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Artificial Intelligence in Education: Solution with Problems

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Introduction

For almost four decades, a growing body of literature and speeches has predicted technological disruption in education. Opinions range from alarm that the end of education as we know it has come to those unperturbed by the wave of technology fad—this too shall pass, they say. Often, proponents cite the technological disruption of the music industry as a harbinger of education's fate. Digital music downloads shut down record stores and changed how music is merchandised and consumed. Indeed, no one can deny that technology has liberalized and broadened access to music across the globe.

Protagonists predict that the fate of education will mirror that of the music industry. It is only a matter of time before schools go the way of music stores. Technology will democratize and broaden access to education, making schools unnecessary and teachers irrelevant. If schools survive, they will, at best, be reduced to an industry solely responsible for credentialing.

The demise of formal education was a recurring topic of conversation and debate thirty years ago, when I was a doctoral student. However, it would be naïve to minimize the profound impact technology has had on transforming formal education over the past three decades. Today, because of technology, we refer to teachers as facilitators of learning rather than the sage on the stage. It would be equally myopic to underestimate future impacts and assume business as usual for the next 10 years, let alone the next 30.

Purpose of the Paper

That artificial intelligence (AI) will impact teaching and learning is indisputable. This paper briefly summarizes the positive impact and the negative consequences of AI in education. Of greater interest are the possible neurodegenerative impacts of generative AI and the implications for formal education.

How Education has Changed since the 1990s

Figure 1 depicts the 30-year evolution of technology in education. The advent of the internet and personal computers in the 1990s was hailed as a revolution that would democratize knowledge and, with the development of multimedia, make learning highly engaging. In reality, teaching and learning were enhanced, but traditional classrooms were not replaced. The “digital divide” also limited the predicted democratization of knowledge.

In the 2000s, the prediction was that teacher-led lectures would be replaced by collaborative, student-centered environments. Web 2.0 technologies, interactive whiteboards, and Learning Management Systems (LMS) were expected to revolutionize education. Teaching and learning absorbed these innovations. Schools adopted digital gradebooks, introduced virtual learning environments, and used smartboards to augment instruction. Schools and schooling survived.

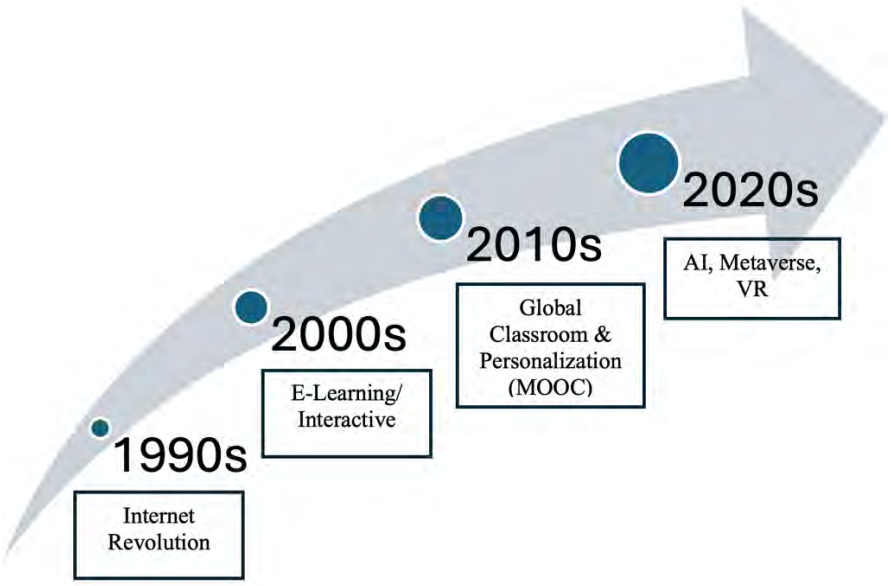

Figure 1: A 30-Year Evolution of Technology Leading to AI in Education

The 2010s brought a wave of predictions about Massive Open Online Courses (MOOCs). The era of personalization and the global classroom was expected to revolutionize education. A new world of education, in which elite institutions would deliver content accessible to everyone across the globe, was expected to shut down zillions of "average and mediocre" schools. In reality, MOOCs provided access to many, but the anticipated school closures did not materialize, and those that shut down were not because of MOOCs. Completion rates for MOOCs remained low, and traditional education survived.

The 2020s mark the emergence of artificial intelligence, which some say will make schooling obsolete. AI can do what teachers cannot, including providing encyclopedic knowledge on the spot, being omnipresent, and offering unbridled responsiveness. COVID-19 shut down schools and forced education to go virtual. Some predicted it would be the end of schooling. However, in most schools, students have returned to their classrooms, and the extent to which AI will revolutionize education remains a subject of debate. While many proponents have tempered their claims about the extent of the revolution, they seem unanimous that AI will not replace teachers, but AI teachers will replace non-AI teachers.

Nature of Learners

Beneath the varying and conflicting opinions about the role and importance of technology and AI in education lie the assumptions we hold about how humans learn and about student behavior. What we do in school, the controls we put in place, the content we transmit, and the pedagogy or andragogy we employ all reflect assumptions about learners' behavior. Invariably, these assumptions predispose us to adopt or reject AI in education.

Type X vs Type Y Learners' Assumptions

Behind the hype and concerns about AI in education lie fundamental, contrasting assumptions about human learning. Consciously or unconsciously, we hold opinions about students and their learning behaviors. The roles that AI and humans play as teachers vary based on these assumptions. Table 1 summarizes the two opposite ends of these assumptions about students as learners.

Table 1: Type X and Type Y Students

No	Type X Assumptions About Students	Type Y Assumptions About Students
1	Students are naturally and relentlessly curious	Students are generally disinterested in learning
2	Students seek formal knowledge voluntarily	Students seek formal knowledge by compulsion
3	Students are undeterred by the difficulty of obtaining an education	Students prefer education that is easy
4	Students are overall hardworking	Students are overall lazy
5	Students seek the path leading to quality education irrespective of its challenges	Students seek the path of least resistance in their quest for education
6	Students will avoid cheating even if they know they can't be caught	Students will cheat if the risk is minimal
7	Students will avoid teachers if they can	Students are excited and eager to learn from teachers
8	Students can readily distinguish facts from misinformation.	Students are generally gullible
9	Students will study hard even without examination	Students are prone to study for the test
10	Students learn better alone by themselves	Students learn better in groups

Figure 2: AI Classroom vs Traditional Classroom Continuum

Table 1 should be viewed as a continuum with two extremes. Most people fall somewhere along the continuum. Overall, those who lean toward Type X assumptions are often eager to embrace technology and explore AI's potential in education, and they are readily persuaded that technology can easily replace teachers. By contrast, those who lean toward Type Y assumptions are more likely to downplay the importance of technology and AI in favor of human teachers.

It is easier to deploy AI and robotics to meet the needs of students who are naturally and relentlessly curious than those who are not. If students seek knowledge voluntarily, without external prompts or encouragement, they will readily embrace technology to satisfy their thirst for knowledge. By contrast, those who assume that external prompts are necessary to encourage students to learn will see the value of human teachers.

Similarly, those who assume that students generally avoid cheating, are self-motivated, and are likely to study not because of examinations will view technology as a tool that can easily replace teachers. By contrast, those who hold that students require assistance in distinguishing facts from misinformation, encouragement to work harder, and group study are more likely to emphasize the irreplaceability of teachers by AI.

Assumptions About Schooling

Assumptions about schooling, its role, and how it should be organized also shape our perceptions of AI in education. Using a contrasting continuum, Figure 3 provides

Figure 3: Two Contrasting Views of the Purpose of Education

views that shape educational policy thinking. Those who view schooling as a place to obtain credentials for employment rely on assessment metrics that focus on the efficient production of graduates. Such a view predisposes policymakers toward technology and the rapid adoption of AI to speed up production and perhaps reduce unit production costs.

On the other hand, those who hold that the purpose of education is self-discovery, with the end goal of living a fulfilled life while contributing to the advancement of society, deemphasize production efficiency and broaden the scope of education's end goal. With this view, technology and AI are tools to augment teaching and learning rather than a means to replace teachers.

Potential Benefits of AI in Education

The potential benefits and impacts of AI in education are still being debated. However, a few claims can be made. When asked, AI itself highlights a few of the benefits, as shown in Figure 4.

To indicate AI contributions in published materials, figures are presented in two colors (dark green and dark purple). Dark purple represents AI-generated benefits. Drawing on personal experience using AI to study Romanian, I can testify that it provides personalized learning, access to lessons regardless of time or place, faster feedback, adaptation to my progress, and accelerated learning.

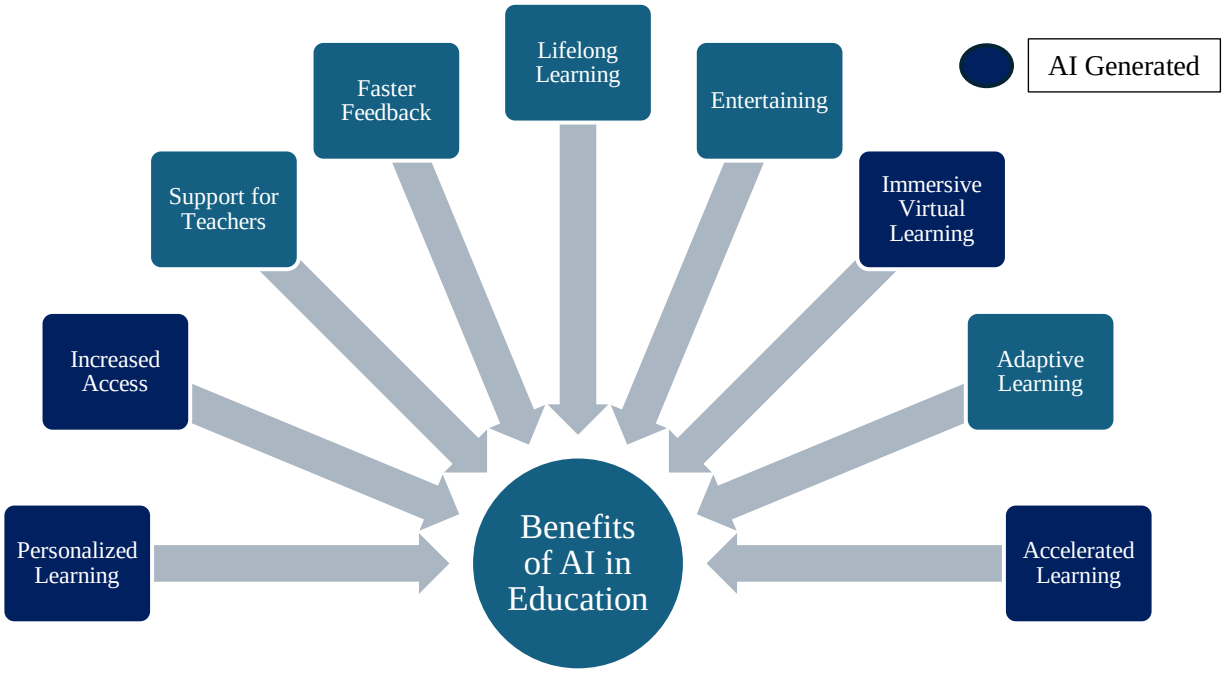

Figure 4: Benefits of AI in Education

The software in use provides engaging feedback and integrates videos for visual and kinesthetic learners. Romanian language teachers could incorporate AI-provided lessons to supplement their classroom instruction. It is also impressive that I can learn at my own pace without added stress to complete assignments.

AI-Related Problems in Education

Figure 5 illustrates AI-related problems in education. A full-scale deployment of AI is expected to pose challenges in education. Educators are grappling with academic integrity as students use AI to prepare their assignments. Generative AI does what its name implies—it generates original essays for students on almost any topic posed to it. Teachers now find it difficult to distinguish students' authentic work from that produced by artificial intelligence.

Increasingly, technology in education is reducing the level of student-teacher physical interactions. A full-scale deployment of AI in education is expected to further reduce human interactions, a trend that some fear will continue to complicate the rising mental health challenges.

The more progress we make in using technology in education, the more vulnerable our privacy becomes. AI further deepens this vulnerability. Some would say it is naïve to think there is any privacy left in 2026, in the era of ubiquitous electronic information. With all our personal data, health data, and personal communications transmitted and stored digitally, and with hackers growing more sophisticated daily, the assumption of privacy is myopic. Jordan Peterson said in a video

> *If a traffic camera caught you jaywalking in China, the digital ID system has you, has your blood [type], has your genetic code, has your photograph. It can identify how you walk. So even if you can't see a face, you can be picked up by[the] gate. It will convict you of jaywalking, take money out of your bank account with no intermediated judiciary at all, show a picture of you to the people in the neighborhood so they know you have jaywalked, and reduce your social credit score. And if your social credit score falls below a certain level, then you can't buy a drink from the vending machine, you can't play video games, you can't go on a train, you can't get out of your 15-minute city—all that is in place in China. @jordanPetersonNation*

His prediction is that what is happening in China will one day happen in North America simply because the technology is available and the temptation to control citizens, even in a democracy, is high.

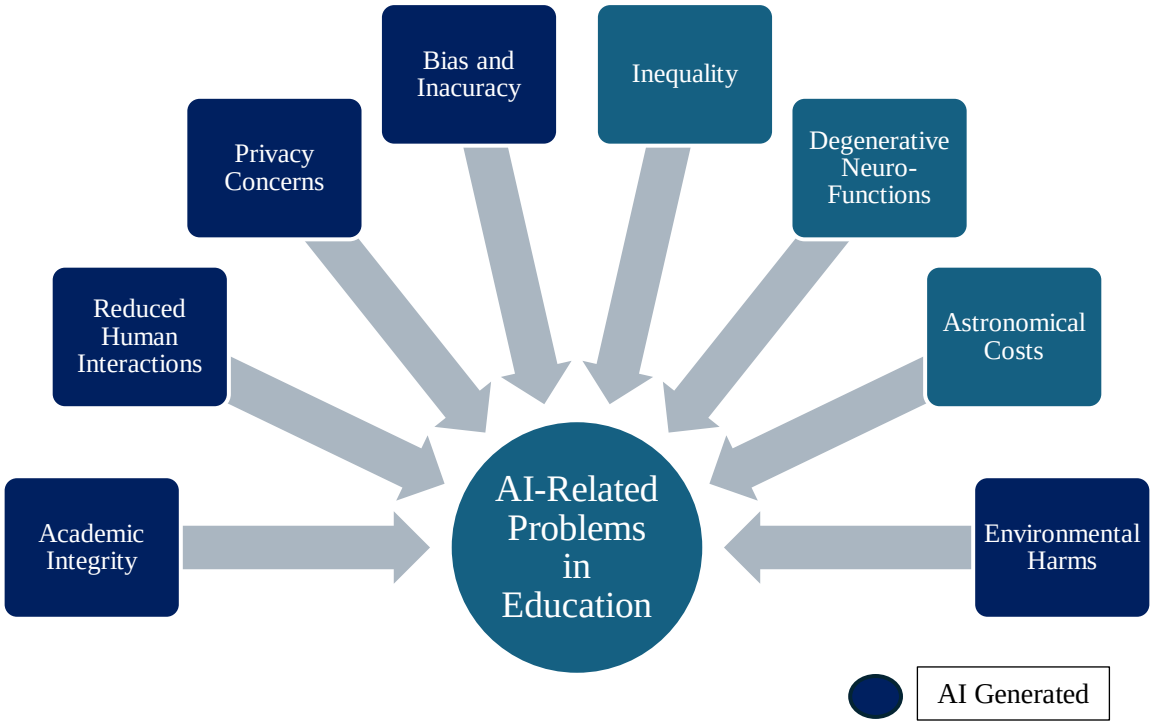

Figure 5: AI-Related Problems in Education

AI is not without bias and inaccuracies. Many have reported misleading AI-generated content. UNESCO reported the following:

> *Type "greatest leaders of all time" in your favourite search engine and you will probably see a list of the world's prominent male personalities. How many women do you count?*
>
> *An image search for "school girl" will most probably reveal a page filled with women and girls in all sorts of sexualised costumes. Surprisingly, if you type "school boy", results will mostly show ordinary young school boys. No men in sexualised costumes or very few….*
>
> *AI-systems deliver biased results. Search-engine technology is not neutral as it processes big data and prioritises results with the most clicks relying both on user preferences and location. Thus, a search engine can become an echo chamber that upholds biases of the real world and further entrenches these prejudices and stereotypes online[1].*

AI contributes to inequality, as reported by Philip Schellekens and David Skilling of the Center for Global Development:

> *While AI will, hopefully, boost macro-level productivity, it could widen income disparities within countries, benefiting highly skilled workers, displacing lower-skilled jobs in repetitive tasks, and concentrating wealth among those who control the technology. But the bigger, and far less explored, concern is the inequality AI could amplify between nations[2].*

Even within the same country, AI will further widen the digital divide, favoring the upper class over the lower class. It is currently predicted that AI will wipe out most entry-level jobs. In His Holiness Magnifica Humanitas, Christopher Lamb quoted Pope Leo XIV as saying

> *"We cannot consider AI to be morally neutral," the pope writes. "Every technical tool embodies choices and priorities through what it measures, ignores and optimizes, and how it classifies people and situations."*
>
> *Pope Leo ultimately prescribes the disarmament of AI, not as a means of "rejecting technology" but rather "preventing it from dominating humanity." That doctrine means "freeing technology from monopolistic control and opening it to discussion and debate, therefore making it human-friendly[3]."*

The world is finally beginning to recognize the astronomical financial costs of AI. Recently, CNN reported that some companies that jumped on the AI bandwagon are now rethinking the cost-benefit of their investments. The California State University system is facing strong backlash over its contract with OpenAI. CSU is reported to have agreed to pay $13 million annually for three years to cover subscriptions for its 460,000 students and 63,000 faculty members. This is said to follow a previous 18-month contract for $16.9 million[17]. CNN Business News observed that

> *The artificial intelligence industry has a big problem: 95% of companies that try AI aren't making any money from it, according to a **report** from the Massachusetts Institute of Technology last month. One AI executive believes he knows why. "There has been this general promise of, hey, you'll just plug in the (AI) model … and everything will work," Jason Droege, CEO of startup Scale AI, said in an interview. "The reality is a little bit different.[4]"*

StartupHub.ai noted that

> *The initial euphoria surrounding artificial intelligence is giving way to a more pragmatic assessment of costs, as major companies begin to reconsider their substantial investments in AI technologies. Recent reports indicate that firms are scrutinizing the expenditure associated with AI development and deployment, leading to a potential recalibration of strategies.[5]*

Environmental Harms

Of growing concern is the environmental impact of massive data centers springing up across the globe. This concern has reached the point that U.S. Presidential executive orders are needed to provide some regulation. Rina Diane Caballar observed that

> *AI relies on energy-intensive computations with a significant carbon footprint. Training algorithms on large datasets and running complex models require vast amounts of energy, contributing to increased carbon emissions. One study estimates that training a single natural language processing model emits over 600,000 pounds of carbon dioxide; nearly 5 times the average emissions of a car over its lifetime[6]*

Degenerative Neuro-Functions

Human beings have evolved for hundreds of thousands of years, developing both our physical and neurological functions to their current level. The gifts nature has given us over thousands of years can be lost through "use it or lose it" due to overreliance on technology. Therefore, the most important implications of AI are its potential to degrade human neurological functions. Cornelia C. Walther stated that

> *AI systems become more capable and ubiquitous, they risk eroding something fundamental to human experience — **our capacity for independent thought,** decision making and autonomous action. This process is called agency decay, and it operates much like muscle atrophy. When we stop exercising our cognitive muscles and avoid activities such as critical thinking, problem solving and creative reasoning, they weaken imperceptibly. Agency decay is a critical concern for business leaders who must navigate an increasingly automated landscape while maintaining human oversight and strategic direction.[7]*

Figure 6 illustrates the degenerative neurological effects ahead of mankind as AI generative capabilities grow in sophistication.

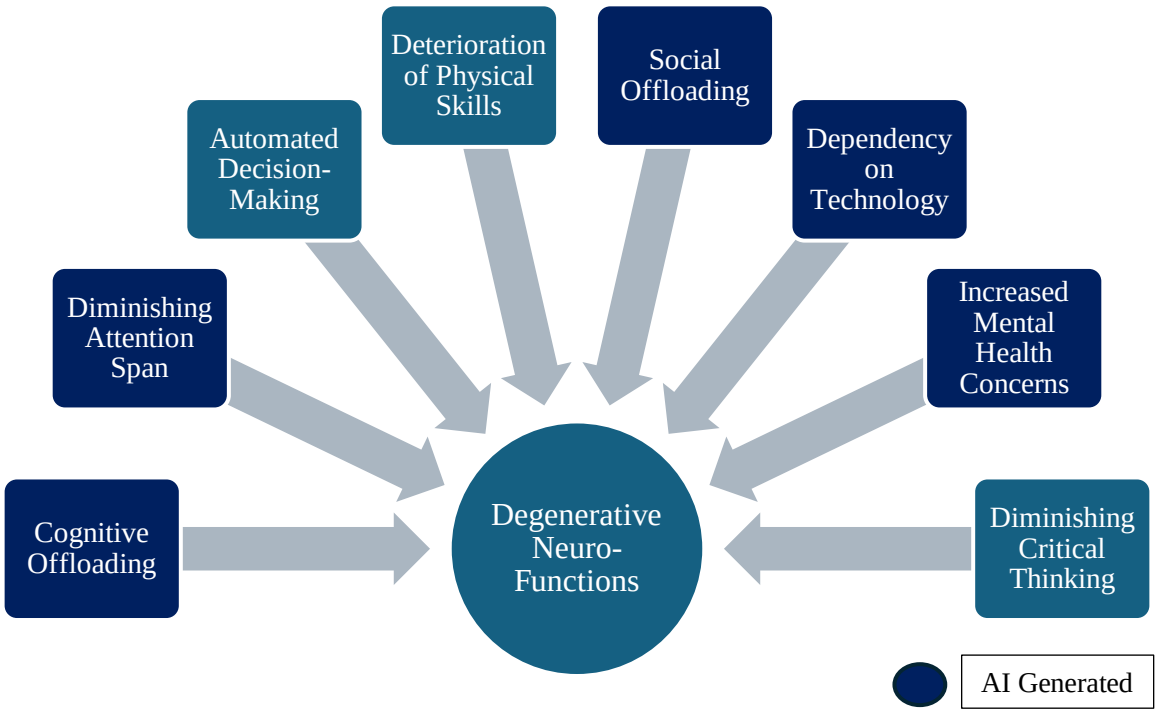

Figure 6: Generative AI Leading to Degenerative Neuro Functions

Cognitive Offloading

Alexandra B. Morrison and Lauren L. Richmond (2020) defined cognitive offloading as

> *…the act of reducing the mental processing requirements of a task through physical actions like writing down information or storing information on a cell phone or computer. Offloading can lead to improved performance on ongoing tasks with high cognitive demand, such as tasks where multiple pieces of information must be simultaneously maintained.*[8]

In Psychology Today, Sebastian Ocklenburg stated,

> *Cognitive offloading means that someone who uses AI to do a task is not as mentally engaged in the task as someone who completes it entirely on their own. While this may not matter much for the outcome of the task, cognitive offloading may be problematic when it comes to learning something new*[9].

Gone are the days when we kept meticulous calendar reminders, used calculators to crunch numbers, or took notes during lectures or meetings. There is an app for almost

every task that used to tax our brains and strengthen our cognition. Attractive as these apps may be, they reduce our mental effort, which cannot be good in the long run.

We now have apps that instantly translate into hundreds of languages, making learning foreign languages practically unnecessary. Yet few things enhance our brains more than learning foreign languages. Certainly, this cannot be good for human beings.

Diminishing Attention Span

> *According to research conducted by Dr. Gloria Mark at the University of California in 2004, she found that an individual's average attention span on a digital device was approximately 150 seconds long. However by the year 2012, that number had plummeted by half, to 75 seconds. Now, recent data from 2024 suggests that it has now reached a staggering low of 47 seconds. (Mark, 2023) Slowly, what will come next? Will it continue to divide and dissolve till nothing?*[10]

Emerging data show that technology, especially AI, affects attention span. The design of social media on digital devices increasingly favors rapid movements that do not promote sustained attention. The rapidity of content pushing is also known to be addictive.

Automated Decision-Making

> *The Consumer Privacy Protection Act (CPPA) [defines] "automated decision system" as, "any technology that assists or replaces the judgment of human decision-makers through the use of a rules-based system, regression analysis, predictive analytics, machine learning, deep learning, a neural network or other technique.*[11]"

The suspension of human judgment in decision-making may speed up decision-making, but its potential adverse effects on neurofunction should concern all.

Deteriorating Physical Skills

Artificial intelligence promotes sedentary behavior, the consequence of which could be skill atrophy. AI optimizes workflow automation, reducing hands-on and manual tasks. Eventually, automation leads to the deterioration of fine motor skills.

Social Offloading

The decline in social interaction skills attributed to AI is known as social offloading. Social offloading occurs as we increasingly rely on algorithms to manage interpersonal relations. As we rely on AI to manage conversations and filter out the natural emotional processing of interactions, we increasingly lose human connection and the ability to handle natural ambiguity.

Dr. Marlynn Wei observed that

> *… negotiating needs, dealing with conflict, and understanding the emotional state of another person, referred to as mentalization, are essential social skills when navigating human relationships. Building relationships in real life requires two-way emotional engagement, including disruption and repair. Becoming emotionally dependent on social AI agents at this point does not accurately mirror building a two-way emotional relationship with another human.*[12]

Increased Mental Health Issues

The link between chatbots such as OpenAI's ChatGPT and generative artificial intelligence and mental health is a growing concern among mental health professionals and an increasingly discussed topic in the media. While data on the residual effects of generative AI on mental health are still in the preliminary stages, the potential impacts warrant attention. Keith Robert Head noted that "*The intersection of technology anthropomorphization, parasocial relationships, and vulnerable mental health conditions creates unique clinical presentations that require specialized understanding and intervention approaches. The severity of this phenomenon became tragically apparent in February 2024 when 14-year-old Sewell Setzer III died by suicide following months of intensive interaction with Character.AI chatbots."*

Keith Robert Head concluded that

> *The rapid proliferation of AI and conversational AI chatbots has introduced unprecedented mental health challenges that mental health professionals are ill-equipped to address. This review reveals emerging patterns of psychological dependency, crisis incidents, and vulnerability exploitation that signal the emergence of technology-related psychological disorders requiring specialized clinical recognition and intervention approaches.*[13]

Over-Dependency on Technology

There is a positive side to technology dependence for individuals who require technology devices for health-related purposes. Hundreds of patients depend on devices such as pacemakers, Total Artificial Hearts (TAHs), and heart monitoring units to live a normal life. Such technology dependence is a positive development.

However, there is a downside to technology dependence. One example is nomophobia, defined as "the fear of being without a mobile device, or beyond mobile phone contact." Another consequence of overreliance on technology is impulsivity, the tendency to act without deep thought or consideration of consequences.

Diminishing Critical Thinking

There is a growing concern regarding the negative impact of artificial intelligence on critical thinking. According to Michael Scriven & Richard Paul,

> *Critical thinking is the intellectually disciplined process of actively and skillfully conceptualizing, applying, analyzing, synthesizing, and/or evaluating information gathered from, or generated by, observation, experience, reflection, reasoning, or communication, as a guide to belief and action. In its exemplary form, it is based on universal intellectual values that transcend subject matter divisions: clarity, accuracy, precision, consistency, relevance, sound evidence, good reasons, depth, breadth, and fairness.*[14]

Critical thinking is one of the most important outcomes of good education and a skill set required in all human endeavors. However, Matteo Wong noted that the advent of AI is critically eroding human capacity for critical thinking.

> *While AI enables rapid data analysis at an unprecedented speed and scale, overreliance on AI can erode an individual's critical thinking skills. In the higher education context, researchers have found that university students who use Large Language Models (LLMs) to complete writing and research tasks experienced reduced cognitive load but demonstrated poorer reasoning and argumentation skills compared to those students using traditional search methods. Another research study found that students using LLMs focused on a narrower set of ideas, resulting in more biased and superficial analyses. Critical thinking–characterized by evaluation of information, questioning of assumptions, and formation of independent judgments–remains a uniquely human skill that AI cannot fully replicate.*[15]

Recommendations

There seem to be four camps of people grappling with the advent of artificial intelligence: the protagonists who are pushing for all things AI and for everyone to learn and embrace it; the antagonists who are pushing against an over-technologized life; the "cautionarists" who are clamoring for a slowdown; and the majority who have no clue what the hype is all about. However, the potential impacts of AI on society are so significant that the Pope has issued his proclamation (Magnifica Humanitas) on the subject. The recommendations below are a few gleaned from commentators and prognosticators on AI:

1) According to CNN, His Holiness Leo XIV's Magnifica Humanitas calls for disarming artificial intelligence due to its overall negative impact on humanity. As stated by His Holiness, *"Artificial intelligence already touches many areas of our lives and affects decisions that shape human co-existence," he said. "I feel entrusted to look upon another huge transformation with eyes of faith, with*

lucidity of reason, with openness to mystery, and with cries of the poor and the earth resounding in my heart.[16]"

2) There are those who call for a slowdown in the rapid deployment and advancement of AI until we can fully understand its implications.

3) There are those who advise educational leaders not to listen to AI experts, but to listen to educators and psychologists who are experts in how humans learn.

4) Educators are also best advised to reexamine their educational philosophy to ensure AI adoption is in congruence with their values and vision.

5) Educators are further advised not to rush investment in AI. Educators should learn a lesson from businesses that rushed into investments and now regret the cost-benefit analysis of those investments.

6) Schools' adoption of AI should not be driven by the hope of budgetary benefits and a drive for efficiency. Rather, AI must promote what makes us more human.

7) Finally, the adoption of AI in schools should begin with teacher training. Schools of Education, where future teachers are trained, are the best places to start learning about and experimenting with AI.

This last point is particularly important because the ultimate benefit of instructional technology depends on teachers' training and experience. For this reason, Danubius International University established the School of Smart Education and Innovative Teachers as a departure from traditional teacher-training schools worldwide. The School aims to optimize the use of technology while minimizing the negative impacts. In short, the School aims to make AI a solution with minimal problems.

Conclusion

There is no doubt that AI is here to stay, and some will say that we are just at the beginning stages of its revolution. Based on what we know so far, it is reasonable to conclude that artificial intelligence is a solution, though it comes with myriad problems. With its ability to mimic human intelligence, AI is perhaps the most powerful invention of humankind to date.

Individual educators' predispositions toward AI adoption are shaped by assumptions about how students learn and the role of education. Those who favor faster, more efficient production are inclined to jump on the AI bandwagon, whereas those who view school as a nurturing place and teaching and learning as an intimate transaction and interaction between humans are likely to be wary of AI's potential impacts in education.

The benefits being touted by AI experts include its ability to individualize and personalize learning, provide faster feedback, and solve complex problems. These benefits come at a cost.

Beyond the financial cost, the loss of privacy, the diminishing human interaction, and the impact on the environment compel a serious evaluation of the cost-benefit of AI.

The most important impact that warrants collective attention is degenerative neuro-function, as mental and physical skills atrophy. As AI replaces mental effort, we must be concerned about cognitive offloading, social offloading, and nomophobia, to name a few.

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