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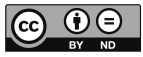

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The Future of Education in the Context of Cognitive Enhancement Practices

Abstract

The exponential growth of technological advancements creates an environment in which the traditionally conceived cognitive enhancement—education—must constantly redefine itself in the face of the invasive presence of AI, social media, and various biotechnologies that strive to augment effect-oriented performance. Whereas on the conceptual level there is a visible shift from static to flow-modelled education—and a growing trend to invest in skills like flexibility and creativity—not many of emerging technologies are seriously considered educational tools. The paper looks into the varieties of cognitive enhancement within an educational context. Of major concern are the currently available technologies of collective intelligence and nootropics, as well as the experimental downloadable learning. I review the problems occasioned by these technologies, as well as the existing solutions, which tend to incorporate rather than exclude the possibilities of radical cognitive enhancement.

Keywords: cognitive enhancement, new technologies, education

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Introduction

Since the inception of work on human enhancement and the creation of artificial intelligence, the ways in which it would affect education have been envisioned in various ways. The wildest scenarios have been imagined: from the telepathy in *Star Trek*, through "knowledge viruses" in *The Child Garden*, to simulations in *Ready Player One* and downloadable learning in *The Matrix*. None of these touch upon the revolution in the educational system as such but on a novel understanding of the working of the human mind, enabled by biological discoveries and technological breakthroughs. In these futuristic visions, learning is brought about by intimate connectivity and symbiosis with other agents within the edu-sphere, and constant rewiring of the central and peripheral nervous systems for the accommodation of new data. Direct brain stimulation, the "conversation" with microscopic beings infused in one's bloodstream, and/or unmediated access to others' thoughts are for the time being an imaginative portrayal of collective intelligence; however, they may soon prove to be more than science fiction. We already possess technologies that have impacted our philosophy of perception, and consequently, the way we think about learning. Nootropic drugs enhance concentration, various forms of brain stimulation (DBS, tDCS, TMS, or temporal interference) seem to "inject" knowledge directly into the brain, the commonly used social media—and less commonly used brain–computer interfaces—enable humans to work as one collective mind in a form of "swarming," whereas virtual reality (VR) and augmented reality (AR) provide safe, mutable environments for testing and practicing one's abilities. In the following paragraphs, I investigate the most common technologies of cognitive enhancement[1] and consider their import on the transformation of schooling and learning.

[1] In this article, cognitive enhancement will be understood in accordance with the definition proposed by Allen Buchanan in his 2011 book, *Better Than Human*: "Cognitive enhancements increase normal cognitive capacities. Cognitive capacities include memory (of which there are several kinds), attention, reasoning, and what psychologists call 'executive function,' the ability of the mind to monitor, direct, and coordinate various mental operations" (Buchanan, 2011, 5).

Education, as the primary technique for cognitive enhancement, already benefits from and chokes on practices from the range of cognitive enhancement technologies that are often associated with radical transhumanist visions of cyborg people. Whereas it is true that cognitive enhancement is a large part of the Humanity+ agenda, it does not necessarily entail the practices of physical, moral, and emotional augmentation that is questioned by ethicists and demonized in dystopias and sensationalist reports in magazines. Smart devices are used as memory aids, e.g., of phone numbers or schedules, and ginkgo extract and omega-3 fatty acids are supposed to fend off the specter of Alzheimer's disease. More advanced cognitive enhancement, though, is already an everyday reality and generates challenges for institutionalized education.

Collective Intelligence

To begin with, Collective Intelligence (CI) has been ubiquitous for some time now, and it is slowly being recognized as a reality to be accounted for both in the process of formal learning and, more broadly, in the informal generation of knowledge items. It may be defined as a collaboration of individuals to achieve a particular goal, to which end they use new technologies and tools. By way of illustration, social media provide an opportunity to share and comment on current events, and Google, Alexa or Siri—i.e., a set of algorithms—can manage our itinerary for us. Some of the solutions resulting from networking with people and bots are codified in the repositories of common beliefs, such as Wikipedia or YouTube channels. This open-source approach encourages many to reach for this type of unstable, ever-changing data, rather than the advice of experts, which is usually costly and quickly becomes outdated.

Obviously, the general discussion revolves around the verifiability of such generated data. This gives collective intelligence a bad name and discourages "serious" educators from incorporating it into their practice. The main obstacle is the distrust with which the volatile, intangible world of cloud computing is viewed, as well as the lack of adaptability, flexibility,

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and what may be called fluidity, which would allow people to function effectively in the fluid environment created by novel technologies. As Laura Beloff (2013) puts it, we need to become hybronauts and to learn at least basic strokes, not to drown in the increasingly virtualized world. The acquisition of such skills and the general passage from static, expert models to dynamic, collective-based educational models seems necessary when students are already using unverified sources, which cannot be monitored, and devices like Google Duplex, an effective artificial editor which allows them to compose whole texts with practically no basic writing skills.

Despite all the hamstrings and reservations about the validity and place of collective intelligence in the classroom, there are already well-established methods striving to introduce integrative networked learning. Massive online open courses (MOOCs), flipped classrooms, and blended learning are all parts of the same phenomenon. The basic premise behind them is the decreased role of static, centralized, and expert-reliant knowledge, and the increased role of the dynamic, participatory, and group-generated solutions for the fulfillment of particular tasks, leading to the rise of problem-oriented courses and studies. The instruction is delivered outside the classroom, either provided by the institution in the form of e-learning content or completely unsupervised by the teacher. Within the classroom, students are assigned different roles depending on their level of mastery and on their individual skills, i.e., some are researchers, some data verifiers, some creative thinkers, etc., and all benefit from their cooperation. The teacher supervises the progress of all of the students, perceiving them as individuals within a group, not as isolated "cases."

Working in a blended environment creates a set of challenges and necessitates the adoption of a collectivist mindset. At the institutional level, it calls for constant teacher support—in a blended classroom educators are coached and receive help with the monitoring of both the group and individuals, whether via specialized systems or human assistants. Problem-oriented learning requires constant activity and awareness of the fluctuating demands of the market, of the local milieu, technological changes, etc.; thus, the designers of such classrooms are under pressure to display lively creativity. Issues of privacy and intellectual property

are another problematic area. The progress of individual students can no longer be measured only in terms of their individual competence, but must be combined with the assessment of their overall skills of teamwork, data curation, and the aforementioned "fluidity," i.e., effective functioning in the environment of liquid modernity. If we treat knowledge as a flow, not as something we can possess, but something in which we partake, issues of copyright infringement appear. Rather than considering whose knowledge it is, students must learn to conscientiously use information from the generally available pool for the benefit of all.

Nootropics

Apart from the external hardware and software that serves as everyone's daily cognitive enhancement, memory, attention, and mental coordination are also being improved by a range of biomedical tools, such as supplements, GM foods (or conversely, ecologically produced foods), and drugs that are easily available not only in pharmacies, but also in regular stores. These drugs, called nootropics, are a synthesized rather than natural means of boosting the performance of the brain and the whole central nervous system in a healthy individual. Many of them are based on dopamine, serotonin, and oxytocin, and they act as mood enhancers. They are commonly used in the treatment of depression and mood disorders. However, the most popular nootropics in an educational context are those based on amphetamine (Adderall), substituted phenethylamine (Ritalin), or modafinil (Provigil). Although they are marketed as ADHD treatment prescription drugs, they are easy to obtain and used by a considerable number of students in the USA and the UK. Recent reports (from 2017) have found that between 10% and 15% of students use cognitive enhancement drugs, which they either obtain from physicians by simulating a disease or they purchase illicitly. In May 2017, *The Guardian* alerted readers that despite the Psychoactive Substances Act, which was passed in the UK in 2016 and bans certain kinds of study drugs, they are still being sold to eager students (Marsh, 2017).

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Although such substances are said to be non-addictive and do not demonstrate adverse effects with occasional use, there are issues of unknown future consequences, especially with prolonged use, and the irresponsible combination of nootropics with other drugs and/or alcohol. Whereas the health hazards stemming from biomedical enhancement are perhaps the domain of doctors, there are also legal problems which affect teachers and school authorities in their everyday work. *Harvard Business Review* and the aforementioned issue of *The Guardian* point out that some Ivy League universities and Oxford, Cambridge, and the London School of Economics are being pushed to introduce measures to regulate the abundant use of nootropics (Cederström, 2016; Marsh, 2017). For instance, at Duke University it is recommended to treat the "unauthorized use of prescription medicine to enhance academic performance" as cheating (Cederström, 2016), and students in the UK are calling for doping controls before exams.

The phrase "unauthorized use" is a watchword here, signaling that as long as it is authorized, enhancement is allowed. Consequently, it has been reported that a diagnosis of ADHD is often abused by doctors themselves to enhance cognitive performance in healthy individuals (Lakhan & Kirchgessner, 2012; Urban & Gao, 2017). Nick Bostrom (2008), a Swedish philosopher, explains the reasons for such practice:

> One of the perverse effects of the failure of the current medical framework to recognize the legitimacy and potential of enhancement medicine is the trend towards medicalization and "pathologization" of an increasing range of conditions that were previous regarded as part of the normal human spectrum. If, for example, a significant fraction of the population could obtain certain benefits from drugs that improve concentration, it is currently necessary to categorize this segment of people as having some disease (in this case ADHD) in order to get the drug approved and prescribed to those who could benefit from it. This disease-focused medical model is increasingly inadequate for an era in which many people will be using medical treatments

> for enhancement purposes. Academic research is also hampered by the disease framework in that researchers find it difficult or impossible to secure funding to study potential cognitive enhancers except in contexts where the study can be linked to some recognized pathology. (Bostrom, 2008)

Within such an environment, it is to be expected that a number of students will be diagnosed with different cognitive deficits to gain access to cognitive enhancers. This cover-up for the unhealthy study conditions in the first place—putting a strain on individual students forced to function in the product- and effect-oriented, marketized education—clouds a range of existing and potential problems and hampers attempts to solve them. "Exam doping" may increase the competitiveness of learning, and it may enhance not only cognition, but a "neurological arms race" (Cederström, 2016) and contribute to the expansion of different pathologies, such as illicit drug trafficking.

Downloadable Learning

The final cognitive enhancement technique which may transform the future classroom is currently being tested by the USA military agency, Defense Advanced Research Projects Agency (DARPA), as an extension of the Brain Research through Advancing Innovative Neurotechnologies (BRAIN) initiative. It involves work on cerebroprostheses (brain–computer interfaces) and neuroprostheses (various brain implants), as well as Targeted Neuroplasticity Training, which is supposed to enable the immediate manipulation of memory and grant instant access to knowledge, understood as both data and skills (thus improving on simple collective intelligence). Downloadable learning can be generally described as invasive and non-invasive stimulation of synaptic plasticity with the use of brain–computer interfaces. What DARPA hopes to achieve is the enhancement of military performance in terms of the arsenal of skills available for soldiers on the battlefield, for example, different combat styles,

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operating multifarious devices, and the ability to communicate via different media and in different languages. Many university centers all over the USA are involved in designing and testing technologies that would deliver just that: for example, the teams at Johns Hopkins University, the University of Maryland, and the University of Texas are performing studies on volunteers in terms of complex skill learning, such as language acquisition.

The potential uses and misuses of brain stimulation are currently being hotly debated by bioethicists, with major issues being the loss of individual autonomy and the risk of brain hacking. Cybersecurity, mind control, and surveillance concern the whole of the society, and should be discussed at the level of state policy and legal regulations. Social stratification, connected with at least the initial costs of implementing the gains of neuroplasticity, may result in distributive injustice when it comes to knowledge and the resulting power. In the context of education, these problems address the selfsame areas as those delineated above: students can no longer be perceived as autonomous agents whose progress is measurable, but as users of data stored in repositories, at least theoretically sound and unfettered by economic and political ties. What follows is that the challenges specific to the future classroom environment directly impact the place of the teacher in the process of education, and the psychological and moral integrity of the student/apprentice who is presented with a ready set of tools and skills, but remains unaware of their own potential and power. The teacher's role as a guide, refiner of the final outcome and, above all, an ethical and moral caretaker, will be far more important than the one we see today—as a deliverer of instructions and a taskmaster.

Education and the Fourth Industrial Revolution

The key phenomenon for cognitive enhancement is synaptic plasticity: "a natural process in the brain, pivotal to learning, that involves the strengthening or weakening of the junctions between two neurons"

(DARPA, 2017). Lifelong learning and the demands of fast-paced alterations call for extreme flexibility and adaptability as critical survival skills, and the exploitation and augmentation of the brain's ability to rewire itself seems to be guiding most enhancement efforts connected with learning. Michio Kaku, in his 2014 *The Future of the Mind*, writes extensively on the science and available technologies, reviewing the then trends, which—to some extent—are still being developed now. The consequences of memory enhancement, brain-net, "forgetfulness drugs," etc., are discussed on the individual and social levels. When it comes to education, on which the impact of these technologies will be unprecedented, Kaku has little to say:

> The educational system would be turned upside down; perhaps it would free teachers to spend more time mentoring students and giving them one-on-one attention in areas of cognition that are less skill-based and cannot be mastered by hitting a button. The rote memorization necessary to become a professional doctor, lawyer, or scientist could also be drastically reduced through this method. (Kaku, 2014, p. 125)

Similarly, little place is devoted to the educational impact of new technologies by the chief theorists of human enhancement. Marvin Minsky, who famously viewed the mind as a "society of agents" rather than a stable entity, in his essay in *The Transhumanist Reader* brushes away the notion of understanding as irrelevant.

> What is understanding? What I claim is that there isn't any such thing. There is no such thing as consciousness, there is no such thing as understanding, and all of the trouble these people are having is because they've gotten trapped into using words that have become very popular for social reasons; it is very useful to say that this kid doesn't understand, meaning that his performance and versatility and ability to apply what he's supposed to learn isn't good enough and he's going to have to come back after school or repeat second grade … but of course that would

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> interfere with his social development, so we can't do that … and blah, blah, blah. (Minsky, 2013, p. 172)

In contrast to the above thinkers, Luciano Floridi devotes more space to the conceptualization of education and learning. When talking about e-learning and education, he emphasized the benefits technology has already brought to teachers and learners, simultaneously showing an awareness that the sea change of the life environment calls for more than a practical application of ever-updated tools:

> A century after Turing's birth, universities are rushing to put their courses online, and the market of e-learning is blooming [sic]. There is much to be said in favor of (distance) e-learning, when it is not a form of "unmanned teaching" or merely cheap outsourcing. As its supporters rightly stress, it has made a vast reservoir of educational contents available to millions of people, and it promises to deliver even more to ever more. ICTs may allow a degree of didactic customization unprecedented in non-elitist contexts: the personalization of the educational experience for millions of individuals. But all this is a matter of delivery policies, methods, techniques, and technologies. If it is taken to be a solution of how to educate Generation Z and the others which will follow, then we are mistaking a painkiller for a cure. The real headache is not the *how*. Since the late eighties we have become enthusiastic about MOOs (text-based online virtual reality systems for multiple users connected at the same time), literary hypertexts, glove-and-goggle VR (virtual realities), HyperCard, Second Life, and now MOOCs (massive open online courses). More fashions and further acronyms will certainly follow. Yet the real headache is the *what*. (Floridi, 2014, 81–82) [2]

[2] By "the what" Floridi means not so much the new subjects and disciplines—he rather asks, "What is education for?" This problem has also been posed and heavily discussed by the representatives of critical posthumanism, which perceives classical education as a humanist project, anthropocentric, and self-contradictory (see Bayne, 2018).

Floridi's theory of the Fourth Industrial Revolution (4IR) is starting to reverberate with professional educators. A refined and detailed learning ideas that aptly apply the above theory are proposed by cyberculture theorist Pierre Lévy (2015). He predicts the emergence of reflexive collective intelligence in which connectivity between different education agents is taken for granted and used on self-reflection, on a social community thus created. For that to be effective, he proposes the following basic set of skills to be acquired, preferably in early development:

Table 1

A new literacy: Data Curation Skills

	AWARENESS	MEANING	MEMORY
Personal intelligence	**Attention management** Prioritize topics Select source	**Interpretation** Produce hypotheses Analyze data	**Memory management** Maintain categorization Manage cloud
Critical intelligence of the sources	**External critique** Diversify sources Cross-examine data	**Internal critique** Identify categories Identify narratives	**Pragmatic critique** Assess transparency Identify agenda
Collective intelligence	**Stigmergic communication** In global memory In local memory	**Liberty** Take responsibility Use power	**Collaborative learning** Externalize tacit knowledge Internalize explicit knowledge

Note. Adapted from Lévy (2015).

Within this set, learning is defined as a mnemonic skill, inseparable from the sense of common heritage of all participants of the network. Lévy sees it not simply as one of the many competences to be acquired, but as the most important one. It is made up of "tacit knowledge" (the local, contextual one) and "explicit knowledge" (the commonly accessible, public memory). The key to connecting these, thus enabling collaborative learning, is language translational skills, which Floridi (2014, p. 85) writes about as being essential for the 4IR era: whether they are national languages or communication systems used in music or programming, they string together the separate worlds of internal and external knowledge, giving meaning to the ocean of limitless data items.

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These ideas of connectivity and a globalized mind begin to be recognized as imminent and tied in with concrete technologies which pose challenges to learning environments. Bryan Edward Penprase, in "Higher Education and the Fourth Industrial Revolution" (2018, 215–216) lists "exponential technologies" that are instrumental to the 4IR, and an impressive array of predictions treated seriously within the context of education. The forecast for the near future is a drive for the cyborgization of human bodies and an increased connectivity between individuals, mostly with the use of wearables, but soon also with invasive implantable technology. In fact, recreational biohacking—as in the case of subdermal jewelry or gadgets—is already quite popular on the market. As cyborgized learners appear, education will have to adapt.

A completely new dimension for education has been created by the fact that even now Robot Sophie has been admitted as a university student, Bina48 teaches ethics at a university level, and the Mirai Bot "attends" a Japanese kindergarten, but it is conceivable to think that some other robots and androids could be eligible for inclusion in the educational models of the future. When social skills, communication, and cooperation transcend simple computational power, AI approaches the state of "becoming human." Brain-netting with advanced AI is yet another consequence of the inclusive and equalizing attitude permeating the contemporary trends. Researchers dealing with Artificial Intelligence in Education (AIEd; Luckin et al., 2016) have developed multiple models of integrating AI into the current systems, and particular changes in the curricula for universities have been proposed (Penprase, 2018). Some form of support may come from Intelligent Tutoring Systems (ITS) that

> use AI techniques to simulate one-to-one human tutoring, delivering learning activities best matched to a learner's cognitive needs and providing targeted and timely feedback, all without an individual teacher having to be present. Some ITSs put the learner in control of their own learning in order to help students develop self-regulation skills; others use pedagogical strategies

> to scaffold learning so that the learner is appropriately challenged and supported. (Luckin et al., 2016)

In their *Intelligence Unleashed* report for Pearson, the researchers envision, among other models of AIEd-enhanced education, the interaction with AI learning assistants that can be introduced as lifelong learning companions. Still, although the report acknowledges the deep systemic changes that will be occasioned by the 4IR, the exact nature of these changes is never specified. AI is still seen as an addition to an anthropocentric and didaskalocentric classroom, where a human teacher is the prime organizing power, the expert, and the formal authority, reining in the seemingly "unleashed" intelligence.

Conclusions

It can be stated that the failure of the current systems is the attempt to forcefully "enhance" classrooms with the use of innovative tools. With the recent introduction of AI teachers in Sweden and Japan, it is important to realize that these are no longer gadgets that we can use with a 2.0 mindset, i.e., the one in which it is enough to move from using a laptop to a tablet in order to upgrade the learning and teaching experience. Teachers themselves have to be familiar users of contemporary technologies, and they have to benefit from them in their everyday life to be able to guide their students in using them appropriately. The role of the teacher as an instructor or designer of materials such as MOOCs or online tests (Moodle) will most likely be taken up by AI instructors or simple bots. In the future classroom, the hybronautic teacher will gather students at a meeting of equals, differing perhaps in the level of mastery and experience, around a certain problem to be solved with the use of available data and skillsets. As Pierre Lévy states,

> young people should be prepared for collaborative learning in social media using a practically infinite knowledge repository

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> without any transcending guiding authority. They will need not only technical skills (that will evolve and become obsolete very quickly), but above all moral and intellectual skills that will empower them in their life-long discovery travels (2015).

In other words, students need to be independent researchers rather than recipients of knowledge and to take responsibility for the knowledge they create. This also pertains to the teachers and school authorities themselves.

To promote high-quality teaching and learning, a thorough reflection on the technological means of cognitive enhancement is in order, and the consideration of their humanistic impact. As Gerd Leonhard (2015) stated in his lecture *Future of Learning, Training and Education*, "we'll only be better by being more human"; that is, if we let machines do their job, and let go of the industrial era perception of humans as cogs in the machine—or even a device or a product straight from the assembly line. The education's role in the face of cognitive enhancements is ultimately not to mechanize the learning process—rather, to liberate the teacher and the students from mundane tasks and grant them a more responsible place, proper for the dignity of human beings: creating and discovering.

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