Preparing Students to Augment Artificial Intelligence Rather than to be Replaced by Machine Learning

By Ashley Etemadi and Chris Dede

Digital tools and artificial intelligence are changing how we teach and how our students learn. From computers, intelligent tutoring systems, AI chatbots (software applications used to simulate human-like chat conversations online), and question-answering digital teaching assistants to personalized learning programs using machine learning (a branch of artificial intelligence that allows software applications to become more accurate at predicting outcomes without being explicitly programmed to do so[1]) to adapt to each student's current performance, artificial intelligence (AI) is bringing about a new age of teaching and learning from pre-K through workforce training.

But AI is not only impacting the process of teaching and learning; machine learning (ML) in the workplace is also changing what capabilities educators should cultivate and what students need to learn for their future occupation. In this article of the Next Level Learning series, we outline some ways in which AI is changing how we think about learning and working, and we discuss implications and strategies for instruction and assessment.

The age of "intelligence augmentation"

In 2020, the World Economic Forum predicted that by 2025 85 million jobs will be displaced in 26 countries, with some skills and occupational areas impacted more than others.[2] At the same time, 97 million jobs are forecast to emerge from new capabilities based on the changing division of labor between humans and machines.[3] According to the McKinsey Global Institute report published earlier this year, the Covid-19 pandemic will accelerate these trends, as two-thirds of business executives say they plan to increase automation and AI investment in the coming years.[4] With advancing machines and changing jobs, what will future work and life look like for our students?

The science fiction series *Star Trek: The Next Generation* painted an apt image of how humans can complement AI in mutual job performance, through the interactions it depicts between a person (Captain Picard) and a life-sized android utilizing ML (Data). Through their interactions, Captain Picard's judgment, decision-making, and conscious deliberation were enhanced by the reckoning, computation, and calculation power of his colleague Data. As a hypothetical illustration:

> *Data:* Captain, we should surrender to the Klingon ship, which is about to fire warp torpedoes that have a 97% chance of destroying the Enterprise. Unfortunately, our repairs to resist this will take 4 hours and 18 minutes.
>
> *Picard*: Mr. Worf (a Klingon who is the ship's Security Officer), pretend to the enemy that you are leading an internal mutiny to capture the Enterprise and turn it over to them unharmed, as an asset for their fleet. That bluff will buy us some time.
>
> *Data*: But Captain, Mr. Worf is loyal, and you are making counter-factual statements to the Klingons?!

Picard: Exactly.

The two complemented each other so that the synergistic combination of Picard's judgment and Data's reckoning yielded greater decision-making outcomes than the sum of their individual contributions. We term this complementary relationship "intelligence augmentation" (IA).

From what the twenty-first century has shown us thus far, our relationship with machines bears a closer resemblance to intelligence augmentation—an interweaving of human judgment with machine reckoning— than to large-scale human replacement. Much like how the word processor enhanced human efficiency, productivity and capabilities, we see AI as holding the potential to augment human abilities—to an even greater extent than past innovations.

As an illustration, for a role such as restaurant management, machines might analyze customer profiles, keep appropriate inventories, and organize financial statements. In turn, humans will be left in a position to work with the machines, leveraging the algorithmic outputs to propose action plans, connect more deeply with customers, and develop menus closely aligned to the community's changing wishes—making judgment-based decisions that further the restaurant's goals.

To support students in this new age, we cannot simply teach them the skills that AI has already mastered; that all but guarantees that our students will be replaced by machines. Instead, we need to target capacities that are uniquely human and cannot be easily replicated by machines. For IA to be realized, students and workers must develop their capacity for judgment as AI takes over reckoning.

The division of labor between machine and human

Technology is advancing at unprecedented rates. Over the last 50 years, we have observed the introduction of the internet, computers, cell phones, cloning, autonomous vehicles, virtual assistants, and automation in just about every industry. The next half-century will see heightened innovation and disruption with globalization, threats to sustainability, climate change, and technologies such as artificial intelligence and data mining.

Forecasts indicate that many of the tasks and activities humans assume in the current workforce will transfer to machines, and eventually the percentage of total task hours performed by machines for many tasks will outweigh that performed by humans.[5] Humans will work fewer hours if they are deskilled[6] as machines take over some tasks, but not if people upskill to complement what machines are doing.

Though most occupations will be affected to some degree by advancements in AI, few, if any, will have their human tasks completely eradicated by it.[7] Instead, a significant redesign of the task content within occupations will occur to reflect the changing distribution of work between humans and their machine counterparts. Whether this redesign will deskill or upskill the human role will depend on what knowledge and skills we develop in our educational system.

A reason why most occupations will not see a complete eradication of their tasks due to AI is that ML is skilled at "reckoning" while humans excel in judgment.[8] Reckoning refers to calculative prediction, process-oriented cognition, and formulaic decision-making—areas where computers and AI/machine learning systems already excel. These include tasks such as conducting a trends analysis, measuring a metal bar in construction or welding, or estimating the life expectancy of a particular cancer patient, given their characteristics and available treatments.

In contrast, judgment is a form of deliberative thought that seeks to be unbiased, grounded in ethical commitment, and contextually appropriate when deployed. Examples of judgment include understanding the next steps for staffing a business given the results of a trends analysis for demand, and helping a cancer patient choose treatment options as they weigh the quality of life and life expectancy.

Performance in many occupations and positions is becoming a complementary relationship between reckoning and judgment.[9] Throughout history, people have had to do both--but now machines have the computational power to do reckoning at a level of speed, accuracy, and scale unattainable by humans. Humans then can utilize this machine-backed reckoning, along with other variables AI cannot factor, to formulate better decisions than they could make unaided.

For instance, AI designed to support the work of teachers might use metrics like how much time students spent on an activity, the number of questions they answered correctly, and the number of attempts in order to evaluate whether particular students need additional instruction in a topic; AI would provide a recommendation to the teacher. The educator then assesses the validity of this suggestion using a host of data points (e.g., students' levels of engagement overall, personality, performance in adjacent subjects, well-being) and decides how to best craft additional, engaging instruction for the student.

It is important to note that, while many lists classify judgment and decision-making skills as soft skills, our conceptualization of these abilities puts them in a separate category. Soft skills are a multitude of social, emotional, attitudinal, and communication skills that influence person-to-person interactions. These encompass skills such as communication, teamwork, negotiation, and empathy. Judgment and decision-making leverage information gathered from an individual's soft skills (e.g., assessing the shifting emotional tone of a meeting, identifying tacit goals and priorities underlying a negotiation, empathizing with the values of another individual) and combine these with the interpretation of larger contextual factors and potentially AI-based reckoning (e.g., predictions, reports, trends analyses) to determine a course of action. As laid out in the definitions, these concepts are connected—with soft skills serving as inputs into judgment and decision making.

Day-by-day, machine learning is inexorably advancing further. If we are to equip students—the next generation—with the skills to complement AI, where do we start and what do we need to do as educators? What does judgment look like? What does it encapsulate? How can it be taught and learned? And how do we empower our students with the requisite skills and dispositions for intelligence augmentation?

Cultivating the human side

Different models of judgment, or what some call "human intelligence," exist. They vary in how many dimensions they include, what these dimensions cover, and the terminology they use to describe the models' elements, but overall, they align on the most fundamental grounds. Here are some of the main aspects of these models related to capabilities unique to human beings that machine-based systems would not be able to emulate:[10]

- *Humans have bodily-based experiences.* Because we interact with and react to our physical surroundings, human intelligence is different from the architecture of artificial intelligence. Even robots with life-like bodies cannot engage with and respond to the environment and social settings in important ways that we can. Humans have individual perceptions, emotions, and motivations that dictate how we conduct ourselves. Our actions are often driven by embodied, contextual, experiential, and meaning-laden knowledge rather than simply observational and scientific knowledge.
- *Humans can be reflective/metacognitive.* We have the capability to consciously monitor, interpret, and regulate our own mental thinking. When we fail to understand something, we can have the awareness to identify a gap, ask questions to build the necessary understanding, and assess whether the responses adequately fill that gap. Research shows that metacognitive skills can be learned and homed in humans. Machines, on the other hand, have no consciousness; they cannot reflect on their design or functions, despite being able to "learn" from patterns in large data sets.
- *Humans are molded by and embedded in culture(s).* Our development and life experiences are guided in large part by culture. Culture is a set of practices groups have developed and shaped—including tools they use, social networks they engage in, and ways they think about and operate in the world—in order to achieve the objectives they value.[11] An integrated, holistic assessment of context, attitude, tone of voice, connotation, body language, character, and much more is used to interpret and construct meaning. AI does not have the capacity, and will not, in the near future to develop this sensitivity because it cannot experience culture in the multidimensional and connected ways that we can. It is difficult for AI to differentiate between the subtleties and nuances of human expression, such as sarcasm, irony, or humor. For us, holding a flexible view of culture and simultaneously entertaining multiple differing paradigms of cultural knowing, as well as recognizing when particular cultural assumptions apply to an expression, is routine—whereas for current versions of AI this would be impossible.
- *Humans have subjective values and points of view.* The experiences we go through are co-constructed with those around us and processed from a first-person point of view. They are colored by consciousness and identity—we factor perceptions, interests, drives, values, and social interactions into our daily dealings. AI will not be able to display a conscious perspective that incorporates moral implications and that shifts to varying degrees dependent on the personal identities at play. Moreover, morality, an area we oftentimes consider black-and-white, in practice, is socially constructed.[12] So, an AI built

to reflect the values of one community or one individual might miss the mark entirely with another one.

These human capabilities are highly interconnected. Our bodily-based experiences, within the cultures and contexts in which we reside and interact, give us our initial values and opinions. How deeply we understand and question these beliefs through metacognitive exercises contributes to the trajectory these points of view and our identities take over time. This all works vice versa as well. Identities and concepts of morality we hold on to dearly will impact our bodies' reactions to certain stimuli and our decisions to process these experiences.

For us to properly complement machines, we need more than just to possess these human capabilities. We must know how and when to leverage them to our advantage. One of the ways that we think about the nature of intelligence at the Next Level Lab includes: "the disposition to reason, plan, solve problems, think abstractly, comprehend complex ideas, learn quickly and learn from experience."[13]

Note that the conception of intelligence being used here is performance-based and aligned with current research on intelligent behavior—what we can do with our intelligence is more important than simply what abilities we hold in our heads.[14] It is framed as dispositional in that one's ability is only part of what contributes to intelligent behavior; sensitivity to the occasion to deploy capacities, calibration of the intensity of the disposition to the context, and the inclination necessary to follow through are also required for intelligence to be expressed in ways that support effective work performance.[15]

The importance of dispositions was especially apparent in the pandemic: Contrasting two workers with equivalent knowledge and skills, one may be confused and inefficient given the disruption of remote work and shifting tasks, the other worker may be empowered and creative, due to greater resilience, initiative, and agility.

The disconnect in our classrooms

Despite the rise in demand for judgment skills, most current education systems and curricula continue to tackle and hone reckoning abilities. A focus on information and pattern recognition means that students graduating from our classrooms are equipped to essentially carry out the same tasks as their machine counterparts, though less efficiently and possibly less accurately.

In math classes, students memorize equations, practice applying the equations in new problems, and then complete assessments that evaluate how well they understand the equation and its applications. They long divide 1,295,403 by 15 despite access to calculators and cell phones with calculator applications. Even though tools exist that can outperform humans in these computational tasks, our mathematics curriculum still predominantly revolves around these abilities.

Coursework outside of STEM also often operates this way. Our history curricula stresses information that is easily searchable on Google—dates, events, people, quotes, and locations. Students learn about major battles and decision makers in the Seven Years' War but don't learn how those decisions were made, what information was available, how the respective values and priorities of the times played a part, and what implications those historical events have in the present day or the future—things that a computer would not be able to comprehend.

If we stay on this path of teaching skills that machines are quickly automating, our students will run into difficulties finding meaningful employment in a few decades. Moreover, the high-stakes tests we use to measure whether our students are succeeding center on reckoning, not judgment.[16] This new age calls for a focused effort on building upon students' truly human capabilities and cultivating the dispositions for using these capabilities when the situation calls for them.

Preparing students for intelligence augmentation

Adjusting our curriculum and assessments in a way that fully supports students towards a future in which they will be partnering with machines will require a significant systemic transformation. That said, as educators, we can start designing and implementing changes in our own classrooms and lesson plans that will help prepare students for AI. The following adjustments might serve as a launching off point:

- Incorporating metacognitive exercises so that students can reflect their own thinking and learning and identify potential areas of interest for further exploration
- Fostering a classroom culture that encourages students to understand their interests, motivations, and contexts and to examine the relation of these drivers, their personal identity, thoughts, and beliefs with the unit material
- Exploring and elevating moral and ethical considerations through case studies and group discussion
- Encouraging students to hold a flexible notion of culture and to identify when an expression fits with the features of certain cultural assumptions
- Providing students with opportunities to connect with their emotions and those of their peers

To learn more about supporting the cultural, emotional, and metacognitive aspects of a learner, we recommend referring to earlier articles in this series, specifically "In A World In Flux, Next Level Learning Is Critical. But What Is It, And Why Does It Matter So Much?" and "Leveraging Students' Emotions To Generate Intrinsic Motivation," which offer practical tips for weaving these strategies into educational contexts.

Next Level Learning champions the creation of powerful experiences that position learners to deal with and succeed in the current and future challenges brought about by a complex, changing world. Given increasing advancements in AI, machine learning, and automation, we should be doubling down on cultivating learners' judgment skills so they can complement machines rather than compete with them. Let's not discount the abilities that make humans unique! Even Star Trek's Data acknowledged the uniqueness that comes with being human—"I am superior, sir, in many ways, but I would gladly give it up to be human."

[1] Burns, E. (2021, March 30). *Machine Learning*. SearchEnterpriseAI. https://searchenterpriseai.techtarget.com/definition/machine-learning-ML
[2] Kande, M., & Sonmez, M. (2020, October 26). *Don't fear AI. The tech will lead to long-term job growth.* World Economic Forum. https://www.weforum.org/agenda/2020/10/dont-fear-ai-it-will-lead-to-long-term-job-growth/
[3] Kande & Sonmez, 2020.
[4] Lund, S., Madgavkar, A., Manyika, J., Smit, S., Ellingrud, K., Meaney, M., & Robinson, O. (2021, February). *The future of work after COVID-19*. McKinsey Global Institute. https://www.mckinsey.com/featured-insights/future-of-work/the-future-of-work-after-covid-19
[5] Cann, O. (2018, September 17). Machines Will Do More Tasks Than Humans by 2025 but Robot Revolution Will Still Create 58 Million Net New Jobs in Next Five Years. World Economic Forum. https://www.weforum.org/press/2018/09/machines-will-do-more-tasks-than-humans-by-2025-but-robot-revolution-will-still-create-58-million-net-new-jobs-in-next-five-years/

[6] To deskill is to make the skills of a person obsolete, and to upskill means to learn additional skills.
[7] Brynjolfsson, E., Mitchell, T., & Rock, D. (2018). What Can Machines Learn and What Does It Mean for Occupations and the Economy? *AEA Papers and Proceedings*, *108*, 43–47. https://doi.org/10.1257/pandp.20181019

[8] Cantwell Smith, B. (2019). Chapter 10: Reckoning and Judgment. In the Promise of Artificial Intelligence: Reckoning and Judgment (pp. 105–113). The MIT Press.

[9] An analysis of US job data from 1960-2000 and 2007-2019 periods and unearthed a rising importance in decision-making skills, especially in the latter period. The changes, interestingly enough, were not limited to certain occupations or managerial positions; instead, a variety of occupations *and* roles were experiencing greater demand for these skills. The author postulates that this trend stems from machines capturing the physical, mechanical, and information processing tasks (reckoning), meanwhile leaving the open-ended, contextual decision-making tasks (judgment) to humans.

Deming, D. J. (2021). The Growing Importance of Decision-Making on the Job. Harvard University and NBER.

Current observation suggests that the pandemic has intensified this shift to a wide variety of roles requiring decision-making (distributed leadership) rather than the command-and-control authority disrupted by rapid, unexpected pivots in the nature and location of work.

[10] Two example models are Gulick's Three Types of Knowing and Luckin's seven elements of interwoven intelligence.

Gulick, W. B. (2020). Machine and person: Reconstructing Harry Collins's categories. AI & SOCIETY, 1–12. https://doi.org/10.1007/s00146-020-01046-3

Luckin, R. (2018). *Machine Learning and Human Intelligence: The Future of Education for the 21st Century*. UCL Institute of Education Press.

[11] Nasir, N., Rosebery, A., Warren, B., & Lee, C. (2014). Learning as a Cultural Process: Achieving Equity through Diversity. In R. Sawyer (Ed.), *The Cambridge Handbook of the Learning Sciences* (pp. 686–706). Cambridge University Press. https://doi.org/10.1017/CBO9781139519526.041

[12] Killen, M., & Dahl, A. (2018). Moral judgment: Reflective, interactive, spontaneous, challenging, and always evolving. In K. Gray & J. Graham (Eds.), *Atlas of moral psychology* (pp. 20–30). The Guilford Press.

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Gottfredson, L. S. (1994, Tuesday, December 3). Mainstream science on intelligence. Wall Street Journal.

Gottfredson, L. S. (1997). Mainstream science on intelligence: An editorial with 52 signatories, history, and bibliography. Intelligence, 24, 13-23.

[14] Grotzer, T.A. & Perkins, D.N. (2000). Teaching intelligence: A performance conception. In R.A. Sternberg (Ed.), Handbook of intelligence, New York: Cambridge University Press.

[15] Tishman, S., Perkins, D., Ritchhart, R., Donis, K., & Andrade, A. (2000) Intelligence in the wild: A dispositional view of intellectual traits. Educational Psychology Review 12(3), 269-293.

[16] Luckin, 2018.