Doctors were considered ‘social worker’ profession.)

With the onset of the industrial revolution, expansion of large-scale private enterprise, and a market economy Western public interest in education underwent a distinct transformation. In the 20th century educated workers became the resource (factor of production) for servicing the advancing intricacies of tools and machinery as well as for staffing the increasing complexity of enterprise administration in ordering a vast competitive consumer economy, and the imposed state regulatory requirements for its inhabitant’s security.

Filling industry requirements for qualified labor once in the province of the enterprise (on-the-job training), had shifted in the post WW-II increasingly to the public and private education sectors. (In the war period, which fully enlisted all available male and female labor for military industrial purposes, skills training/application for production was the purview of the employer.) In the post war period the evolving requirements by the private industrial economy and public services sector for qualified technical skilled workers steadily shifted to a public and private education sector.

With the expansive demand for ‘knowledge’ workers their preparation became a regular function of ‘schools’ with the costs steadily borne by the individual preparing for a ‘job’ and public subsidy. By the early 1970s nearly 40 percent of the working population in the USA and Canada had become classified as active in ‘knowledge’ occupation sectors (‘white collar’ workers) and educated in schools⁶. Meanwhile, by 2030 the ILO estimates a

‘world need to create 600 million new jobs just to get back to pre-crisis levels of employment’⁷. (These additions would be timed during the same period that several million robot worker would enter the labor market.) Public education qualifying individuals to fill and maintain these jobs would engage a vast global education establishment. The sources and quality of the jobs uncertain, and candidates for public office wary, what is advocated confidently as surrogate for employment policy is an acclaimed education policy as ‘symbolic’ preparation for future jobs prospects.

In a post, WW period an increasingly *technical* vocational educated workforce with knowledge of complex production and administrative systems had spurred rapid market applications of innovation for industrial production. The period also coincided with the post war ‘baby boom’ and rapid expansion of non-durable consumer goods sectors which required intermediate skills (high school education)⁸.

Meanwhile expansion of the economy in two decades of post war scarcity and recovery expanded further the presence of female workers in the labor pool. The presence of female workers in the workforce was expanded further by social policy (‘adult worker model’) which entitled female individuals equal rights to, and protection on, jobs and which ultimately set targets for a female employment strategy in the work force as means to promote gender equality⁹.

More recently, the ready employment of youths in the labor force has assumed social policy as well. So with its ‘Youth Guarantee’ policy the E.U. has directed that all young people under the age of 25 years receive either a good-quality offer of employment, continued education, or an apprenticeship or a traineeship position. *The education establishment in the post WW-II period has shifted from a social service institution to a public-operated employment training establishment for private sector economic enterprise*¹⁰.

An expanded human capital base and ready industry demand for knowledge workers in the post WW-II period spurred a massive private and public financial investment in student formal education¹¹. With follow-on diversity and complexity in worker job qualifications, the scope and level of workforce education had reached a phase in which both the ‘tools of the trade’ and their skilled worker’s competence had yielded a prosperous period¹² for jobs, full-employment and economic ‘growth’. Level of education and select choices for career specialization came to determine the individual’s job, income, employment security, and upward mobility.

Size, and level, of education for a nation’s workforce would become a proxy measure for the might of its industrial economy and the arms potential of its military establishment. (Public policy was to match the Soviet Union in its surge of engineers and scientists for military and space projects.) Educated/trained man minding clever machine had become a foremost resource for spurring output (GDP), productivity (GDP/Capita), and general ‘standard of living’.

The individual worker now was enlisted in a ‘labor pool’ from which the employer freely/randomly selected/rejected for jobs those with choicest attributes. Financial assistance for student education (particularly technical) became a central US public policy for advancing the nation’s industrial growth goal¹³. As enrollments in higher education steadily increased employers routinely inflated their preference for educated labor¹⁴. The number of private ‘universities’ increased¹⁵. Knowledge-based graduates extended their opportunities for secure positions, higher wage incomes and enhanced upward mobility. Higher education (university) resource providers had become integrated into a supply chain strategy for industrial production¹⁶.

It is this period of the ‘job economy’ with its diverse prospects for jobs for mid-level educated workers (male and female) that came to characterize an expansive middle-income class economy; the urban/suburban divide (with its shopping malls); and, the attraction of education certificates as license for steady paycheck, entry into adult livelihood, family formation, and occasions for leisure¹⁷.

ERA OF ARTIFICIAL INTELLIGENCE

The education ‘industry’ confronts a radical transition into a formative 21st century economy and society. Posed are three challenges for education policymakers: How to help existing workers acquire relevant knowledge/skills for maintaining incomes?; How to keep future generations of potential workers engaged in industrial activity amidst a robot/AI presence?; How to prepare individuals for a purposeful social life as ‘free time’ periods increase?

Yet to be particularized are the education provision/requirements for individuals; the relevant education institutional formats¹⁸, in a period of advancing competence in embedded artificial intelligence and post job-intensive employment economy¹⁹; and, ways in which knowledge—scientific, social, and cultural—is produced²⁰.

The 20th century economy had machines/systems and man coupled. Only their mix—capable machine and smart worker—yielded staggering productivity. As advent of automated machines, had displaced mid-level educated workers²¹, so new productive forms/systems (‘intelligent robot labor’) now steadily displace higher-level educated workers²². Into the 21st century human labor will steadily mingle with ready available diverse forms of substitute ‘intelligent’ labor—trained/skilled labor that constantly, rapidly, and increasingly unerringly performs productive processes the while assimilating data/information for decision processes. Human labor with its limited physical and mental endurance, and its commitments to family life and distractions from social life, will mingle with smart ‘creatures’ in their varied forms and capabilities.

Artificial intelligence overcomes the limitations of man’s own application of the human brain and infinitely multiplies an individual’s ready mental power.

Andrew McAfee, MIT

Even as in Western demographics the human prime-age workforce into 2050 is projected to decline²³, the robot/AI industrial and household workforce (e.g., Watson, Siri, Cortana along with complimentary productive technologies) is set to multiply²⁴. And while it is commonly reported that these operate at the ‘low-level’ of the knowledge spectrum and compete with unskilled labor, the reality is that these additions to the workforce presently operate most efficiently and effectively at the mid-to-high end of the knowledge and communication spectrum²⁵.

On the horizon is the appearance of a new, well-educated/trained workforce, whose numbers are limited only by the pace of their assembly line, and whose knowledge is instantly reproducible in successive models. (Within humans each child must learn to count and read.) With their numbers, applications, and instructors (program writers) momentarily limited the education establishment unmindfully continues the conventional development of its enrolled for numerous semi-skilled and skilled tasks yet available to human labor.

The status of AI and its foreseeable development and rate of application remain disputed. It is commonplace by parties to opine what are deemed natural limits to its functioning in robots as human ‘substitutes’. Among those who posit ‘fixed’ limits there is foreseen an educated, fully human, workforce *augmented* by robot/AI ‘tools’. Yet for the diverse research activity on robot/AI forms already in progress there appears no natural, or evident, limit to its intellectual and emotional capacity²⁶. Herbert Simon, Nobel in economics, **was first to explore the psychology of human cognition. At the core is AI’s capability to recognize and react to emotions.** Conventional scientific understanding now classifies six key emotions: happy, sad, fear, surprise, anger, and disgust. With rapid progress in ‘robotic surrogacy’ there are predictions that by 2020 the Ishiguro robot ‘Erica’ will respond with the emotions of intention and desire. Erica is now able to engage in a 10-minute unrehearsed conversation. Foreseen

are more complex socially developed expressions. Research confront these developments not in the realm of media fiction but in the laboratory²⁷.

At hand are new educational processes for embedding intelligence (problem-solving skills) and emotion display in a robot/android workforce. The future development of this educated/intelligent workforce will be progressive and startling²⁸. (There are yet no certification limits on the content of the material or on the means applied for its conveyance.) And there is in progress a new type of education establishment with a new form of enrollment. Yet to be considered are: By who, or by what means, will robots be instructed? Will there be certifications, and qualifications for instructors as is common in public school classes²⁹? How to maintain control of the instruction process for advancing robot/AI actions and/or penetration into personal and private decision realms?

Ethics training for AI practitioners and students should be required for certification. Student curriculum for AI, computer science, or data science should include ethics and social science topics. *Code of Programmer Ethics* should articulate the values to which AI Programmers commit themselves as licensed members of the programming profession.

To be assessed is whether/how the education establishment which presently serves the human's integration into the economy and the society, remains relevant as it confronts other intelligent forms embedded with customized instruction³⁰ in pursuit of work and in expression of desires.

The Council urges Austria/E.U. Brussels prepare coherent guidelines for the beneficial development of artificial intelligence technology and support/sponsor applications in social enterprises (with due care on limits for advancing robot/AI penetration into personal and private conduct.)

AIMS FOR FUTURE EDUCATION¹

In a 21st century period of industrial and social transformation public education institutions now confront questions on: (a) the course for childhood/adolescent education for purposeful participation in society in a period of intermingling with intelligent objects; (b) the course for Universities to remain relevant—beyond channeling cognitive knowledge on industrial occupations—as prospects for financial gain/benefit to youth recipients becomes less certain. To be considered:

- What is the function of the public (and private) education establishment as mass preparation of youths for jobs and favorable employment declines as its central 'commodity' in the resource supply chain for industry?
- What remains the purpose of public education in the era of artificial intelligence?
- What competences remains a distinctive purview for human development?
- What should students be learning for employment as robots/AI engage in work humans performed?
- How should education adapt to the era of 'sozial Wissen' from a highly-sophisticated media and social interaction environment?

As public education confronts an era of industry-based private, individual, 'programmers' rendering artificial intelligence requirements³¹ for 'robots labor' occupations, what competences remain for an enlightened Academia serving the course of 21st century human development³²?

¹ The Council considered two E.U. Commission Reports which address transformative education proposals: (a) *Rethinking Education*; (b) *Employment and Social Developments*. While the identified education 'competences' for the 21st century *add important dimensions to education* for the formative economic and social transformation in progress, there seems limited attention to their *purpose* viz., **"To face the current crisis (undefined), increase productivity and encourage growth, education systems have a crucial role in building the right 21st century skills and competences."** Implicit is public policy wishing to aid worker employability and mobility in the labor market. The while enhancements (improvements in classroom instruction, or reductions on teacher burden) are merited as better professional 'grooming', not for their vision of a new order society amidst a period of increased opportunities for life-style choices. For what public engagement are the multiple proposed student and instructor performance assessments?

As a generation of youth mature amidst a first-generation of robots (with their yet rudimentary AI levels of intelligence) the E.U. policy response has been to outpace their presence in industry employment with more intensive public youth and adult education. In 2012 the Commission presented 'Rethinking Education', an initiative to encourage E.U. countries to ensure that young people develop the skills and competences preferred by employers. Provided was guidance to the teaching profession and proposed assessment of key competences in initial education and training³³.

Further policy support proposed an intensive regimen for youths in STEM/MINT type education. Confronted with extensive and rapid pace of technology application (viz., robot, AI, 4.0, digital, 3-D printing, among others) there were further proposed public education policies on 'life-long-learning'. Anticipated are stints of sporadic education/skills training³⁴ for maintaining a trained and adaptable workforce and labor market responsive to industrial technology changes in the workers' steady race for out-pacing proliferating robot/AI labor applications.

If continuous education is to succeed it needs conditions under which individuals feel safe and secure so with its rigors and risks these are not paralyzed by anxiety and fear. And its participants need a sense of identity, confidence about their self-worth, and a sense of agency about their own future. David Brooks

Meanwhile public higher education institutions—producing in annual 'batches' young workers for industry employment—are deemed now never to fully complete their task of educating (preparing) individuals for sporadic available jobs³⁵, or for the student's own needs in searching for employment and means for livelihood. Just what those constantly shifting industry qualifications/competences for human education are likely to be in an advancing robot/AI era and the organization for the mass education provision remain in doubt.

In doubt also, is the prospect that displaced workers will be recycled in education skill development programs and available jobs and so set to secure, or maintain, future steady, wage jobs; or, that the emphasis on education will assure a future full-employment economy; or, that the industry's awaited skill competences will be apt for meaningful individual participation in a mixed human/robot society. With a formative public education establishment, fully responsible for preparing and maintaining individuals ever qualified and poised for jobs in private industry³⁶, a public education industry (with uncertain financial means³⁷) becomes set to dominate the rhythms of human social and private life.

While public policy advocates pursuit of STEM/MINT, there are those in the scientific and industry community who question any across-the-board education regimen in STEM/MINT as future security for either industry or society. These cite foreseeable requirements for skills yet well beyond 'robot intelligence. Proposed are 'wider' noncognitive skills (one's useful in social and civic affairs as well as free-time activity) such as working well in teams, using initiative, group problem-solving³⁸.

The concentration of public education on meeting the advancing technical requirements for industry neglects the mission of education to prepare individuals educated to address the mounting social and civil society needs for organizing, and maintaining, a cohesive, vital, societal order.

To prepare individuals for industrial jobs, some propose education paradigms beyond present cognitive, knowledge-based, skills³⁹. Urged are a range of *skills* and *traits* that involves a mix of *types of learning*—learning that is self-directed, collaborative, and socially-based⁴⁰. For these proponents, the challenge in education is to discern for its students how to hold their own distinctly human quality against robot/AI presence in employment or in communal living. To elicit in the student body just what perceptions remain uniquely for human experience and expression? Cited are 'higher order' mental skills, like *critical thinking* including abilities such as reasoning and reflective thinking focused on deciding what to believe or do' and 'artful thinking', which includes reasoning,

questioning, and investigating, observing and describing, comparing and connecting, finding complexity, and exploring viewpoints.

It is proposed that skills students must come to master include: ability to judge the credibility of a source; identify assumptions, generalization, and bias; identify connotation in language use; understand the purpose of a written or spoken text; identify the audience; and to make critical judgments about the relative effectiveness of various strategies used to meet the purpose of the text. While such are present boundary skills for human/robot competitive abilities, these are likely not a certain refuge for preserving man's distinctive human quality.

Yet others cite *new states of knowledge* emerging as data/information from all manner of cycles through cyberspace. In an era abounding with ready information via the internet and digital social media the individual's ability to master text material or perform standard cognitive operations is deemed of slighter merit on the job, and less appealing as the individual's distinguishing social and intellectual characteristic⁴¹.

And there are those that mind a natural limit to individuals with abilities, and desires, to engage in protracted periods of intensive, and 'life-time' repeated sessions of STEM/MINT learning. These cite that man naturally adapted to regimented jobs with their clearly defined range of tasks and decisions. Only in mobility was momentary uncertainty. Questioned is man's disposition to constant cycles from industry employment to education enrollment and necessity for perpetual re-qualification for new skills.

Moreover, a 'job economy' afforded employment opportunity to a spread of levels in education for workers. A future industrial economy comprised of robot and freelance workers exercising rare intellectual skills is not likely to yield similar opportunities. And it is not likely to realize opportunities for employment of the handicap classes.

Future (jobs) belongs to people who excel at expert thinking (solving problems for which there are no rules-based solutions) and complex communication (interacting with people to acquire information, understand what that information means and persuade others of its implications for action).

Frank Levy and Richard J. Murnane

A 21st century E.U. government will need to redefine employment policy questions beyond scaling-up a public education establishment and burdening it with repeated skill-upgrading for individuals clinging to jobs and employment⁴². (Constraints on growth, expanded application of robot/AI labor, among other applied technologies, and a declining learning vigor with advancing age, will limit the beneficial employment effects from education⁴³.

If growth and education policy are incapable of off-setting disruptive dynamics with its stalled industry requirements for human resources, policy initiatives will need to explore new, innovative, methods for engaging human resources and compensating the surplus industrial labor.)

Any 21st century policy assigning (designating) to public education responsibility for qualifying an individual's ready 'life-long-learning' and so seek to reclaim masses of skilled workers for industry 'jobs' and employment during their prime years is a dubious economic endeavor.

However, within society at-large there will remain ample opportunities for human endeavors. It is incumbent on public education officials to identify forms of beneficial education redirected to human engagement in *social innovation* and social enterprises with their activities furthering higher levels of the public's well-being⁴⁴. Expansion of social enterprises would address also an increasing imbalance in the application of human resources favoring commercial industry⁴⁵.

Howard Gardner contributes insight into what is perceived as relevant education for human *work* in a future economic and social order. Gardner believes current formal education still prepares students primarily for a job

fit into a waning industrial and societal order. He attributes to education the important function of developing 'mind sets' for a 21st century civilization. While architects conceive new forms for integrating work and free-time activity, education yet perceives education for defined occupations in conventional settings. Garner proposes for education the development of 5 minds for engaging humans in gainful activity. Proposed is basic education which would further development in individuals the possession of a disciplined, synthesizing, creative, respectful, and ethical minds. Qualifications for employment in the era of robot/AI labor and digital solutions are said to require five *state of mind*:

- The *disciplined mind*, to learn and become competent in at least one profession or skill.
- The *synthesizing mind*, to organize the massive amounts of information and communicate effectively to/with others.
- The *creating mind*, to revel in unasked questions - and uncover new phenomena and insightful apt answers.
- The *respectful mind*, to appreciate the differences between human beings - and understand and work with all persons.
- The *ethical mind*, to fulfill one's responsibilities as both a worker and a citizen.

Project Zero (developed at Harvard University) provides an example of how teachers might assist students to think deeply by viewing works of art, using an 'Artful Thinking Palette'. Students are asked to use six thinking dispositions to view art: exploring viewpoints, reasoning, questioning and investigating, observing and describing, comparing and connecting, and finding complexity. Instructing students on these thinking skills is not only deemed befitting in art but in other knowledge disciplines.

In Western industrial economies, the intensity of human productive labor input to meet basic needs has steadily declined⁴⁶. The new challenge for public education is to discover for its students what satisfies human striving while robot laborers toil steadily, dutifully, unerringly.

Even as education has contributed to improvements in organization of industrial processes steady gains in productivity and economic prosperity, the organization of government and ability to govern, and legislate on critical issues for national well-being, has steadily degraded. A public education policy on increasing annually the numbers of STEM/MINT educated individuals for a large and preferential selection of workers by private industry (while offering limited job prospects) is a questionable human resource strategy even as public sector operations minding civic affairs for satisfying human social cares are poorly attended and staffed. As robot/AI labor yet further advance private sector industrial performance, public education for a 21st century society must prepare students for active engagement in diverse social activity for coping with environmental, demographic, and geo-political challenges to human survival.

And there awaits preparation for 2050 when inhabitants of EU states may interact with 40 million intelligent robot labor objects in their midst. What education competences are fit for credible human regular engagement with these 'itinerants'?

Public policy advocating increased enrollment and financing for higher education in STEM/MINT will not on its own, constitute an adequate education/competences for ordering unattended civic work in civil society.

EU INVESTMENT POLICY IN EDUCATION

The EU through diverse agreements has sought with its labor policy to stabilize employment and enhance workforce education⁴⁷ with diverse investments. The Amsterdam⁴⁸ and Lisbon⁴⁹ protocols establish ways and means for harmonizing labor and labor-education policy. With practical programs the Commission (without citing

technology specifically in displacement of jobs) has cited deficiencies in skills education/training for workers in its program of 'Life-Long Learning'⁵⁰.

With its growth policy the E.U. government relies-on/burdens workforce education with maintaining a 'knowledge-based' competitive industrial economy and (perhaps) with outpacing robot/AI applications preserve a measure of jobs.

'Life-long learning' is viewed as an individual's obligation for preserving employment and income. The privilege for a job is one's staying, constantly, one step ahead of pursuit from robot, AI and digital technologies'⁵¹. As such, education is foreseen to engage in a vast market enterprise for recycling humans of all ages for any moment's industrial job demand. Cited are: any moments mismatch of available labor with reported job openings; the failure of the E.U. education industrial complex with its student drop-out rate of 11 percent; and, 87 million individuals of working age not having completed upper secondary education. As such education performance for a 21st century economy and society is cast a commercial enterprise.

Recently E.U. has restated program support for: Skills Agenda for Europe. The Agenda's stated aims is to assure that persons develop the skills in *market demand for ready jobs* of today⁵². (A presumption that with just the *right* education a job is at-hand.)

The E.U Council created the Youth Employment Initiative to increase the EU financial support available to the regions and individuals confronted with youth unemployment and inactivity. While the stated aim is making education and training *more relevant to young people's needs* the intent is to integrate the individuals into the private sector industrial economy. The program aims to improve young individual's education and employability, to reduce high youth unemployment and to increase the youth-employment rate – in line with the wider EU target of achieving a 75 percent employment rate⁵³.

The E.U. investment for public education remains set for distinctly *economic* missions (a) to ready ample human productive resources for *possible* industrial applications across the region; (b) to expand education as an economic sector providing refuges during perpetual spells of joblessness (viz., life-long-learning) with the presumed achievement of further individual employability. The presumption is that the education 'industry' will produce a highly skilled labor force⁵⁵ that will remain fully employed even as the industrial sector exploits educating (programming) an alternative intelligent robot labor pool.

In the 20th century education became institutionalized as a quasi-industrial establishment. It has been merited for providing skilled labor resources to *private industry*. Yet in measuring education institution performance, the OECD (relying on its PISA evaluation measure) reports significant scope for improving educational efficiency across OECD countries⁵⁶.

In a future 21st century industrial economy where skilled robot labor becomes preferred for its flexible application and productive skills, applications for human work will require from the education establishment new forms of intellectual and behavioral mastery for now rendering services with a uniquely human aptitude⁵⁷ for advancement of civil society.

In E.U. education policy there is, yet, no stated insight into a future in which humans may be spared needless competition for jobs with 'robot labor'. A period when human abilities are relieved from draft into the rigors, routines, and tedium of an industrial job economy. A period in which education assumes a new distinction—to

Automation, now beyond routine manufacturing activities, has the potential, as least with regard to its technical feasibility, to transform sectors such as healthcare and finance (among others) which entail a substantial requirement of knowledge-based work. McKinsey Report, Where Machines Could Replace Humans

prepare individuals to engage in endeavors suited to their native abilities; to explore knowledge for one's own pleasure; or, to apply knowledge for communal endeavors in advancing an enlightened civil society⁵⁸. A period in which able and smart robot labor is welcomed as an alternative, and affording individuals opportunity to develop human abilities for services beyond those applied for industry.

RELEVANT CONSIDERATIONS

The evolution into a new era industrial and social order is incremental spanning generations. Social policy must however keep abreast of rapid industrial reformation. Political adjustments assume either public regulation, or transformation of public institutions. The incursions of robot/AI (among other transformative technologies) into communal life are certain to remain with us. There is no denying their impact on human activity by minimizing their 'presumed limits'. Whatever 'natural' limits on mental and psycho-social attributes are presumed today for robot/AI workers, these with their indelible memory, rapid information processing, and dependable social interaction will mature into 2050 and far surpass what are yet limits.

We should be alarmed from 'AI' only to the extent that humankind will not learn (be educated) how to extend its own unique capacities for its common social good⁵⁹. Christian de Looper

The pressing question is whether political, and governmental, processes can respond to the changes with aptly and timely policies⁶⁰. Major changes in education—structure, purpose, social and economic role—progress in slow-motion⁶¹. For instance, implementation of the 'goals' for E.U. universities from Bologna Process (1999) has been a lagging and uneven development⁶². In a 21st century socio-economic order public education may well best fulfil its purpose in advancement of civil society.

For some period, public policy pursuing immigrant labor for employment in unskilled, and semi-skilled, manual labor, as well as financial support for enrollments in advanced education, will inflate the labor pool for sufficient hiring selections from among human labor in meeting industry needs⁶³. Meanwhile, distinct new specialty trades servicing computer and digital technology applications will create the basis for new technology-based subjects for vocational instruction and fill-in present labor skills *gaps*.

During the industrial transformation, momentary *gaps* and unmatched needs (structural imbalances) may create a perception of an intermittent labor dislocation⁶⁴. (Policymakers and commentators who are against fiscal stimulus have a strong incentive to accept and propagate the myth that today's high unemployment is because workers lack the right skills.) *For the sake of sustaining public confidence in the governing process, opportunities for technical education/training efforts to address immediate dislocations should not be ignored. Yet, also not to be ignored is the incremental application and reliance on artificial intelligence in industrial and civil society and the requirement for a new order of education relevant to personal development and one's engagement in self-determined purposeful activity.*

Resort to public education as default for lack of labor employment policy (viz. preparing stand-by human resources as industry randomly selects its choice sources for employment from among human and robot/AI labor) distorts the public interest/investment in the aims and merits of education for advancing the performance of social and political demands of the civil society sector.

Access to work has been a precondition for personal development and social identity. How will short-term and transient/mobile employment and intermittent stints of education substitute for that development? And if public education is to assume its new (post job preparation) dimension of heightening student intellectual perceptions and critical human/AI intellectual interface, what testing measures of student performance will be apt?

Learning assessment has come to mean examinations—which, generally, test what students have grasped and can *recite*. As artificial intelligence penetrates human realms of cognition⁶⁵ new forms of intellectual discipline will be required. Researchers at the University of Luxembourg believe it now feasible to evaluate skills known as ‘intelligence.’ Foreseen possible is evaluation of complex psychological processes that enable individuals to solve creatively complex problems. Projects are in design for student assessment methods for *demonstrating* habits of thinking (reasoning discipline). Digital technology would enable ‘data mining’ of student histories and enable pinpoint diagnostics and remediation or accelerated achievement opportunities. It will also enable instructors to track student projects without passing hours on marking tests thereby creating unprecedented opportunities for personalized evaluation⁶⁶. Instruction will be more customized⁶⁷.

The most vital asset for society will be individuals educated to prevail over the robot/AI incursion into the industrial and social life pattern while *prepared* for initiative and responsibility to conceive and initiate their own, distinctly human, endeavors/enterprises for personal enrichment⁶⁸.

SUMMARY

Previous changes in the nature of industrial work required radical policy shifts in education. Universal high school commenced the beginning of the 19th Century in the transition from farm to factory work. Transition from factory (blue-collar) to office (white-collar) work in the 1960s and 1970s spurred the universal college movement. Into the 21st century as regular, well ordered jobs, and minutely detailed qualifications, for industry tasks wane there looms an *uncertain* course for education institutions as ready suppliers of qualified workers.

Vocation and university curriculums designed for mass, standardized, student indoctrination, and their ready placement in jobs, stand to contend with industry programmer-designed instruction that prepare for robot/AI ‘workers’ their own aptitude for knowledge and its application. To be considered for future scope of education are the means for development of intellect to its most distinctly human capability. Education for simply outperforming robot/AI abilities would have to contend with constant rivaling between the parties for employment.

What does it mean to be literate/educated in the era of artificial intelligence and digital technology?

The substance for what is deemed to distinguish the human intellect for man’s economic and social activities remains to be particularized. Frequent reference to man’s creative capacity and need for its exercise provides scant insight into the development for its capacity. The often-cited instance of young children displaying ‘curiosity’ or in play exhibiting ‘originality’ and attempts at preserving such quality may simply be an aspect of the moment’s psychological development. The means for adult education to engage students in the rigors of creative thought would require that the instructor themselves can demonstrate that capacity. The education establishment as provider of alternative means for preparation for human self-development in a robot/AI era must remain abreast of its striving programmers in industry for fashioning the intelligence and abilities of the human’s destined companion.

Preparing for a 21st century AI presence, the Council foresees for public education urgent revisions in *what* is to be learned, *how* it is to be instructed, and at what stages in the maturing development process specific mental learning should be experienced.

A 21st century social order will place demands on individuals for new (more deep-seated) forms of learning. Proposed is a joint public/private Institute to conduct research, develop education policy, and disseminate information on subjects that require long-term research and are focused on understanding and solving education

issues, including those associated with the goals and requirements, for work as well as communal life amidst intelligent robot activity⁶⁹

The Institute would develop topics that require long-term, sustained, systematic, programmatic, and integrated research efforts on education requirements for human work and socialization in an era of advances in artificial intelligence.

ADDITIONAL REFERENCE

- A recent report [Auswirkungen der Digitalisierung](#) addresses some aspects of the conditions identified in this document. The Council considered CCMI/136 and while its findings are deemed relevant its scope for necessary adjustments to the perceived economic transition in progress is not comprehensive. CCMI/136, [Auswirkungen der Digitalisierung auf die Dienstleistungsbranche und die Beschäftigung im Rahmen des industriellen Wandels](#), Brüssel, den 27. July 2015.
- [When Work Disappears: The World of the New Urban Poor](#) (1996), [William Julius Wilson](#), Professor of Social Policy at [Harvard](#), examines the consequence from joblessness for the ghetto poor.
- Organization for Economic Co-operation and Development.
- [Post-work: The Wages of Cybernation](#), Stanley Aronowitz
- [The Ideas for a 21st Century Education](#): Education for Today's Future, Martha Hampson, Alec Patton and Leonie Shanks
- High Tech High, a group of charter schools in San Diego, USA, has addressed this by creating its own Graduate School of Education, as part of which teachers conduct their own research projects, using their classrooms as laboratories.
- [The Ideas for a 21st Century Education](#): Education for Today's Future, Martha Hampson, Alec Patton and Leonie Shanks
- U. S. Federal Reserve policy is said to be shaped by BLS (U-3) unemployment data particularly for those first entering the job market.
- [The Technological Society](#), Jacques Ellul,
- [Autonomous Technology](#), Langloid Winner,
- [Our Society Pushes People To Do Machine's Work](#), Dr. Chris Brauer, Globes, Israewl's Business Arena, 5 December 2016
- [EU Labor Market Policy](#), Ideas, Thought Communities and Policy Change, Autoren: **Schellinger, A.**
- [Knowledge, Communication and Creativity](#), Arnold Sales, Marcel Fournier
- [Employment and Social Development in Europe 2012](#), European Commission

FOOTNOTES

- ¹ Post WW-II there is strong correlational relationship between educational attainment and employment. Educated people in the U. S. experienced the lowest levels of unemployment and earn the most money. Bureau of Labor Statistics (BLS).
- ² See: [New Rules for a New Economy: Employment and Opportunity in a Postindustrial American](#), Stephen A. Hertzberg, John A. Alic, G. Howard Wiel.
- ³ [U.S. Economic Growth Over? Faltering Innovation Confronts the Six Headwinds](#), Robert J. Gordon, National Bureau of Economic Research
- ⁴ Education is notable for its exceedingly slow change in education content and method.
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- ⁶ In most other OECD countries, the figures remained considerably lower. A large portion of the increase was attributed to female workers entering the labor market.
- ⁷ [The Future of Work Centenary Initiative](#), Report of the Director General, 2015, ILO, Geneva
- ⁸ J. Schumpeter had termed the phenomenon of rapid succession and upgrading of products expanding the consumer market "creative destruction".
- ⁹ The Lisbon Council 2000 set the target for an overall employment of female labor rate at 60 percent. Meanwhile, the EU Commission adopted a 5-year strategy for promoting equal male/female employment levels.
- ¹⁰ The aim is to reach by 2010 an overall employment rate of 70 per cent and an employment rate of more than 60 per cent for women. The employment rate for older workers (55 to 64 years) should reach 50 per cent in 2010.
- ¹¹ Student loan debt
- ¹² There is no certainty that growth persists indefinitely, or that education will continuously be a vital means for full-employment. The 'growth effect' of the past 250 years may well have a unique phenomenon timed to the course of technology and the marginal state of the human condition. See: [Is U.S Economic Growth Over?](#), Robert J. Gordon, National Bureau of Economic Research, August 2012.
- ¹³ The Federal student loan repayment program permits agencies to repay Federally insured student loans as a recruitment or retention incentive for candidates or current employees of the agency.
- ¹⁴ Presently 65 percent of job postings for secretaries who work for executives require a college degree. But among executive secretaries hired prior to 2000, only 19 percent had college degrees. Joseph Fuller, Professor, Harvard Business School. Thirty-seven percent of companies say they hire college graduates for positions that in the past were primarily held by people with only high school degrees, and 26 percent say they hire people with master's degrees for jobs that used to go to candidates with bachelor's degrees. 60 percent of the employers hiring college grads over high school grads said a loose labor market has allowed them to attract college graduates to jobs that traditionally have not relied on higher education. Such *credential creep* compounds inequities, drives individuals to pay for degrees they can't always afford and perpetuates a cycle of ever-heightening education standards amid rising tuition costs and student debt.
- ¹⁵ By 2005 in the U.S. there were 1845 private, 4-year, colleges/universities with an enrollment of 40 percent of students in higher education.

<http://www.infoplease.com/ipa/A0908742.html>

¹⁶ In the U.S. over the past 20 years, even as the education level for the workforce increased, employment growth has not matched performance on GDP growth and labor productivity growth. Projecting forward the period growth rates, work-age population, and education levels, the gap between economic growth and employment will continue to widen. The American Middle Class Is Losing Ground, PEW Research Center, December 9, 2015.

¹⁷ Average work hours per week steadily declined.

¹⁸ Massive Open Online Course (MOOCs)

¹⁹ Freelance workers are projected to outpace full-time employed workers by 2020. The E.U. and U.S. economies are rapidly shifting to a more contingent workforce. Recent estimates by the Freelancers Union of 42 million American independent workers, up from 10.3 million workers in 2005. Jeff Wald, Forbes.

²⁰ Knowledge, Communication and Creativity, Arnold Sales, Marcel Fournier

²¹ U.S. steel industry lost 400,000 jobs, to new technology called the *minimill*, 75 percent of its work force, between 1962 and 2005. Shipments did not decline. American Economic Review.

²² After more than four decades of serving as the US economic majority, the middle class is now matched in number by those in the economic tiers above and below it. In early 2015, 120.8 million adults were in middle-income households, compared with 121.3 million in lower- and upper-income households combined, a demographic shift that signals a tipping point. Pew Research Center.

²³ The global population of prime age individual is projected to expand. In Western industrial economies, the prime age cohort will decline but increases in longevity and working age will off-set some of the decline. The addition of a robot labor force is not included in demographic projections. Global Demographic Change: Dimensions and Economic Significance, David E. Bloom David Canning, Working Paper 10817 <http://www.nber.org/papers/w10817>

²⁴ One industry source estimated that by 2050 as many as 40 million robot-smart working 'means' will populate the continent with the capability to work around the clock under nearly all environmental conditions. Meanwhile, ROBOTBASE with its 'Personal Robot' has assembled a smart 'household assistant' that understands and replies in human language with all manner of advice/direction to family questions. Japan has created a Council to aid industrial expansion with a goal of tripling the robot market to \$24. B. by 2025. IBM is investing 3.0 B. for chips development in AI applications.

²⁵ Even as the manufacturing sector output expands the employment in the sector declines.

²⁶ Already demonstrated in laboratory a robot can react from ethical consideration, in a way that is surprisingly close to Asimov's famous laws of robotics. We now need to prove that such a robot will always act ethically, while also understanding how useful ethical robots would be in the real world. New research will help robots know their limits, University of the West of England, 08 December 2014

²⁷ Among the most notable efforts with robots that look and act more like human beings are Waseda University's Wabot, MIT's Cog, NASA's Robonaut, Sarcos's Sarcoman, the Toyota partner robots, Japan's METI HRP series, Sony's Qrio, and perhaps most famous of all, Honda's Asimo.

²⁸ If technologies that power AI, progress at a Moore's law trajectory the performance of robots will improve geometrically. Within the decade computing power may reach the capacity of the human brain by 2030.

²⁹ It has been proposed there be a certification for human/robot relations experts whose function is to probe robot disposition in decisions-making. Our Society Pushes People To Do Machine's Work, Dr. Chris Brauer, Globes, Israewl's Business Arena, 5 December 2016.

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³¹ We must decide who is entitled and qualified to instruct the bot.

³² See: Key Competences for European Citizens in the knowledge Society Eu, European Commission, 20 December 2012.

³³ EU Assessment of Key Competences in initial education and training: Policy Guidance

³⁴ Eurofound ERM Annual Report 2015: 'Job Creation in SMEs' specified 8 categories of new forms of work activity.

³⁵ I don't think the schools realize that industry is their customer. They need to produce students with skills that allow them to get a job. If they don't, they are essentially producing a defective product...and in this instance a defective human being." Rex Tillerson, Exxon-Mobil Corp.

³⁶ The gains for individuals from private industry sectors served by education for life-long-learning is uncertain. High-end manufacturing, a well-paying sector, employs only 12-15 percent of the workforce (in the US 12.2 million workers). The auto industry which dominates manufacturing is set to further reduce its workforce.

³⁷ Both companies and individuals may under invest due to the perceived uncertain/temporary value/gains of the derived benefits. And older workers will have less incentive to upgrade skills because of a shorter period within which to recoup benefits. 'Who should Bear the Cost Continuing Education', Employment and Social Development in Europe 2012, European Commission.

³⁸ See: Key Competences for European Citizens in the knowledge Society Eu, European Commission, 20 December 2012.

³⁹ Recent decades have seen the neglect of the social sciences, the humanities, the arts, civics, civility, ethics, health, safety, and fitness education with the dominance of science and technology.

⁴⁰ For a more detailed examination and presentation on the subject see: Skills for the 21st Century: teaching higher-order Thinking, Robyn Collins

⁴¹ With megabytes of information at-hand to any individual with access to a computer, the global popular culture – such as tweeting, messaging, 'instagramming' events— readily conveys what individuals for themselves the world over deem relevant for their knowledge, discernment, and sensibility.

⁴² U.S. technology companies shed 63,000 jobs in 2016; estimated lay-offs for 2017 are 370,000. See: As Technology Shifts More Layoffs Loom at Tech Companies, Malathi Nayak, Deborah Todd, Reuters News, 18 August 2016.

⁴³ See: The Education Myth, Ricardo Hausman, Chief Economist for Inter-American Development Bank, Project Syndicate, July 19, 2016,

⁴⁴ Today the focus of innovative industrial activity is primarily on labor-saving cost.

⁴⁵ Wirtschaftskammer Oestreich (WKO) in its report: AGENDA 2015, "Impulse für Wachstum und Beschäftigung" details specific actions in education for developing sufficient human resource for the requirements of its private sector industrial enterprises. Also proposed are reductions in industry oversight. There is, however, *no* hint that industry applications for robot/AI labor may well lead to a surplus of trained workers for private sector industries.

⁴⁶ Only 11 percent of the US working-age population are used produce all the basic product and service needs of the population.

⁴⁷ The Lifelong Learning Program (LLP) was designed to enable people, at any stage of their life, to take part in stimulating learning experiences.

⁴⁸ Amsterdam Treaty formally created the European Employment Strategy and an Employment Committee to promote co-ordination of member states' employment and labor market policies for a coordinated strategy on creation of a skilled, trained and adaptable workforce and labor market responsive to technology change.

⁴⁹ In 2000, the European Council at Lisbon embraced full employment as an overarching objective of the employment and social policy.

⁵⁰ A new Skills Agenda for Europe: The Role of Education, <http://ec.europa.eu/education/news/2016/0610-education-skills-factsheet> en.htm

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⁵² The EU skill agenda report discussing: 'How will formal education contribute to achieving the objectives of the Skills Agenda?' fully overlooks the basis for personal education beyond jobs.

⁵³ Five million young European individuals (under 25) were unemployed in the EU-28 area in the second quarter of 2014. This represents an unemployment rate of 21.7% (23.2% in the euro area). 7.5 million between 15 and 24 were neither in employment, nor in education or training (NEETs).

⁵⁴ Declared Goals of the Bologna Process was increasing student mobility and employability.

⁵⁵ The few that will remain will be the technology controllers, or will be consulted only in the difficult cases that a bot cannot solve.

⁵⁶ Taxpayers could expect 22 percent more output for their current investments into schooling.

⁵⁷ The New Division of Labor: How Computers Are Creating the Next Job Market, Frank Levy, Richard Murnane

⁵⁸ It has been established that physical activity is the most valuable 'purchase' improving the quality of human life. Lacking are education programs for strengthening health by means of physical activity. Yet education establishment itself is unprepared for scientific skills training in this aspect of human social life. Lithuanian Academy of Physical Education.

⁵⁹ Is Artificial Intelligence Really A Threat To Humanity? Christian de Loooper, Tech Times, 28 August 2015

⁶⁰ The rapid shift of workers from farms to urban factories contributed to unrest across Europe. Governments took a century to respond with new education and welfare systems.

⁶¹ Higher Education Policy Convergence and the Bologna Process, Eva Maria Vögtle, 2014.

⁶² Even as employment opportunities for individuals with a college degree increases, that a 'college wage premium' will persist as the number of college graduates increases is uncertain. A stronger macroeconomy for workers may have more beneficial impact on employment and wages than education. What Increasing Education Will and Will Not Do, The Hamilton Project.

⁶⁴ Despite the clear consensus among researchers that the problem is a shortfall of aggregate demand for labor, there is a public narrative that job recovery is weak because workers do not have the right skills. Is There Really a Shortage of Skilled Workers?, Economic Policy Institute, Heidi Shierholz.

⁶⁵ Within the E.U. 70 percent of GDP derives from SMEs/ _____. European Commission, The E.U. and SMEs: A Contract for New Growth.

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