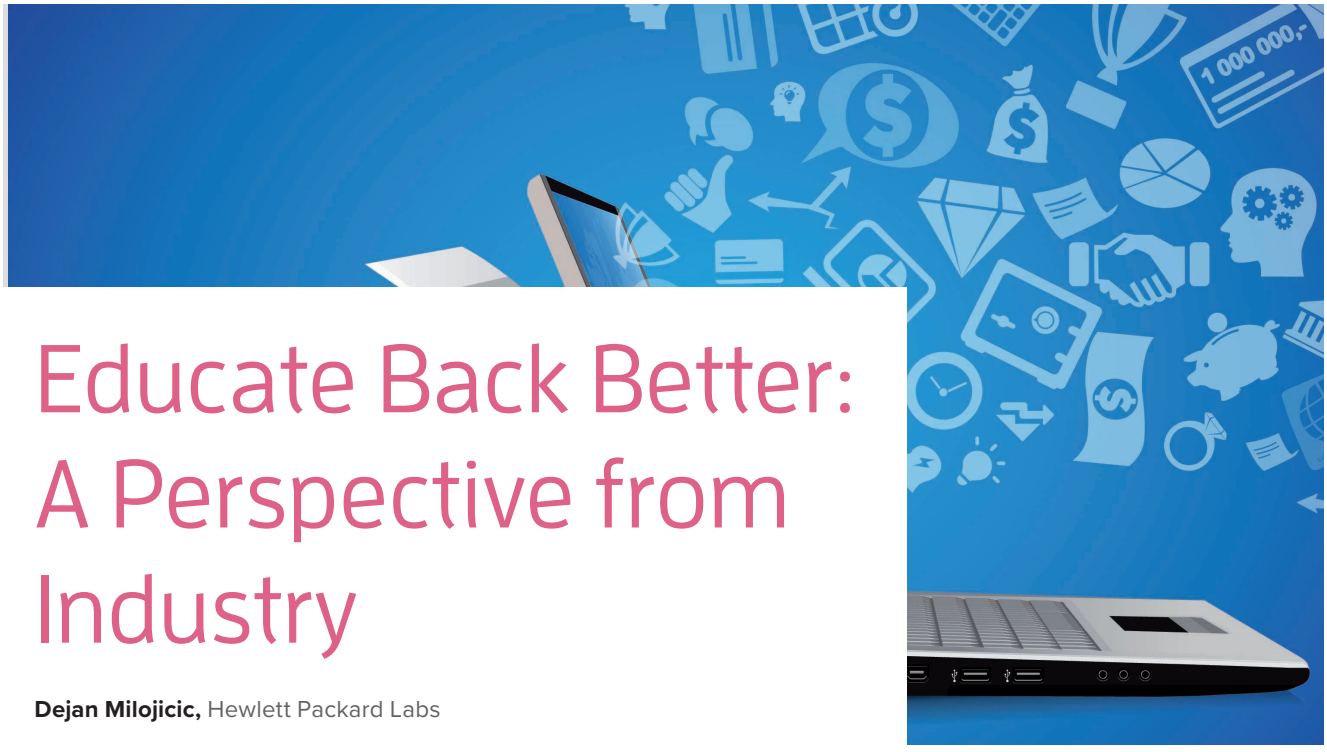

Educate Back Better: A Perspective from Industry

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COVID-19 has accelerated and scaled out remote education beyond our wildest imagination. How can we retain benefits, eliminate downsides, and build education better for the long-term future?

COVID-19 has had a detrimental impact on human existence. It dramatically affected the way we live, work, and get educated. COVID-19 has also necessitated acceleration in the development of vaccines, hospitalization, remote work, supply chains, and numerous other areas. The reverberations of COVID-19 have caused tectonic shifts in industry and consequently in the ways that individuals from industry are educated. Similarly, whole education systems, from kindergarten through university, have had to quickly switch to remote teaching.

Education had already started changing prior to the COVID-19 pandemic, from partnerships among industry and academia around industry instructors for select courses (mostly at flagship universities), to industry funding curricula (e.g., what IBM has been doing in the New York area or Hewlett Packard Enterprise in Silicon Valley and Houston), many online programs, to recent hiring policies that do not require any academic credentials. COVID-19 accelerated some of this and made it obvious that it can happen at a completely different scale than what was thought before. The challenge will be to prevent technology-facilitated education from creating an even greater gap in education for those with less access to technology.

Many industry verticals in the developed world were fortunate in that the technologies and infrastructure required for their employees to work remotely already existed. This enabled the shifts to happen very quickly and business disruptions to be kept to a minimum. However, adopting tools for in-person study to remote education are only the tip of the iceberg. The problems caused by lack of necessary Internet infrastructure run deep from sub-Saharan Africa to the poor population in Latin America as well as parts of sparsely populated regions of Australia, Canada, and Russia.[1] Going up the stack, school educators have not been retrained, curricula have not been adjusted for remote education, the critical topics for new times are

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completely nonexistent, and the whole system is inadequate for the needs of the future workforce.

"Build Back Better" is a strategy and movement to better prepare us for future disasters, pandemics, and dramatic changes to the way humanity lives today. COVID-19 has exposed all these problems and emphasized them. Solutions require thinking outside of the box to find new solutions to an old but now magnified problem. We need not only patch up our education system but also prepare it for many years to come and for other possible catastrophic scenarios.

HOW HAS THE LANDSCAPE CHANGED?

The world has become increasingly more interconnected, as labor can now be hired from anywhere in the world and the types of jobs have also changed to enable this.[2] Similarly, education can be obtained remotely. How does this affect education and students? In the past, schools were primarily educating students for the local labor market and "traditional jobs" for which the demand is dwindling and may soon exceed supply. Now suddenly there are no more limits on where graduating students can be hired. Similarly, competition is no longer just local schools but any remote school in the world.

New science and technology advances are dramatic, and they have radically outpaced existing curricula in most countries. Revising curricula is not trivial, and the only way out is through close work with local governments to subsidize the education system and leverage industry to support schools. Education is no longer only a matter of schools but now has become deeply intertwined with the education system as a whole. Governments and industry are ever more influencing or supporting education, and this is further influenced by societal, economic, and environment factors (see Figure 1).

Tools nowadays enable anybody to work remotely. There are still jobs that require physical presence, but many that traditionally required physical presence are evolving. Zoom, Teams, Skype, WebEx, Google Meet, and many other tools for collaboration enable secure remote meetings. A plethora of other tools enable virtual boards and document exchanges, and the workforce can still rely on the traditional Microsoft and Google suites of tools. Finally, many tools exist for teaching remotely and conducting tests, lab experiments, exams, grading, and much more, just as if you were in an in-person class. What was earlier an exception at best today is a common approach.[3]

INDUSTRY NEEDS

Most of the people who exit schools go on to work in industry (e.g., see examples and classification for the United States[4]); therefore, it is most important to understand the nature of demand (industry) to best prepare supply (schools). Industry has not always been served sufficiently well by schools, triggering corporations and even whole nations to deal with it in different ways. At the same time, industry hasn't engaged academia as openly as it should have. A more positive symbiotic relationship is needed.

In Germany, for example, vocational schools were very successful in preparing students for their ultimate occupation. However, the way it was traditionally done wouldn't be economically feasible in areas of low population density. Leveraging remote learning technologies might make it generally feasible. Large corporations establish their own training programs to prepare new employees for the specific job they will be pursuing. Professionals are used to learn by doing, but

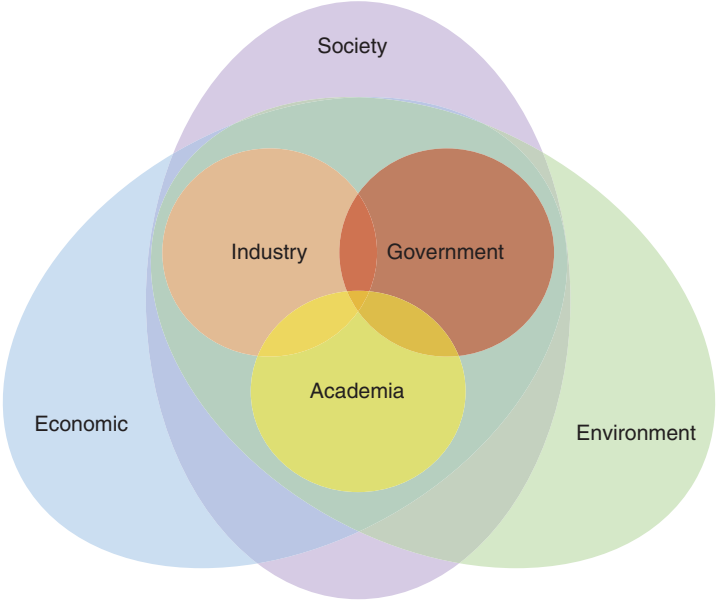

FIGURE 1. Education is ever more so deeply intertwined with industry and legislature (governments), and all three are motivated by economic, societal, and environmental factors. Economic factors are often the ones used to base decisions on, particularly if there are hard costs involved. Societal factors include diversity, equity, and inclusion; reverse migration from cities to rural areas; globalization of the workforce; and so on. Environmental factors are likely to play a bigger role in the future, given global concerns about climate change, hunger, space travel and space pollution, and so on.

as technology becomes more and more complex, months and sometimes years are wasted until a well-performing employee can start to contribute fully. Focused education, complementing experiential experience, can go a long way.

WHAT IS NEEDED?

What does industry need from new employees, from schools, legislatures, and from professional organizations like the IEEE Computer Society?

Industry would prefer a new employee who is already equipped to start working quickly, one who also has sufficiently broad knowledge to adjust as market and industry needs shift quicker than ever before. Students need to be well versed in the tools that are used in the workforce and able to contribute both remotely and in in-person work-place scenarios. New employees should be proactive in learning new skills and be aware of how to achieve them. Industry would also like quicker ways of establishing that recent graduates have the necessary skills. Recruiting/interviewing tends to be a heavyweight process for jobs that require special skills. The hiring process also needs improvements in terms of diversity.

Industry could benefit substantially from schools that can teach new and current employees updated skills, such as how to predict new trends in artificial intelligence, machine learning, and ethics. Education should be with purpose, for specific broad domains of knowledge, supplemented by special vertical courses, potentially delivered with the help of industry. A healthy exchange of visiting professors to industry and teaching professionals can help to cross these boundaries.

Industry prefers elastic scaling of the workforce, growing it as the business works well and shrinking it at times of lower business demand or changes in focus. It is not trivial to grow teams in new areas, hence the need for reeducation for repurposing the existing workforce. Governments could facilitate more effective programs and curricula for a future elastic workforce.

Industry expects that professional societies such as the IEEE Computer Society can continue to support and educate its members in the lifelong learning process. This could be achieved through publications and events that have more practical and immediate value to employee training rather than academic papers.

EDUCATION OF THE FUTURE

Given the changing educational landscape and ever-evolving industry needs, what should future education look like?

While remote education was evolving even before COVID-19, the pandemic has proven change possible on a global scale. Even postpandemic, education will retain a substantial amount of online teaching, deferring to in person only for courses that require deep interaction, such as innovation, design, and troubleshooting.

Education will organically move away from entirely independent systems and become integrated into a global ecosystem that respects the needs of individual local regions. Education will continue to maintain a holistic, broad approach, just enough to provide a sufficient base, but the rest will be with purpose to fulfill the needs of emerging industry verticals, markets, and new technologies.

Part of this broad knowledge will come from home schooling and self-education, but the focus will be on the use and application of knowledge. "Educating by doing" will increase in importance, especially complemented with practical assignment projects and internships, which all have been proven possible remotely even if not desired (interns like to travel to new sites).

Synergy between highly successful schools and industry in some unique areas such as Stanford in Silicon Valley, Santa Clara University, and San José State University will continue, but this will become more global. For example, schools will start satisfying the needs beyond immediate geographical proximity, serving the entrepreneurial community globally. Similarly, some professors and students may continue to work remotely.

Diversity, equity, and inclusion (DEI) will be at the core of all educational activities. Behavior will not be confined only to the walls of one room and go unnoticed. Recordings of unacceptable statements during lectures have raised DEI awareness and reduced tolerance for any unacceptable behavior. Statistics of diversity participation in schools has enabled industry to hire underrepresented minorities much more easily, but there is still future progress to be made in that direction.

LITMUS TEST FOR AN IDEAL HIRE

I am both a technologist and a manager, and I frequently hire new employees and, even more so, interview candidates. The best litmus test of my whole theory behind "Educate Back Better" is proved via the "eat your own dog food" model. My own ideal new hire

- has both broad and deep skills in at least one new area (see Figure 2), as evidenced by prior results
- has the ability to learn quickly, as evidenced by learning in a variety of areas and via multiple internships
- can adapt to new needs of the company and the market, as evidenced by evolving his/her own technical agenda during education or prior work

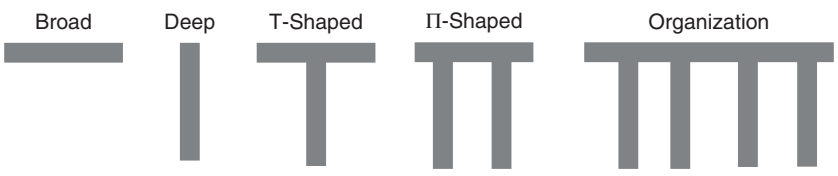

FIGURE 2. The shapes represent people with broad knowledge versus those with deep knowledge. People who have both deep and broad knowledge are rare (T-shaped) and those with two areas of depth (Π-shaped) are even more rare. However, an organization has the ability to build teams with a portfolio of technology areas that meet its needs.

- fits well with the culture and social styles of the organization, as evidenced by extracurricular activities
- fulfills self-purpose while working in the company, not just to do the job, and matches the higher goals and purpose that organization has, as evidenced by the opening statement of his/her résumé
- approaches work with a healthy dose of excitement and fun not just as a job, usually evidenced in the interview, remote or in person
- understands international and cultural differences and fully respects DEI, as evidenced by shared values.

In summary, education, just like work, and the workforce are undergoing substantial changes due to COVID-19. A large number of these changes will continue even after the pandemic is over. Education will be assisted more by industry and governments, weaving into a global ecosystem. New graduates should be much more prepared for awaiting jobs, but the traditional hiring criteria of doing the job well will be enhanced by DEI, broader purpose, and the common good. All of this will be increasingly more practiced in a connected world.

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