FUELING INDIA’S SKILL (R)EVOLUTION
Harnessing the power of technology to bridge the growing skills gap
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India is a country of young minds. Half the population is under the age of 25 and two-thirds are less than 35. By 2027, the country will have the world’s largest workforce, with 1 billion people aged between 15 and 64 years.\textsuperscript{1} While this demographic dividend promises immense opportunities, it brings its own set of challenges.

The biggest challenge facing the economy today is equipping the youth with adequate, relevant, job-ready skills. Only about 4.7 percent of the total workforce in India has undergone formal skill training (see figure 1).\textsuperscript{2}

Employability of graduates is another area of concern. Every year, more than 3 million graduates and post-graduates enter the Indian workforce, according to NASSCOM. However, of these, only 25 percent of technical graduates and 10–15 percent of other graduates are considered employable by the rapidly growing IT and ITES segments in the country.\textsuperscript{3}

The Indian education and training system has been long reeling under inadequate infrastructure and resource availability, outdated curriculum and misalignment with industry needs. There is also a significant divergence in opportunities and infrastructure between urban and rural India.
The National Skill Development Corporation (NSDC) has estimated an incremental requirement of 8.6 million teachers and trainers in rural areas by 2022.4

A committee appointed by the Ministry of Skill Development and Entrepreneurship identified several shortcomings in India’s skilling ecosystem.5

<table>
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<tr>
<th>Absence of nation-wide vocational education and training standards</th>
<th>Lack of an integrated on-site apprenticeship training</th>
<th>Inadequate industry interface</th>
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<td>Insufficient financing</td>
<td>Limited training capacity</td>
<td>Poor quality outcomes</td>
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<td>Shortage of qualified trainers</td>
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In addition, rapid technological advancements and innovations are reimagining the way businesses operate. An exciting new generation of tools and resources are altering the nature of work, making reskilling and upskilling the workforce the need of the hour. As roles and tasks change, new skills will increase in importance.

Accenture analysis reveals that for almost every single role, a combination of complex reasoning, creativity, socio-emotional intelligence and sensory perception skills is increasingly relevant. It’s a finding that raises a daunting challenge: today’s education and training systems are ill-equipped to build these skills.6
The stakes are high—not only for India but also globally. If skill-building does not catch up with the rate of technological progress, the G20 economies risk losing up to US$11.5 trillion in potential cumulative GDP growth over the next 10 years.

That’s equivalent to losing more than one entire percentage point from the average annual growth rate every year over that period. The impact will differ by country and by industry, depending on how labor is distributed across different roles. India, for example, could forgo up to 2.3 percentage points from its annual growth rate and this could be as much as US$1.97 trillion over 2018–28. Beyond the economic impact, the risk includes higher rates of unemployment and intensified income inequality (see figure 2).

Figure 2: The potential cost of the skills crisis

Note: *The scenario assumes investments in intelligent technologies per worker in each country reach current US investment levels in traditional technologies per worker.

Source: Reinventing the Learning Experience, Accenture, 2018
A LOT OF GROUND TO COVER

The Indian government has about 40 skill development programs implemented by more than 18 different departments targeted at the country’s large workforce of around 500 million and new entrants each year.

The National Skill Development Mission launched by the government in 2015 seeks to consolidate and coordinate skilling efforts and expedite decision making across sectors. It provides a framework for implementation, offering state governments a clear action plan for achieving skilling targets. The Mission hopes to provide the institutional capacity to train a minimum of 300 million people by 2022.8

NSDC, working with the various Skill Sector Councils, has estimated the training need across sectors in India. The top 10 sectors account for more than 80 percent of the total estimated workforce requiring training (see figure 3).

Figure 3. India’s training requirement by sector

Estimated training need (top 10 sectors, 2017-22, million)

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<tr>
<th>Sector</th>
<th>Estimated Need (2017-22, Million)</th>
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<tbody>
<tr>
<td>Construction</td>
<td>32.00</td>
</tr>
<tr>
<td>Retail</td>
<td>10.70</td>
</tr>
<tr>
<td>Beauty &amp; Wellness</td>
<td>8.20</td>
</tr>
<tr>
<td>Road Transport &amp; Highways</td>
<td>6.22</td>
</tr>
<tr>
<td>Textile Handloom and Handicraft</td>
<td>6.00</td>
</tr>
<tr>
<td>Electronics</td>
<td>5.30</td>
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<tr>
<td>Furniture &amp; Fittings</td>
<td>5.26</td>
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<tr>
<td>Tourism &amp; Hospitality</td>
<td>4.90</td>
</tr>
<tr>
<td>Logistics</td>
<td>4.29</td>
</tr>
<tr>
<td>Automotive, Auto Components &amp; Capital Goods</td>
<td>4.10</td>
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</table>

Source: National Skill Development Corporation
TAPPING INTELLIGENT TECHNOLOGIES TO ENABLE SKILLING AT SCALE

Addressing India’s skilling challenges calls for an innovative approach, aided with intelligent technologies, to help people develop future skills. Traditional skilling methods may prove to be inadequate, given the changing nature of work and the requirement of new skills. The large number of people who need to be skilled, as well as institutional gaps, calls for radical changes in how programs are developed and delivered. Incremental changes to education and corporate learning systems will not be sufficient. There is a need to identify individuals who are most in need of skills training and help them learn quickly.

Technology can enable rapid reskilling and upskilling at scale. It can not only help people learn new skills quickly and efficiently, but also cost-effectively. Intelligent technologies and tools can provide personalized learning experiences, addressing the unique needs of learners at different life stages.

To assess the potential of technology tools in skill development at scale, Accenture mapped an individual’s learning journey. We looked at every stage of the learning journey, identified challenges and assessed the application of intelligent technologies to overcome those challenges. Adopting a learning journey-based approach helps meet the needs of a diverse multi-generational workforce. Preferences around learning setting (time and location) and pace vary widely, and technology allows for such personalization.

We developed a “New Skilling” framework (see figure 4) to enable more than 160,000 Accenture employees to be conversant in New IT skills and more than 100,000 to be job ready in less than two years. The framework guides our ambition based on a progression of skills from awareness to expert, while relying on a suite of innovative learning methods grounded in neuroscience research.

Using this framework as a foundation, let’s look at each stage of the learning journey and see how technology interventions can help overcome challenges and enable skill development that is personalized, continuous and accelerated.
Figure 4. New Skilling Framework

TECHNOLOGY ADDS VALUE AT EACH STEP OF THE LEARNING JOURNEY

<table>
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<th>POTENTIAL TECHNOLOGY APPLICATIONS</th>
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<tr>
<td>• Digital learning platforms</td>
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<td>• AI for content curation</td>
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<th>AWARENESS</th>
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<tr>
<td>Build awareness of new skills needed to make the pivot</td>
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<th>CONVERSANT</th>
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<tr>
<td>Assess skills, using analytics, to customize learning based on individual needs</td>
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<tr>
<td>• AI-based adaptive learning to build specific learning pathways</td>
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<th>JOB READY</th>
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<tr>
<td>Foster job shadowing and test job readiness</td>
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<td>• AR/VR for simulations and immersive job training</td>
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<th>EXPERT</th>
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<td>Monitor individuals and help them navigate the change as they build expertise</td>
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<tr>
<td>• Blockchain-based micro credentials for lifelong learning</td>
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| MIT’s Media Lab has developed Blockcerts, an open standard for blockchain certificates, that can be used for academic, professional and workforce credentialing. |

| Arizona State University has an adaptive learning platform built by Knewton as their tutor for introductory courses rather than the more familiar teaching assistant. |

| Honeywell has developed a cloud-based simulation tool that uses a combination of AR and VR to train plant personnel on critical industrial work activities. |

Source: Accenture Research
AWARENESS

Build awareness of new skills

Individuals are not always aware of the new skills they need to develop to remain relevant or advance in their careers. Many have limited insights into how automation and technological advancements are changing the nature of their work. Those who are aware of the skills they need to acquire find it challenging to identify the appropriate medium and course, given the multitude of learning options available.

In a 2017 Accenture survey, Indian business leaders and workers agreed that difficulty in identifying learning opportunities prevent them from developing new skills.

Another reason cited by survey respondents for not being able to address the skills gap was the lack of clarity on what they need to learn.9

Intelligent technologies and digital platforms can go a long way in helping tackle these challenges. They can help learners make an informed decision that is relevant to their interests, experience and life stage. By analyzing the available data on individual learning, social contexts, personal interests and life stage, organizations can assess the skills an employee lacks. They can start conversations that lead to change and encourage the employee to take ownership of his or her learning. If people can see their progress, they can set goals and reflect on themselves and acquire the skills they need to succeed.

The use of AI is a natural progression from the current paper-based interest mapping and assessment for those entering the workforce. Technology not only enables scale but also augments human intelligence to offer a more accurate and comprehensive evaluation of the learners’ requirements.

TalentBoost Academy, a Dutch talent development company, uses artificial intelligence (AI) to offer personalized learning to individuals and track their progress. The solution looks at motivation, personality and learning data to see if a person is suitable for a job.10

Skillsoft, a global educational technology company, has implemented an intelligent online learning platform, Percipio, that provides access to curated content and an immersive learning experience. The platform leverages engaging content that is curated for more than 500 learning paths and is updated continuously.11
Digital technology also helps democratize learning. About 900 experts curate Accenture’s 3,000 Pinterest-like digital learning boards, giving 459,000 employees access to more than 300 content categories. The topics range from technical skills such as blockchain to soft skills such as coaching. Accenture employees have completed more than 42 million learning activities via the digital boards since their inception in 2016.
Create an individualized learning program

Once the learner identifies the right course and learning medium, the content and delivery need customization to the individual’s needs. Adaptive learning makes this possible. **Powered by AI, adaptive learning not only creates customized content for different learners but also tracks their performance in real time and modifies the teaching methods based on the data.** When a learner encounters a difficulty during the course, he or she can be directed to additional resources, while those who grasp quickly can be fast-tracked.

New digital learning platforms that incorporate adaptive learning characteristics are being launched to expand the scope and reach of skill development opportunities.

The Government of India, for example, has initiated development of a national platform called SWAYAM (Study Webs of Active-Learning for Young Aspiring Minds), built on the lines of a massive open online course (MOOC). The platform will host 2,000 courses and 80,000 hours of learning, covering school, undergraduate, post-graduate, engineering, law and other professional courses. The University Grants Commission, a statutory organization established by an Act of Parliament in 1956 for the coordination, determination and maintenance of standards of university education, has advised Indian universities to identify courses where credits are transferred onto the academic record of the students for courses done on SWAYAM. The platform seeks to bridge the digital divide and bring on board students who have not been able to join the digital economy.¹⁴

According to Area9 Learning, which specializes in adaptive learning, 70 percent of the training content in the United States is forgotten within 24 hours. The company uses AI to understand what the learner is doing and adapts the lessons and activities in response, suggesting additional drills to improve mastery of a specific skill, for example. Area9 believes its adaptive learning system not only enhances knowledge retention but also cuts training time by 50 percent.¹³

NASSCOM, the trade association of Indian IT Business Process Management industry, has launched Future Skills, an online platform that offers courses in emerging technologies. It has an ambitious goal to train 2 million seasoned IT professionals and 2 million younger workers and recent graduates. The courses cover AI, virtual reality, robotic process automation, Internet of Things, big data analytics, 3D printing, cloud computing and social and mobile apps.¹⁵
Foster job readiness

Mismatch between university curriculum and industry requirements is a crucial reason for the shortage of talent across industries. With rapid changes in technologies, the shelf-life of skills is reducing, causing acute workforce challenges. It is in this area that technology can make a big difference.

Digital learning platforms, simulators and augmented reality/virtual reality (AR/VR) can be used to recreate work environments and get people ready for the job in a faster and more economical way. While some AR/VR tools may prove to be too expensive to scale, alternatives such as the Google Cardboard, which provide an immersive experience affordably, can be considered.16

Digital learning methods can provide realistic simulations to help workers master new manual tasks so that they can work with smart machinery. These technologies can help reinforce correct procedures on the shop floor—monitoring how employees execute tasks and coaching them to do it the best way possible.

Apart from developing technical skills, AR/VR technologies are just as effective for soft skills training.

ThyssenKrupp, a German conglomerate, is overcoming skills mismatch through AI. The industrial services giant equips its elevator technicians to consult subject matter experts through Microsoft HoloLens, an AR headset.

At Walmart, US employees are being trained at the retailer’s training academies using Oculus Rift VR headsets, enabling trainees to experience and practice responding to real-world scenarios. Consider a spill in aisle three of a store with the instructor and trainee peer group able to provide performance feedback as they watch remotely through the employees’ eyes. Walmart has now rolled out the program to all 200 academies, following the success of the pilot.

The US Navy teaches a wide range of cognitive and non-cognitive skills to its young officers. Working with the University of Southern California, the US Navy prepares its junior leaders with interpersonal and social skills training before they are given positions of responsibility, in or out of combat. The Immersive Naval Officer Training System (INOTS) involves VR and classroom response technology. It offers a safe space in which officers can learn to handle not just technical issues, but the interpersonal skills required to handle sensitive or challenging situations. INOTS has trained more than 15,000 sailors since 2012.17
Skillveri, an Indian startup, offers low-income youth advanced manufacturing skill training through high-quality simulators. The company has built a “made in India” simulator, which is among the most affordable of such products in the market. Their simulators offer students an interactive learning environment and inbuilt formative assessments and testing tools that enable understanding of performance at a granular level for continuous improvement.

Industrial conglomerate Honeywell’s advanced training solution combines mixed reality with data analytics to create an interactive environment for on-the-job training. The cloud-based simulation tool uses a combination of AR and VR to help train plant personnel in critical industrial work activities. The tool helps bring new industrial workers up to speed quickly by enhancing training and delivering it in new ways. The approach has led to improvements in skill retention by as much as 100 percent and a reduction in training duration by 150 percent.

A 2015 study at the University of Chicago used brain scans to show that hands-on learning activates sensory and motor-related areas of the brain. Students who learned this way—experiencing a science concept by doing experiments, for example—understood more and scored better in tests.

Also, the US National Training Laboratory found that retention rates for training through VR are 75 percent—far above the 10 percent for reading-based learning and the 5 percent for lecture-style learning.

As part of a strategic transformation of its global finance workforce, Imperial Brands sought to build stronger commercial and partnering skills across its finance function: a new solution that would be easily accessible and consistent worldwide. Accenture Academy worked with the British tobacco company’s learning leaders to define specific curriculum paths and the solution was configured to reflect branding, learning path and user-experience requirements. The upshot: more relevant and agile online learning that has become embedded in the company’s culture. Rather than waiting for face-to-face training opportunities, employees can now learn at any time.
Enable lifelong learning

In the digital economy, work is not restricted to one employer, job or team. People need to learn new skills to remain relevant continually. **Lifelong learning has become essential to retain expertise in a field.** Digital learning platforms make learning available to everyone based on their convenience. However, challenges such as completion, assessment and credentialing need to be addressed. The current average completion rate for MOOCs is only about 15 percent.23

Including elements of gamification and social learning can help improve completion rates for courses. Social learning is essential to support lifelong learning. It is no longer sufficient to concentrate on traditional classroom teaching when the culture and habits of the target audience have changed.

Besides, blockchain can improve the transparency and efficiency of systems that support education and lifelong learning. For example, blockchain can be used to issue fraud-proof certificates that all employers will be able to accept, even across borders. Blockchain also offers significant opportunities for transparent education funding models, a particularly attractive application for countries where systems suffer from inefficiencies and corruption.

**General Electric Company (GE), a global digital industrial company, uses AR to boost manufacturing productivity and efficiency.** The use of an AR headset providing line-of-sight instructions by a technician wiring a wind turbine’s control helped improve performance by 34 percent on the first use.24 Also at GE Healthcare’s laboratory in Wisconsin, the United States, they are piloting the use of an Xbox and a connected Kinect motion tracker to bring AR into the factory and enable workers to be more efficient.25

**Media Lab and Learning Machine at the Massachusetts Institute of Technology (MIT) have launched Blockcerts—an open source and open standard to secure credentials on blockchain.** For example, an educational institution like MIT can cryptographically sign a credential and place it on blockchain, then another person (say, an employer) can use the Blockcerts app to verify that the credential is valid.26
The Indian government plans to launch its first blockchain project issuing tamper-proof degree certificates for students graduating in 2019. The project is based on a blockchain solution called IndiaChain that the government-run think tank NITI Aayog is building. Pilot trials are running with the first set of universities and will be extended to other educational organizations in 2019.27

Spain-based startup Tutellus uses blockchain-based tokens so that both teachers and students can earn from learning experiences. Teachers receive a share of the fee students pay as well as a number of tokens, depending on how much time students invest in their courses. Students can earn tokens which can be traded outside the platform by helping other students or for passing exams.28

The Open University of the United Kingdom is experimenting with “open badges” as credentials. These are focused on soft skills and are earned in a peer-to-peer way: the peers a person works with during assignments can give him or her credentials for the soft skills that he or she applied during teamwork. The University’s Knowledge Management Institute (KMI) is using Ethereum, an open-source public blockchain, for accreditation to turn badges into smart contracts and has developed a prototype for assembling and issuing micro-credentials. The university—with more than 170,000 students, its own MOOC platform (FutureLearn) and a core Open Learn platform—has provided KMI with the opportunity to badge all courses and notarize these on blockchain.29

The Government of Malta launched a blockchain-based pilot project for its educational system recently. It seeks to empower Maltese citizens to own their credentials as part of the workforce which is increasingly mobile, international and self-developing.30
HARNESSING THE TECHNOLOGY ADVANTAGE

A successful training and upskilling ecosystem should meet the diverse and context-specific learning needs of people of all ages at all education and digital literacy levels. For a skilling ecosystem struggling with inadequate training capacity and a lack of qualified trainers, the move toward a more collaborative effort making the best use of intelligent technologies is the best way forward. Here are four actions that stakeholders, including government departments, industry bodies, non-profit organizations and corporates, in India need to initiate to ensure the creation of an adequately skilled workforce.

1. Foster multi-stakeholder partnerships
2. Unleash blended learning models
3. Start at the source
4. Customize to the local context

1. Foster multi-stakeholder partnerships

Public-private partnerships have been tried in the skill development area before. However, it would be worth expanding the scope to include all stakeholders and using digital as the glue to connect them. Digital platforms can connect the complex stakeholder system so that employers, education providers, start-ups and other public authorities can work together to address skills demand, create jobs and tackle other challenges job seekers might face. Once a country establishes a system that “connects the dots” of the education and employment ecosystem, tremendous opportunities emerge to make learning and job seeking more dynamic and interactive.

The need of the hour is to bring together the currently fragmented ecosystem. A central body must have access to and ownership of all relevant data so that public and private actors in the system can track skills, work preferences, work history and other related circumstances. Analytics can play a role in this ecosystem by determining what kind of learning activities and labor market interventions will have the most significant effect and assess them continually. From public-private partnership experiences, it is vital to have the right incentive structure (outcome-based rather than enrollment-based) in place for skill delivery partners. Transparency and accountability are essential in the skill grants management process, and government agencies should consider the use of blockchain and related technologies to enable this.
Accenture recently piloted a blockchain-based application with a government agency in South East Asia to allow a more transparent and user-friendly grant management process. The application helped minimize exposure to fraudulent claims, avoid duplicate grant disbursements and enable real-time reporting of grant progress.
2. Unleash blended learning models

The low completion rates among MOOC enrollees across the world is indicative of the limitations of an online-only learning channel. Several platforms are now working to offer more blended courses that incorporate in-person study groups and tutoring sessions into online learning to provide more personalized attention and a human touch to the MOOC experience.

Furthermore, blended formats can create the optimal mix of in-person, dynamic interactions and intellectual activity, facilitated by technology. The success of blended learning models such as the one used by Quest Alliance and Accenture reinforce the case for using technology and online platforms as one among many delivery channels (refer to the Quest Alliance-Accenture case study). Blended learning creates a better learning environment that enables learners to be more engaged, which is essential for learning retention and course completion.

3. Start at the source

Familiarity with advanced technology and tools is possible by promoting their use in the education sector. Governments are piloting the use of tech-enabled tools in schools and colleges.

Organizations also need to join in this effort. In addition to “new skilling” efforts to upgrade the skills of employees, organizations must redouble efforts to address the skills gap at the source—in the education system. They must also collaborate with industry groups that are working with the education system and on their own to improve the talent pipeline.

Organizations must step up their engagement with the education system and government agencies, including universities, community colleges and nondegree programs, to affect change in the academic agenda at the source, and not just in engineering programs. Joint efforts by companies in various industries are also critical. Employers should define common skill requirements and actively communicate them to local educational institutions.

The French Ministry of National Education has included AR as a recommended technology for use in middle school technology courses.31

The Ministry of Education in the United States Emirates (UAE) is piloting the use of VR headsets in schools to explore worlds and scenarios that are too dangerous or difficult to experience in real life. The pilot is run in 17 schools across the country.32
4. Customize to the local context

Technology is often presented as a magic pill to solve skilling as well as other social challenges. There is, however, the need to review the applicability of a particular technology solution in the context of the local environment. Some attributes that are crucial to the assessment of any technology solution are:

- **Cost-effectiveness**
  
  Cost is often a critical limiting factor in the adoption of new technology. While a solution may be the most effective to address a skilling challenge, the cost of acquiring and implementing it at scale needs to be appropriate to the region or organization. For example, customizing Raspberry Pi to replace the desktop server model.

- **Offline accessibility**
  
  Technology solutions should preferably blend in with the physical environment to ensure broader access and adoption in areas where infrastructure and network connectivity is inadequate or expensive. This approach is even more important in rural areas in India where the lack of power and internet impacts access to learning content without an offline option.

- **Mobile-first**
  
  The solution needs to be compatible across devices and platforms to ensure all segments of the population have access to it. Mobile versions are essential in a country like India where most people own a mobile while the penetration of PCs is low.

- **Language**
  
  India is a diverse country because of the many languages spoken. Any skilling platform or solution should provide multi-lingual options to ensure greater adoption and derive benefits of scale.

- **Open source and interoperability**
  
  The use of open source software, publicly available code and datasets not only leads to greater adoption but also helps build an ecosystem of developers and solution providers. For example, the Government of India’s Digital India initiative encourages the use of open source software because of the various inherent advantages such as increasing interoperability, developing local capacity, reducing costs, achieving vendor independence, enabling localization and reducing piracy infringements.
Quest Alliance is a non-profit trust working to bridge the education and skills divide by enabling self-learning for young people between 10 and 35 years. Quest invests significantly in education technology solutions for youth and facilitators, giving them the on-demand learning that is imperative for a changing and dynamic world.

After extensive interactions with different stakeholders to understand the gaps and challenges confronting youth, vocational training institutions and employers across India, Quest Alliance developed and pilot-tested a comprehensive classroom-led training curriculum for trainers and students.

With Accenture’s support, Quest Alliance sought to build a blended learning model (see figure 5) that combines digital learning tools with a traditional classroom model. The program meant developing, piloting and implementing a technology-led version of the same curriculum, for CD-based learning, internet-enabled learning, and even mobile-based simulations and games.

By its very nature, the program aims to provide a greater unit impact than conventional vocational training programs that tend to focus on providing skills in a specific domain that will fetch the candidate an immediate job.

Quest required a low-cost server to share digital learning lessons in computer labs at partner sites. For this, they customized a Raspberry Pi to replace the desktop server model. Quest then customized the Raspbian OS with its offline web application to deliver digital lessons. It also experimented with Raspberry Pi and an Arduino board for introducing Electronics and programming in school using MIT Scratch software.

While the human element keeps the personal touch alive, the use of interactive technology enables the learner to find his or her path to successful learning, to interact with others and with the system, and to stay engaged with the learning process at every step personally.
The Skills to Succeed (S2S) project creates a technology-enabled blended learning environment that helps youth gain skills, confidence and knowledge to succeed in the workplace and beyond.

In a country like India where the cost of the program is a critical factor influencing feasibility, the S2S project is very cost effective. Since its inception in 2015, the program has reached more than 80,000 individuals across the country in a cost-effective manner. The target would have been near impossible via a traditional approach. One big misconception about tech-based learning is that adoption would be slow in a country like India, especially in remote locations. The truth is quite the opposite.

One of the main attractions of the S2S project is its use of technology, which can be used appropriately to train multiple types of skills. S2S itself has four different components, all of which have been designed to incorporate a blend of technology and human touch. Hence, the nature of skills imparted does not constrain the use of technology; it only requires fresh and innovative thinking.
Transforming India’s skilling challenge into an opportunity will require the committed participation of all stakeholders. Companies need to partner with the government to advance the use of intelligent technologies to ensure that those entering the workforce and those already employed have the relevant skills to succeed in the digital economy. With the maturing of intelligent technologies such as AI and blockchain, there will be newer opportunities for their application in the skilling space.

For India not to be left behind in the race for new technology use and implementation, it is imperative for the government to support research and development efforts. The effort will involve fund allocation and incentivize the mainstreaming of niche technologies. The government can play the role of a bridge-maker in bringing together ecosystem partners and addressing skilling challenges unique to the Indian context.

For companies, the skilling agenda is now core to business operations and not just part of their corporate social responsibility. Companies will have to upskill their employees base rapidly to remain competitive and respond to the changing market conditions.

Learning is in many ways a personal choice, and it is incumbent on each individual to take ownership and make it a lifelong pursuit. Technology will continue to be a key enabler in this journey.
APPENDIX

RESEARCH APPROACH

To identify the intelligent technologies that have the greatest potential in skill development, we studied analysts’ reports as well as venture capital investments in the education technology space. The key technologies we selected are:

**Digital platforms**
Dynamic digital learning content (such as adaptive, gamified/games-based and social) is better at leveraging the unique capabilities of the digital format to improve efficiency and effectiveness of training than the more popularly adopted static learning content.

The power of online courses in reaching learners at no or low costs has created breakthroughs in access to digital learning content. MOOCs have improved the scalability and reach of adult learning courses through the advent of dedicated learning platforms such as Coursera, Udacity and edX.

**Artificial intelligence**
AI-based tools can be used to assess skills, curate content, create personalized learning pathways and automate more routine course-management and assessment tasks. Intelligent virtual assistants can cost-effectively ensure scale and free up trainers’ time for other more important tasks.

**Adaptive learning**
Adaptive learning leverages advanced technology to deliver personalized learning at scale. The ability to create program content that is not only customized for each learner but also adaptive to that learner’s performance is a key advantage and distinguishing factor digital learning has over traditional classroom learning.

Adaptive learning also provides a large amount of data to program operators and instructors—data on the content areas learners generally find difficult versus easy to grasp. This functionality enables targeted future content modifications for the more problematic areas to make the material more effective. It also provides a way for blended learning programs to understand which content areas to focus on in the in-person part of the programs to maximize learner comprehension.
AR/VR

VR and AR technologies can provide realistic simulations to help workers master new manual tasks so they can work with smart machinery. Organizations are incorporating AR/VR in their training solutions, especially in the context of building soft skills, as the technology provides an immersive platform. It targets emotional processing centers in the brain and helps the learner understand at a visceral level what it is like to be in a position of weakness and to be the direct target of harassment, prejudice or bias.

Blockchain

Blockchain is a new way of storing data in a distributed ledger that allows multiple stakeholders to confidently and securely share access to the same information. The blockchain technology provides new infrastructure to build the next innovative applications beyond cryptocurrencies, driving profound, positive changes across business, communities, and society.

In the skilling ecosystem, blockchain can be used to award qualifications, licensing and accreditation, manage student records and intellectual property, and make payments.
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