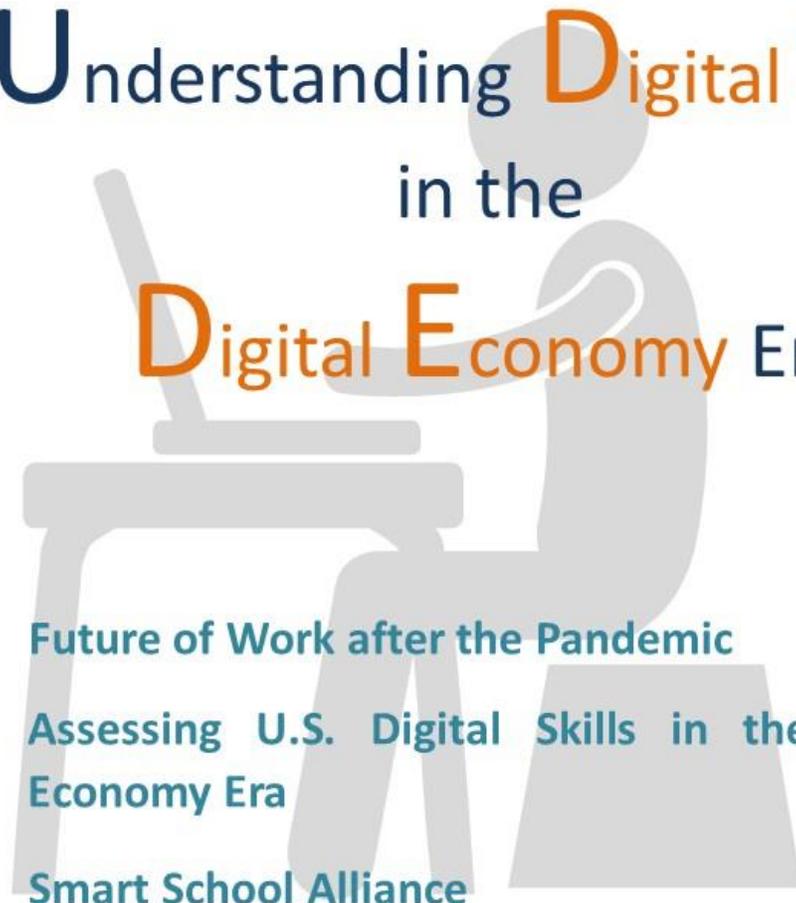


Understanding Digital Skills in the Digital Economy Era



-  Future of Work after the Pandemic
-  Assessing U.S. Digital Skills in the Digital Economy Era
-  Smart School Alliance

*Published by
Chinese Taipei Pacific Economic
Cooperation Committee (CTPECC)
December 2021*

CTPECC Digital Economy Project

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1. Introduction

Project Objective

The 2020 APEC Economic Leaders' Declaration has called for enhancing inclusive economic participation through digital economy and technology. As people is an important element of the digital economy, it can be surmised that some people may not be able to benefit from the advancement of the digital economy. In light of the importance for APEC to advance an inclusive digital economy, the CTPECC digital economy project is examining the most important element and that is digital skills. In the digital economy, workers must attain digital skills, so as to be productive. Specifically, the project begins to conduct studies of PECC economies in terms of understanding their digital skills development and the generation of recommendations for enhancing digital skills.

Project Description

The project seeks to comprehend the present situation with the development of digital skills in the Asia-Pacific region through the generation of reports from experts. In addition, the project seeks to generate recommendations for strengthening digital skills. As APEC has recognized the importance of promoting inclusive economic participation through the digital economy, the project conforms to PECC principles and values in that the project is promoting economic cooperation and the Pacific Community idea. The recommendations from the project on advancing digital skills will provide the starting point for further discussion on how to implement the recommendations, so as to strengthen economic cooperation among APEC and PECC members.

In addition, the project is of regional significance, since the APEC Economic Leaders have stated in their 2020 Declaration that it is important to promote inclusive economic participation through digital economy. Most importantly, the people is crucial for the digital economy and the enhancement of their digital skills will be necessary to build an inclusive digital economy. Furthermore, the people will continue to be the workers in the firms of the digital economy, so that businesses will be delighted to have workers with the digital skills. The project's analysis of the digital skills' development and the policy recommendations will provide businesses with the knowledge to adjust to the digital economic trends. Moreover, the experts for developing the studies will be experts from research institutions and business. Furthermore, the experts have gathered together to present at one of the sessions of CTPECC's 2021 Pacific Economic Community Seminar. In the Seminar, participants have come from academia, government and business. As a result, the various studies and the policy recommendations can be further discussed and the importance of advancing digital skills will be disseminated. The possibility of developing more studies will be examined.

Summary

Report: Future of Work after the Pandemic

Cindy Chen, Regional Head of Adecco Group Taiwan & South Korea

In this report, Adecco Group, the largest international provider of human resource services has conducted a survey on “working method before- and after-pandemic.” The objective of the survey is to examine how the COVID-19 pandemic is viewed by corporate employees in Asia, and how their ways of working has changed since then.

With regard to hybrid working, the report has stated that many people believe that the hybrid working format will lead to opportunities for a more diverse and inclusive workforce. People with disabilities, working parents and people from different geographic regions could benefit from the new way of working. There is also the possibility of working remotely for companies in different regions which has not been in their options before the pandemic. In addition, the report has mentioned that there exists the need to enhance upskilling, coaching, resources and technology, so as to manage teams and to increase and nurture motivation. A strong team morale and culture is a priority for businesses in the new hybrid working model.

Furthermore, managers in the future need to attain different skills and characters than managers now. Companies are expected to invest in technology to facilitate better digital ways of working and to increase the focus of wellbeing of staffs. Workers need to see and feel opportunity. They have become more autonomous, agile, adaptable, and proactive. Workers have been getting new skills. They are ready for change, and they are looking for more agency, career development, mobility opportunities or upskilling and reskilling.

Recommendations:

- It is important for companies to consider a hybrid working model that strikes the right balance between office and remote for all their employees.
- Companies must build a culture of trust and re-invent planning and collaboration for a new era of flexible work.
- There is certainly more room for improvement in supporting employee physical and mental wellbeing across sectors.
- Companies must support the new breed of leaders who will be best placed to address major threats to company cohesion. Equipping leaders with upskilling, coaching, resources and technology that will help them to better listen to and manage their teams, increase and nurture motivation.
- In addition to IT and digital infrastructures, security, agency, culture, wellbeing, and development are the most important to workers going forward. Companies need to prioritize them to keep workers engaged.

Report: Assessing U.S. Digital Skills in the Digital Economy Era

Stephen Ezell, Vice President of Global Innovation Policy, Information Technology & Innovation Foundation

The purpose of this report is to examine the digital skills situation in the U.S. economy, assessing what they are, why they matter, the current extent of workforce digitalization, and how the United States performs in international digital skills comparisons. This report also provides an overview of some of the best practices and programs being introduced by nonprofit, academic, and corporate organizations to deepen the U.S. digital skills base and suggests policy recommendations to further foster U.S. digital skills development.

This report recommends that the United States double the Number of STEM Charter Schools. It further calls for increasing the federal investment in workforce training and reskilling programs. Another suggestion is about expanding Section 127 tax benefits for employer-provided tuition assistance. In addition, this report suggests the establishment of a knowledge tax credit to allow firms to take a tax credit for expenditures on R&D and workforce training.

In conclusion, this report states that a facility with digital skills becomes ever-more imperative for individuals wishing to make productive, value-adding contributions in their occupations. The broader quality of a workforce's digital skills base becomes a key determinant of enterprises' and industries' competitiveness and innovation capacity. Therefore, a broad range of stakeholders—from individuals themselves to education systems across the K-12, community college, and university levels to businesses and nonprofits to government agencies—play important roles in developing a society's digital skills.

Recommendations:

- Doubling the number of STEM high schools would allow more students with a passion and deep ability to excel in computer sciences. Efforts should be made to ensure that all existing STEM-focused high schools provide a deep and rigorous curriculum in computer science.
- There exists the need to increase federal investment in workforce training and reskilling programs. Such “active labor market policies” refer to government initiatives to help unemployed workers effectively transition back into the job market.
- The government could expand Section 127 Tax Benefits for Employer-Provided Tuition Assistance. Section 127 of the federal tax code allows employers to provide employees up to \$5,250 per year in tuition assistance. Congress has not increased the eligible amount since 1996 and should increase Section 127 to at least \$8,700.
- The government could establish a knowledge tax credit that would allow firms to take a tax credit for expenditures on both R&D and workforce training.

Report: Smart School Alliance

Jose Cheng, Director of International Cooperation, Institute for Information Industry

This report is about the work of Chinese Taipei's "Smart School Alliance." In 2013, the Institute for Information Industry (III) established the "Smart School Alliance" (SSA) project and has continued to implement this program. Through live distance learning and collaborative learning, III has integrated the technology and education solutions of smart learning providers and introduced learning resources to small schools in remote areas. The SSA breaks regional restrictions, makes learning free from borders, and gives equal rights to practical education.

The global outbreak of COVID-19 in 2020 has driven "online learning" from only an option or assist of our education environment to an irreversible new norm of education and learning. In addition, "cross boundary talents" has also become an important direction of education and cultivation in the post-epidemic era. In the face of a changing and unpredictable world, there exists the need for more flexible and adaptive education models and methods.

It is also mentioned in this report that the future of education will shift to "learner-centered" personalized learning. And in the big data analysis, artificial intelligence (AI) and other digital technology, students can not only learn in accordance with their own level, pace, interest, the content and progress of learning, the teaching system can also be based on student preferences, pushing students interested in learning topics to improve learning motivation. Technology cannot replace teachers, but it can increase innovation in education. Finally, this report has related that the secret to success in education is no longer just to impart a lot of knowledge, but to encourage students to discover their own dreams and passions in learning, and then to support them to become independent learners by setting their own learning goals.

Recommendations:

- It is important to reduce educational inequality through the use of science and technology. It is not only a trend, but also necessary for future learning to acquire the way of live distance learning mode or adapt to online courses.
- Online education could be further advanced, as it gives teachers the opportunity to analyze data to determine what students are good at, what subjects they prefer, what topics they are particularly interested in, and what stage of learning they are at, so that they can design differentiated teaching methods and move one step closer to the vision of teaching to the individual.
- There is the need to explore the shift to "learner-centered" personalized learning. In big data analysis, artificial intelligence (AI) and other digital technology, students can not only learn in accordance with their own level, pace, interest, the content and progress of learning, the teaching system can also be based on student preferences.
- It is suggested that the secret to success in education is no longer just to impart a lot of knowledge, but to encourage students to discover their own dreams and passions in learning, and then to support them to become independent learners by setting their own learning goals, designing experiments, identifying problems and finding solutions.

2. Report: Future of Work after the Pandemic

Cindy Chen, Regional Head of Adecco Group Taiwan & S. Korea

Overview

The impact of the COVID-19 pandemic is significant in every corner of the world. International trades came to a standstill, business froze their personnel budgets, economy went into recession and unemployment skyrocketed. The influence did not only exist in economy, the global workforce and how organizations work together have also been affected by the pandemic as well.

The pandemic has not yet come to an end. Meanwhile, many businesses worldwide are beginning to adopt changes and have developed new ways of working in offices. Many believe that a new and optimized organizational structure will ensure their market position in the fast-changing post-pandemic era.

The Adecco Group, the largest international provider of human resource services, conducted a survey on “working method before- and after-pandemic,” which included 1,495 corporate workers across nine economies in Asia (including China; Hong Kong, China; India; Republic of Korea; Malaysia; Singapore; Chinese Taipei; Thailand; and Viet Nam) in 2020. The aim of the survey is to explore how the COVID pandemic was viewed by corporate employees in Asia, and how their ways of working has changed since then.

Overall Situation in Asia

The COVID pandemic has resulted in many businesses introducing working-from-home/remote working in the last two years. At the starting point, the policy was intended to reduce contact between employees within the organization, the implementation of such a policy and the support of corporate technical resources increased corporate workers’ familiarity with remote working and desire for the flexibility of managing their own work as well.

Only about 18% of Asian corporate workers wanted to spend all their work time in the office. At the same time, about 34% of Asian corporate workers believe that workers would spend all their work time in the office once the pandemic has passed.

Most Asian corporate workers prefer “blended working” as the new norm. They want to be able to work-from-home or remotely partially and in the office in the rest of the time. Such an arrangement would give employees more flexibility and control over their working time.

81% of Asian corporate workers indicated that increasing work flexibility through a combination of physical offices and work-from-home benefited not only the employees, but also the businesses.

Before the pandemic, as an example, only 35% of Asian corporate workers felt that they were able to balance their work and private life. This number rose to 58% during the pandemic. At the same time, only 4% of Asian corporate workers felt that there was a decrease in work-life balance during the pandemic.

Furthermore, working schedules are not limited to the standard 9-to-6 window anymore. To organize own working hours has become the new norm. Before the pandemic, about 45% of Asian corporate workers indicated that their working hours were completely dictated by their employers. This number dropped to 32% during the pandemic. In other words, nearly 70% of Asian corporate workers have owned the ability to adjust their own working hours for their own needs.

When asked about what Asian employees expect from an employer in the post pandemic era, respondents said that ensuring a strict cleaning and hygiene policy was most important (82%), followed by allowing staff to have more flexibility in where and how they work (80%) and ensuring staff are equipped with the right tools to work remotely (79%).

In the post-pandemic world of work, employees rated trust on the part of their employer to get the job done as the most important element in their working life (80%), followed by maintaining a good balance between work and life (79%), the ability to maintain physical health and fitness, and job security (78%).

In the post-pandemic era, under the future way of work, it's becoming more important for businesses to support employees through education and training, such as digital skills, time management, remote teamwork skills and creativity training. Also, supporting employees' personal physical and mental wellbeing would also become critical.

Resetting Normal

The Adecco Group published the "Resetting Normal: Defining the New Era of Work" report in 2021, with surveys conducted in 25 economies across the globe, to explore how attitudes towards work have changed a year after the pandemic and to uncover new

perspectives and insights on what the future world of work can and should look like.

Respondents of the survey are between 18- to 60-year-old employees work in desk-based offices, who were forced to alter the way they work during the pandemic such as remote working. It includes 14,800 respondents across Latin America, Nordics, EMEENA, APEC and North America regions.

Five key findings emerged from the survey are listed below for organizations to consider in the next normal.

1. Hybrid Working

Over 70% of global corporate workers have successfully created their own set up for effective remote working style. Among that, 84% of U.S. corporate workers have set up home offices, followed by 81% in Australia, 79% in Switzerland, 78% in Latin America, 76% in EMEENA and 72% in China.

Of this experience working at home in the pandemic, 71% of the respondents said working remotely will become important to them in the future. They do want to keep this routine in the future, and full-time in the office isn't an option for them anymore. Further, more than 80% of corporate leaders agree that both employees and businesses will benefit from increasing flexibility in the office and remote working.

Diving into generations, over half of corporate workers want to work remotely 50% of their time. Among them, younger people want more office time – as in the order of GenZ (56%), millennials (48%), GenX (46%) and Baby Boomers (44%). Except in China, all surveyed economies want to spend at least 40% of their working time remotely.

% Wanting to work remotely <u>after</u> the pandemic							
All want to spend at least 40% of their work Time remotely (except in China)							
64%		63%			62%		
Japan		UK			Canada		
59%	54%	54%	54%	54%	52%	52%	50%
Spain	Nordics	Germany	LATAM	USA	Italy	Bel/Ned	France
49%		47%		43%		23%	
Switzerland		Australia		EEMENA		China	

As for corporate levels, non-managers have a greater desire for remote working (59%) than leaders (42%) and managers (49%).

Moreover, many people believe that the hybrid working format will open opportunities for a more diverse and inclusive workforce. For instance, people with disabilities, working parents and people from different geographic regions could benefit from the new way of working and, therefore, work remotely for companies in different regions which were not in their options before the pandemic.

For companies planning to re-start office working, employees' anxiety about returning to the office cannot be neglected. About 42% of the corporate workers expressed their feeling of anxiety about returning to the office, especially GenZ and millennials generations. Also, women (46%) tend to feel anxiety about returning to the office more than men (38%), which links potentially to more common issues with mental and physical wellbeing.

This anxiety appears as stronger emotions among leaders than those in the non-manger level. Around 68% of leaders want to see colleagues in person while 49% of leaders feel/have felt anxiety about going back to the office. For non-managers, 51% want to see in person as 42% feel/have felt anxiety.

Among those who are anxious about returning to the office, one third of them say their mental wellbeing got worse in the last 12 months; one fourth of them feel their relationships with colleagues got worse; and 29% of them say their physical wellbeing got worse. These number have showed that employees' wellbeing towards physical, mental, and social aspects will become more significant for corporates in the post-pandemic era.

For those who felt anxiety, 77% rate a redesigned office for people to work safely and effectively as important, and 68% rate ability to manage caring for others around work as important. The last 18 months have proved that remote working doesn't come with a loss of productivity, and that a more inclusive and flexible way of working is possible. Most workers do want to maintain the flexibility over when and where they work.

The challenge for leaders is to capitalize on this and build the right structures, technology, and resources to ensure this new way of working is future proof, looking beyond the location of their employees. It's important for companies to consider a hybrid working model that strikes the right balance between office and remote for all their employees and consider that "one size

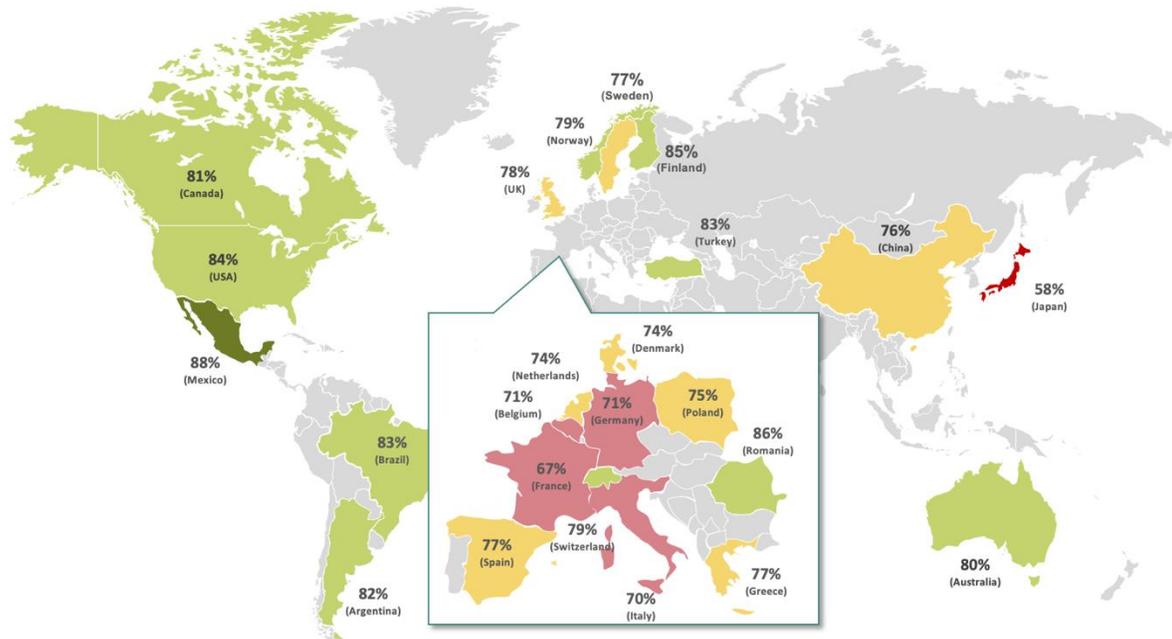
won't fit all" when addressing employee needs.

Technology is a key enabler to make hybrid mode work: cloud infrastructures, cybersecurity, and digital transformation are key foundations for a successful next normal. Physical office will still play an important role in the next normal. Companies must consider how they can provide a safe, comfortable, and enjoyable office environment to boost communication, colleague relationships and a sense of team culture and morale, especially for those who are anxious to return to the office.

2. The New Week in Demand

The flexibility corporate workers gained during 2020 has led them to want more – the length of the working week is being addressed into the discussion of the future of work. During the pandemic, more corporate workers were able to decide their work schedules were given great autonomy while working from home. Around two thirds of corporate workers have maintained some flexibility and control over their working schedule. Most of them have felt their work and life balance have improved in the pandemic, and 75% of them don't want to lose this autonomy for flexibility over their own schedule in the next normal.

Across geographies, over 80% of corporate workers in North America say support for flexible working needs will be important after the pandemic. This number is also high in Australia,



Latin America, Nordic, and Romania.

Flexibility is highly valued across gender, age and life-stage, especially for those with children and caring responsibilities. For instance, 80% of women corporate workers seek flexible working needs after the pandemic; 81% of corporate workers as mothers and 79% as care for adults hold the same need.

Flexibility and autonomy for corporate workers haven't affected their performance at work. 82% of workers say their productivity has stayed the same or even improved in the last 12 months.

Hours worked have increased 14% since last year with 63% of workers working over 40 hours per week. But 6 out of 10 (57%) say they would be able to do their work in less than 40 hours. The disconnection between hours worked versus hours deemed necessary is clear across geographies. For instance, 86% of Japanese workers worked over 40 hours per week in the past 12 months and 62% think 40 hours or more is needed in the future, as 50% of British workers worked over 40 hours per week in the past 12 months and 32% think 40 hours or more is needed in the future.

Instead of counting working hours to evaluate employee performance, outcome-based working has drawn higher attention in the last 12 months. 73% of corporate workers say employee contracts should focus more on meeting the needs of the role and less on number of hours worked, and 81% of leaders agree on this idea. Also, 72% of workers say employers should revisit the length of the working week and the hours that employees are expected to work, and 79% of leaders agree on this.

In other words, the policy of a company and the way of evaluating performance in the management will need to change. Currently, 52% of workers say their managers did not meet their expectations for assessing performance on outcomes or results instead of hours worked. Meanwhile, almost half of leaders haven't found it easy to adapt themselves to remote management. 55% of leaders found onboarding new staff to the team and the business not easy in the 12 months, 45% found supporting and guiding the team to focus on achieving the business goals not easy, and 44% found assessing performance of the staffs based on outcomes or results instead of hours worked not easy.

Looking back at the changes at work, only 49% of corporate workers say they are happier following the changes at work in the last 12 months. The number is higher than average in regions like North America, Latin America, China, and Australia, while a lower number in Japan,

Norway, Netherlands, and France.

Polarized experience is evident across aspects of working spanning wellbeing, career, relationships, and company engagement. For instance, 32% of workers found communication between colleagues got worse in the last 12 months as 29% of them found it got better; and 33% of workers found their mental wellbeing got better in the last 12 months as 32% of them found it got worse.

The polarized result might be caused by the different characters and environments of industries. Industries such as design, offline retail, digital, and IT are happier with their working experiences in the last 12 months while areas like education and hospitality found it less content with.

The levels of positions also play a role – much has got better for leaders compared to non-managers in the last 12 months, especially the ability to collaborate with their colleagues, the trust towards getting the job one, pride in the company, and professional learning and development. Last, parents are happier with changes at work in the last 12 months than those with no dependents.

People's needs at work go towards to work smarter, not longer. Maintaining flexibility and autonomy over their own schedules is key for workers going forward. Companies must build a culture of trust and re-invent planning and collaboration for a new era of flexible work.

Measuring employee performance based on their activity and time spent online is outdated and inadequate in the next normal. Companies need to provide support and guidance on how managers can assess performance on outcomes and results instead of hours worked.

With only 36% of non-managers being measured based on their results, performance management appear as a clear opportunity for improvement for leaders and companies. Using technology and creating resources such as clear and personalized score cards, ongoing analysis and feedback processes, and collaborative and adapted actions will be key to link the success of teams and individuals to the company success.

Therefore, calls for companies to revisit hour-based contracts and to focus instead on outcomes and results continue to be strong and leaders share the vision. Automation of

repetitive tasks via technologies such as AI and machine learning will play an important role in this shift.

It will also be important for companies to create a hybrid model that encourages and fosters a better normal for all individuals, acknowledging that “one size does not fit all.” Listening to employee feedback and striking the right balance will be the key to successful hybrid working.

3. Burnout as the Next Worker Pandemic

Alongside the pandemic, corporate workers are facing lots of mental changes such as uncertainty, anxiety, stress, loneliness in the last 12 months. Overall, 32% of corporate workers say their mental wellbeing got worse in the period, as around half of them in Poland and Canada. Compared to the survey result in 2020, the percentage of workers who can manage mental wellbeing has decreased 12% in 2021. Among them, all generations have expressed similar experiences on mental wellbeing and the difference in genders isn't significant.

Further, 28% of corporate workers say their physical health has got worse in the last 12 months. Compared to the survey result in 2020, the percentage of workers who can manage physical wellbeing has decreased 11% in 2021.

67% of non-managers say leaders don't meet their expectations for checking on their mental wellbeing. At the same time, 53% of all managers say they have not found it easy to identify when staff may be struggling with mental wellbeing. Supporting employees' mental wellbeing is becoming more important in the office setting: 71% of workers say having the right support for mental wellbeing at work will be important to them in the future.

Office workers are working in a high-pressure environment. 63% of corporate workers have worked over 40 hours per week in the last 12 months. Working long hours has become common, and on the increase.

Meanwhile, burnout has been a significant issue over the last year. Around 38% of corporate workers say they have suffered from working too hard or burnout during the last 12 months, led by Generation Z workers (45%), millennials (42%), and Generation X (35%). Geographically, workers from Australia (53%), EMEENA (50%), Italy (49%) are most likely to admit suffering burnout.

As for corporate levels and generations, 54% of young leaders and managers are suffering from burnout, more than older leaders and managers. In other words, the generation who will take over significant responsibilities for future progress are suffering from mental exhaustion.

Over half of managers have not found it easy to manage other on issues of burnout and mental wellbeing, especially in Japan (80%) and France (70%). Also, there's a vast disconnection between burnout people feel and expectations of this being addressed in the future. For instance, in Italy, 49% of workers suffered from burnout and only 11% think their company will provide coaching on preventing burnout; and 20% of Japanese workers have suffered from burnout and only 4% think their company will provide coaching on preventing it.

From the survey result, there's certainly more room for improvement in supporting employee physical and mental wellbeing across sectors. No more than half of the employees said their physical wellbeing has improved during the last 12 months, and lowest percentage was seen in education (28%), science, pharmaceuticals, and biotechnology (29%) and hospitality (31%). Same situation appears in the mental wellbeing perspective with lowest percentage in charity and voluntary work (21%), education (24%) and science, pharmaceuticals, and biotechnology (28%).

Last, disparity between what has got worse for non-managers compared to leaders is vast. 18% of leaders felt the effective communication between colleagues have got worse during the last 12 months versus 30% of managers and 37% of non-managers; and 19% of leaders have felt their mental wellbeing have got worse in the last 12 months versus 31% of managers and 35% of non-managers.

Companies must re-evaluate how they can better support and provide wellbeing resources to their employees within the new hybrid working model. Building pro-wellbeing working environments, cultures, and skillsets from top to bottom will be key in the next normal.

With most managers saying they have not found it easy to identify when staff may be struggling with mental wellbeing, overwork, or burnout, and almost 4 in 10 workers suffering with overwork or burnout it's increasingly urgent for companies to set up processes, resources, and tools to foster openness and listen to employee needs, as well as helping workers develop resilience to prevent it.

Moreover, 67% of non-managers say their leaders don't meet their expectations for

checking on their mental wellbeing. Leadership development, coaching and resources for managers on how to deal with and respond to these situations is key.

The usage of cognitive technologies for employee wellbeing can provide increased visibility into burn-out warning indicators and generate awareness amongst individuals and leaders to address the issue.

4. Leaders to Reconnect the Disconnect

There is a large disconnection between management views of their own performance and the opinion of their employees. According to the survey, 80% of leaders and 62% of managers say they are satisfied with their company's senior leadership while only 43% of non-managers are satisfied. Especially in Western Europe economies and in Japan, the satisfaction with senior leadership tends to be low among other regions and economies. At the same time motivation at work has also the lowest result in Western Europe and in Japan.

Compared to the result in 2020, the percentage of workers that are motivated at work has dropped 13% in 2021. Among that, non-managers have seen the largest decrease of 12% in motivation over the last year. Also, staff-manager relationships have deteriorated with less than half of non-managers feeling the relationship is strong with their managers. Geographically, less than half of employees in Italy (46%), Germany (43%) and Japan (21%) have a strong relationship with their managers.

77% of managers say they are satisfied with their own performance, while only 57% of non-managers say they are satisfied with their line manager. There is a clear disconnection between management views of their own performance and the opinion of their employees.

As well as for the working culture, 74% of workers say it is important for managers to promote and nurture strong team morale and culture, but only 37% of non-managers say their manager is encouraging a good working culture. Economies such as Australia, China and USA have been more successful at encouraging a good working culture within the team than other economies like Italy, France, and Japan.

While 71% of leaders and 51% of managers say their manager has met or exceeded expectations in keeping staff contributions visible and recognized in the business, only 33% of non-managers hold the same opinion. Further, as 71% of leaders and 54% of managers say their

manager has met or exceeded expectations in supporting work-life balance, only about 42% of non-managers hold the same opinion. Overall, non-management take a much less favorable view of managerial performance across range of leadership tenets.

Importance of skills and career development is important for a company as well as for employees. Even though this seems a belief among leadership, it isn't a reality felt throughout the business. For example, while 78% of leaders think the company is investing effectively in developing employees' skills, only about 56% of managers and 37% of non-managers hold the same opinion.

Since companies are not taking steps to upskill the employees, 60% of workers are taking it upon themselves to do new courses and qualifications. While 78% of leaders and 54% managers are satisfied with career prospects at their company, the number for non-managers is only 34%. Overall, 48% of workers are satisfied with the career prospects at their company. This ratio is especially low in Western Europe and in Japan, and high in China, Australia, and the USA.

As the result shows that non-managers are not as satisfied as the manager level, nearly half of managers (46%) also have not found the overall experience of managing other people easy in the past 12 months, such as supporting the career development of the staffs, identify when staffs may be struggling with mental wellbeing, and support staffs who may be struggling with the pressure of work.

Leadership plays an important role in the company, especially as the new ways of work drives the new management style. However, there's wide disparity between perceived importance of leadership training and those that are actually doing it. 78% of leaders think leadership coaching is important while only 31% of them have done that; 68% of managers think it's important while 22% of them have done that.

With workers' motivation, relationships, feeling of recognition and sense of team and culture deteriorating, leaders hold the key to re-connecting people to the company purpose, helping them feel like they belong and providing them with development and career opportunities that can motivate them.

However, leaders are struggling to see the issues. Companies must support the new breed of leaders who will be best placed to address major threats to company cohesion. Equipping leaders with upskilling, coaching, resources and technology that will help them to better listen

to and manage their teams, increase and nurture motivation, and a strong team morale and culture is a priority for businesses in the new hybrid working model.

5. Re-Evaluation

The predicted “mass-resignation” or “mass exodus” may be overstated for now, but the nascent normal is triggering many to re-evaluate working life. Many people, after experiencing the pandemic, are re-assessing their working life in a variety of ways. 42% of them have taken a new course or other professional development, 31% have moved to a job with more flexible working options, 30% have changed careers and 27% have reduced the number of working days a week.

Especially in Australia and in EEMENA, over half of workers are looking at career changes. As for sectors, more than half of workers in media/journalism and hospitality are looking at career changes. Men and women are equally re-assessing options in their working lives.

The other element of changes in working life is relocations. About 66% of workers have done or are considering buying products to make remote working easier; 57% have done or are considering changes to the home to make remote working easier. At the same time, about 25% have done or are considering moving to a different part of the economy or to a different economy, either for long-term or short-term. Among that, Generation Z (41%) and those in senior positions (44%) are mostly likely to have done or be considering a move from home.

Going forward, pay, work-life balance, trust and security remain the top fundamental needs of workers. Meanwhile, flexibility, a clear sense of purpose, recognition, and the change to learn and develop are also important. 80% of workers believe maintaining a good work-life balance and a good salary will be important to their working life after the pandemic, followed by feeling trust and to get the job done (79%), feeling confident that my job is secure (77%) and retaining flexibility over my working hours and schedules (76%).

However, different generations have shown various value towards working life. Generations prioritize praise and recognition for good work in a company before a good salary, followed by a strong enjoyable company culture. At the same time, Baby boomers take being able to maintain a good work-life balance as the first-place value, followed by feeling trusted to get the job done and good salary.

	Generation Z	Millennials	Generation X	Baby boomers
1 st	Praise & recognition for good work*	Good salary / pay scheme		Being able to maintain a good work / life balance
2 nd	Good salary / pay scheme	Being able to maintain a good work / life balance		Feeling trusted to get the job done
3 rd	Strong enjoyable company culture*	Feeling trusted to get the job done		Good salary / pay scheme
4 th	Good learning & development opportunities*	Feeling confident that my job is secure		
5 th	Feeling trusted to get the job done	Retaining / having flexibility over my working hours / schedule		

N.B. *Bold Statements in Top-5 for Gen-Z only

Trust & agency
Culture & engagement
Wellbeing
Career & security

In other words, managers in the future need to attain different skills and characters than managers now. 78% of corporate workers believe that placing trust in staff to get the job done will be important in the role of managers after the pandemic. Other than that, 76% for supporting employees’ flexible/remote working needs, 75% for a leadership style focused on empathy and a supportive attitude and 75% for encouraging people to feel safe sharing their honest opinions and ideas.

There’s also different expectation from companies after the pandemic. 76% of workers expect companies to ensure staff having good IT infrastructure and systems, 74% expect them to invest in technology to facilitate better digital ways of working, and 74% expect them to increase the focus of wellbeing of staffs.

There is no turnover-tsunami on the horizon but there are warning signs for companies with employees re-assessing their careers. The time is now for organizations to reconnect with their workforce rather than hastily turn to external hiring out of fear of a mass resignation.

People need to see and feel opportunity. During the last 12 months, people have become more autonomous, agile, adaptable, and proactive taking it upon themselves to get new skills. They are ready for change, and they are looking for more agency, career development, mobility opportunities or upskilling and reskilling into the next chapters.

Workers have a wealth of new skills, and they are ready to action them. Companies must use the momentum to re-assess their talent and put those new skills to use. Not only will it future proof the organization but it can also help people re-discover themselves and reconnect with their purpose.

With only 37% of non-managers believing their company is effectively investing in developing their skills, Assessing, and upgrading employees' tech skills can open new career paths for them, as well as provide them with a renewed sense of purpose and connection to the company.

In addition to IT and digital infrastructures, security, agency, culture, wellbeing, and development are the most important to workers going forward. Companies need to prioritize them to keep workers engaged. Nurturing stronger relationships and instilling a stronger sense of culture is key – one that encourages healthy working styles, engagement with company goals and psychological freedom.

Reflection: Chinese Taipei

Each economy has its own pace in terms of economic development and digitalization. In 2021, most Chinese Taipei's companies have been focused on digital transformation or digital enhancement.

Due to the third-level alert of COVID situation in May, many companies have experienced their first hands-on work-from-home months. The policy has accelerated the development of companies' cloud infrastructure and digital applications, as well as their management shifts towards remote working.

In this case, the future ways of working and new management challenges mentioned in previous chapters would be key knowledge and discussions for Chinese Taipei's leaders and managers. However, 80% to 90% of Chinese Taipei's companies are SMEs and most of them have not caught up the digitalization paces as international companies. Even some Chinese Taipei's public companies haven't reached that level. The level of digitalization in a company will decide how it respond to the pandemic and the future.

Employee wellbeing and generation challenges appear after a company's digitalization. A company needs to enable remote working infrastructure first, to talk about flexible working schedules and employees' wellbeing afterwards. If company leaders still insist on traditional "monitoring" management style, the issues mentioned in the report do not matter to them.

But company leaders hold on to the traditional management will damage the company branding and not allow young generation talents to join the company. Further, the company will face market challenges and isolation without the help of the young generations.

As suggestions, Chinese Taipei's company leaders can start from understanding whether there is technology system plans and workforce plans in the company – they need to know what kind of talents they want to hire, how to train their talents and what do future talents care about. "People" need to be the priority of the leaders' minds, instead of profits and businesses.

Break Down to Industries

Software engineer positions are demanded around the world, which leads to career opportunities worldwide. Especially as work-from-home becomes the new normal, Chinese Taipei's software engineers are also able to work for companies located in the U.S. or in Germany.

It is an exciting change in the workforce setting. However, policies and regulations for international talents to work remotely for the company haven't in place yet. Employees' retirement fees, health and accident insurances and taxes all need to be considered. As the policies are designed and launched, the workforce market will welcome a drastic change.

Bio-technology sector is also growing positively. However, Chinese Taipei's companies in the sector have faced challenges to attract young talents. The companies must change their hiring strategies, their own culture, or even to change their ways of leadership, to convince and to lead the young generation talents.

Last, the booming semi-conductor sector is gradually shifting its manufacturing power to Chinese Taipei's South. It will boost the development of the region but will also face the workforce shortage due to the declining birthrate. More, the sector will draw attentions of most talents, leading other industries to more difficultly find the workforce they aim for.

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3. Report: Assessing U.S. Digital Skills in the Digital Economy Era

Stephen Ezell, Vice President of Global Innovation Policy, Information Technology & Innovation Foundation

Overview

The global economy is increasingly digitalized. Oxford Economics estimates that in 2016 the digital economy accounted for 22.5 percent of global gross domestic product (GDP).¹ Going forward, analysts at the research firm IDC estimate that as much as 60 percent of global GDP will be digitalized (meaning largely impacted by the introduction of digital tools) by 2022.² Countries that wish to successfully compete in the global digital economy must cultivate workforces possessing the requisite digital skills so that industries, enterprises, and even individuals can thrive in the digital environment. This report explores the state of digital skills across the U.S. economy, examining what they are, why they matter, the current extent of workforce digitalization, and how the United States fares in international digital skills comparisons. It concludes by providing a brief overview of some of the best practices and programs being introduced by nonprofit, academic, and corporate organizations to deepen the U.S. digital skills base and suggesting policy recommendations to further foster U.S. digital skills development.

What are Digital Skills and Why Do They Matter?

The globalization of the digital economy profoundly impacts every industry. For instance, while certainly the digitalization of the global economy has brought entirely new industries and enterprises to the fore—web search, social media, artificial intelligence (AI), cloud, etc.—at least 75 percent of the value of data flows over the Internet actually accrues to traditional industries such as agriculture, manufacturing, finance, hospitality, and transportation.³ This dynamic explains why the vast majority of the economic benefits from information and communication technologies (ICTs)—likely more than 80 percent for developed nations and 90 percent for developing ones—stem from greater adoption of ICTs within an economy, far more than the benefits generated by ICT production.⁴ In other words, the value that gets created in the global economy is increasingly created digitally: In fact, some estimate that as much as half of all value that will be created across the global economy over the next decade will be done so digitally.⁵ That’s why one estimate predicts that 97 million new digital jobs will be created globally in the first half of this decade.⁶ Similarly, a separate report finds, “If America could train just five million workers for digital jobs in the next five years, it would drive an estimated \$250 billion more in

U.S. GDP growth.”⁷ Therefore, if individual workers are going to be able to contribute value in such an economy, they’ll need sufficient digital skills to be able to do so.

Digital skills can be broadly construed across two different categories. First are the digital skills needed to work directly in ICT or digital industries, including computer science skills needed to code software, AI, and other computer systems; electrical engineering skills to design semiconductors, high-performance computers, and quantum computers; cybersecurity skills; and competencies to manage data centers and telecommunications networks. It’s these digital skills that have given rise to an Internet/digital tech sector that contributed \$2.1 trillion of the U.S. economy in 2018, or about 10 percent of GDP.⁸

The Computing Technology Industry Association (CompTIA) has developed a count of tech workers in the U.S. economy including workers in the technology sector (e.g., software developers, network architects, database administrators); professionals employed by ICT firms though not working in ICT roles directly (e.g., sales, marketing, customer service professionals); and self-employed workers in the ICT-enabled “gig” economy (e.g., Uber drivers).⁹ By this measure, CompTIA generated a count of 12.4 million “tech workers” in the U.S. economy, with 66 percent, or 8.2 million, of those workers directly employed in core ICT roles.

A second category of digital skills pertains to individuals’ facility with using digital tools in traditional work environments, such as the ability to work with basic Microsoft Office programs such as word processors, spreadsheets, email, or networking software; the ability to use databases or customer relationship management (CRM) tools; the ability to engage in social media or use video conferencing tools; to use mobile applications supporting point-of-service operations; to interpret the output of AI-based systems; or to use automated reality/virtual reality (AR/VR) tools to repair an automobile or jet engine. Indeed, it’s this broader capacity of a nation’s workforce that constitutes the transmission mechanism for digitalization to manifest its transformative impact across traditional industries from agriculture and finance to manufacturing and medicine. As the Brookings Institution’s Mark Muro and his colleagues frame it in their excellent report “Digitalization and the American Workforce”:

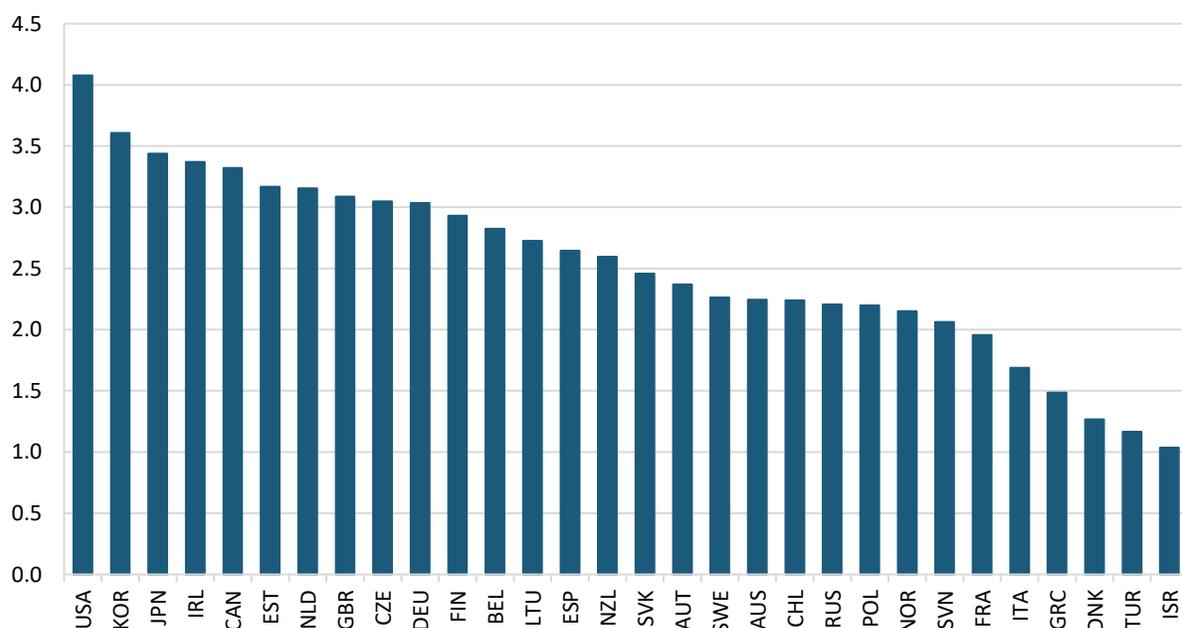
A sizable portion of the nation’s middle-skill employment now requires dexterity with basic information technology tools, standard health monitoring technology, computer numerical control equipment, basic enterprise management software, customer relationship management software like Salesforce or SAP, or spreadsheet programs like Microsoft Excel.¹⁰

Economies need to support the development of digital skills across both ends of this spectrum. Economists have long recognized that ICTs constitute a general purpose technology that turbocharges the productive, innovation, and business-model-generation capacity of virtually all downstream industries that utilize it.¹¹ Indeed, ICT represents “super capital” that has a much larger impact on productivity growth than do other forms of capital.¹² For instance, ICT capital has a three to seven times greater impact on firm productivity than does non-ICT capital. ICT workers also contribute three to five times more productivity than non-ICT workers do.¹³ This dynamic explains why the digital economy has contributed to 86 percent of U.S. labor productivity growth in recent years, despite accounting for only 8.2 percent of U.S. GDP.¹⁴

The greater productivity of ICT-industry workers, or workers who possess greater levels of digital skills, explains why such workers are often able to command higher wages. For instance, the Organization for Economic Cooperation and Development (OECD) has found that a 10 percent increase in the ICT-task intensity of jobs (at the economy mean) correlates to an average 2.5 percent increase in hourly wages across OECD economies, with the United States experiencing the highest effect at 4.08 percent. (See

figure 1.)

Figure 1: Returns on ICT tasks—percentage change in hourly wages for a 10 percent increase in ICT task intensity of jobs (at the economy mean), 2012 or 2015¹⁵

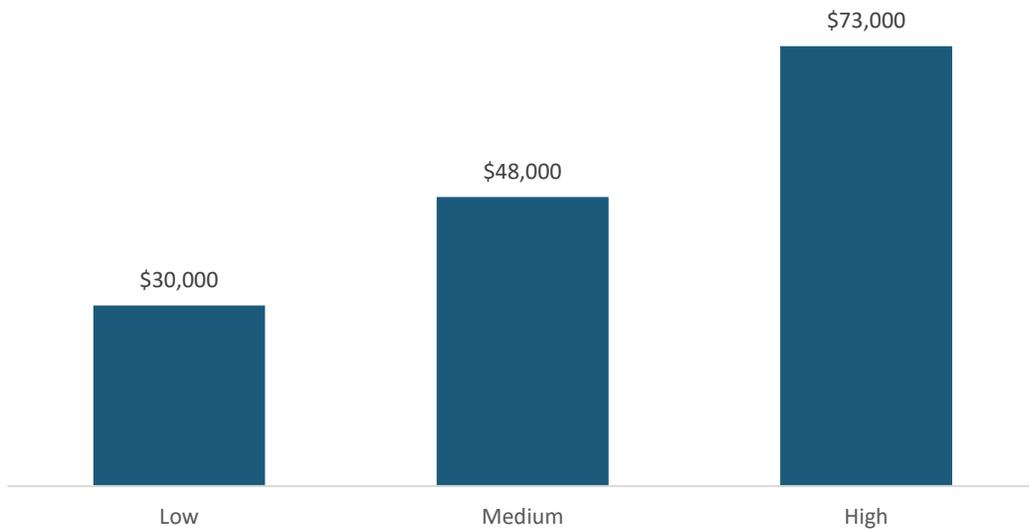


The finding that jobs involving high digital-task intensity and greater levels of digital skills earn more has been corroborated repeatedly. Brookings' 2017 "Digitalization and the American Workforce" report examines the digital content of 545 occupations covering 90 percent of the U.S. workforce in all industries from 2001 to 2016. The report leverages the Occupation Information Network (O*Net) database, which surveys workers on their knowledge, skills, tools and technology, education and training, and work activities required to perform their jobs.¹⁶ Here, two of O*Net's three technology-related variables are relevant: "Knowledge: Computer and electronics" (which measures the overall knowledge of computers and electronics required by a job) and "Work activity—interacting with computers" (which quantifies the centrality of computers to the overall work activity of the occupation).¹⁷ Brookings used this to develop occupational digitalization scores for 545 occupations across 23 highest-level industries, segmenting occupations into 3 tiers of digitalization: low, medium, and high.

Not surprisingly, Brookings found that the mean annual wage for workers in highly digital occupations reached \$72,896 in 2016, with workers in middle-level digital jobs earning \$48,274, and those in the least digitally intense positions earning \$30,933. (See

Figure 2.) Importantly, Brookings found that digitalization scores have significant and positive effects on real annual wages even when controlling for education level, and that the wage premium for computer skills nearly doubled between 2002 and 2016. To wit, in 2002, a one-point increase in digitalization score predicted a \$166.20 (in 2016 dollars) increase in real annual average wages for occupations with the same education requirements; by 2016, this wage premium had almost doubled to \$292.80.¹⁸

Figure 2: Mean annual wage by digitalization level, 2016¹⁹



Assessing the State of Digital Skills in the U.S. Workforce

This section assesses the state of digital skills across the U.S. workforce broadly, first by industry and occupation and then in terms of international comparisons.

Assessing U.S. Workforce Digital Skills Broadly, By Industry, and By Occupation

The OECD Survey of Adult Skills (formally known as the “Programme for the International Assessment of Adult Competencies” or PIAAC, and subsequently elaborated upon), assesses workers from over 40 nations on 11 ICT-related measures ranging from simple use of the Internet to use of a word processor, spreadsheet software, or programming language.²⁰ It categorizes adult workers into four levels of digital skills: no digital skills, limited digital skills, proficient digital skills, and advanced digital skills.²¹ (Technically, the survey tests for “digital problem solving in technology-rich environments.”)²²

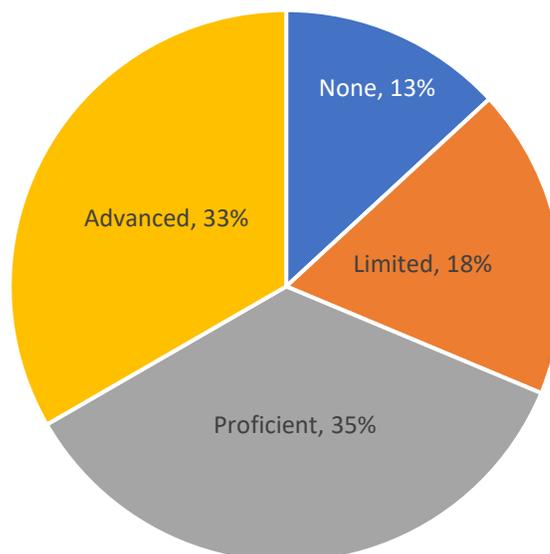
Individuals with no digital skills failed to meet one or more of three basic digital skills criteria: 1) prior computer use; 2) willingness to take the computer-based assessment; and 3) ability to complete four out of six extremely basic computing tasks, such as using a mouse or highlighting text on a screen. Individuals with limited digital skills could complete only very simple digital tasks involving a generic interface and a few steps (e.g., placing incoming Outlook emails into specified folders). Those possessing proficient digital skills were capable of using basic digital productivity tools (e.g., Microsoft Outlook), and could use digital tools such as the sort function in spreadsheets to solve problems, yet still struggled with tasks involving the use

of both generic and specific technology applications. Lastly, those possessing the most-advanced digital skills in the PIAAC survey have facility in “the use of both generic and more specific technology applications... [can navigate] across pages and applications... [and can solve tasks that] may involve multiple steps and operators.”

While it should be apparent that even the above-referenced digital-problem solving skills measures don’t constitute “tests” for extremely high levels of digital aptitude, the PIAAC data reveals that even then fully one-third of American workers lack digital skills, with 13 percent of U.S. workers having no digital skills and 18 percent having at best limited digital skills, while 35 percent could be deemed proficient and 33 percent advanced in digital skills. In essence, one in six working-age Americans are unable to use email, web search, or other basic online tools.²³ (See

Figure 3.) As the National Skills Council observes, there is significant digital skills knowledge fragmentation among U.S. workers: Many may be comfortable using smartphone apps but unfamiliar with how to operate a mouse, use Microsoft Office productivity tools, or even upload employment applications to websites.²⁴ In part, that’s because 23 percent of U.S. households do not own a desktop or laptop computer, while over 7 percent of all Americans simply don’t use the Internet.²⁵ This digital divide hits U.S. minority groups particularly hard, with 23 percent of African Americans and 25 percent of Latino respondents to a 2019 Pew Research Center study reporting having smartphone-only Internet access.²⁶

Figure 3: Extent of digital skills in the U.S. workforce according to OECD PIAAC survey data²⁷



The lack of workforce digital skills is particularly acute in certain industries. Across the U.S. construction, transportation, and storage industry, fully half of all workers have no or only limited digital skills, while that share is over one-third across the health and social work, manufacturing, hospitality, and retail and wholesale industries. (See

table 1.) The lack of digital skills in the manufacturing sector is particularly concerning, especially because jobs in U.S. manufacturing increasingly demand a facility with digital skills, which is important for individual workers to be both competitive and productive, and for broader U.S. manufacturing industries to be productive as well.

Table 1: Percentage of workers with no or limited digital skills, selected industries²⁸

Industry	Percentage of Workers With No Digital Skills	Percentage of Workers With Limited Digital Skills	Combined Percentage of Workers With Limited or No Digital Skills
Construction, transportation, and storage	22%	28%	50%
Retail, wholesale, and auto repair	14%	23%	37%
Hospitality and other services	18%	18%	36%

Manufacturing	16%	19%	35%
Administrative and support services; arts, entertainment, and recreation	13%	22%	35%
Health and social work	12%	21%	33%
Finance, insurance, and real estate	6%	14%	20%
Education	5%	11%	16%

Unfortunately, despite this rather significant gap in digital skills across the U.S. workforce, the digital skills requirements of U.S. occupations continues to increase apace. Brookings’ study “Digitalization and the American Workforce” finds that, from 2002 to 2016, the share of employment in occupations with high digital content (defined as occupations with digital scores above 60 on a 100-point scale) more than tripled, from 4.8 to 23 percent of employment, while employment in occupations with medium digital content requirements increased from 39.5 to 47.5 percent, and the share of jobs with low digital content requirements nearly halved, shrinking from 55.7 to 29.5 percent. (See

Figure 4.) In essence, over 70 percent of U.S. jobs now require middle- to high-level digital skills. In absolute terms, Brookings found that, as of November 2017, over 32 million U.S. workers were employed in highly digital jobs, 66 million held moderately digitally intense positions, and only 41 million were in jobs requiring only low levels of digital skills.²⁹ Archetypal occupations requiring high levels of digital skills included ICT workers, electrical engineers, and financial managers; occupations requiring medium digital skills levels included attorneys, mechanics, and registered nurses; while examples of low-digital-skill-level occupations included security guards, restaurant cooks, and personal care aides.

Brookings further found that digitalization scores rose in the overwhelming number of analyzed occupations (517 of the 545) from 2002 to 2016. Moreover, Brookings found that “job creation in the last few years has heavily favored digitally oriented occupations,” with nearly 4 million of the 13 million new jobs created from 2010 to 2016, nearly 30 percent, requiring high-level digital skills.³⁰ (See

Figure 5.)

Figure 4: U.S. employment by levels of digitalization³¹

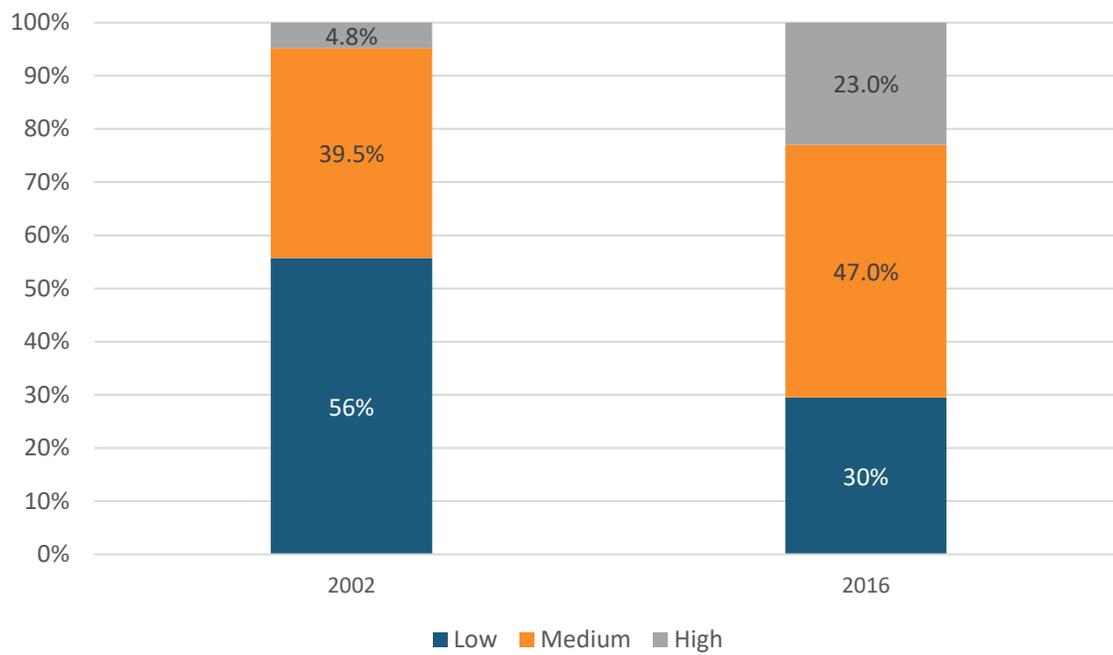
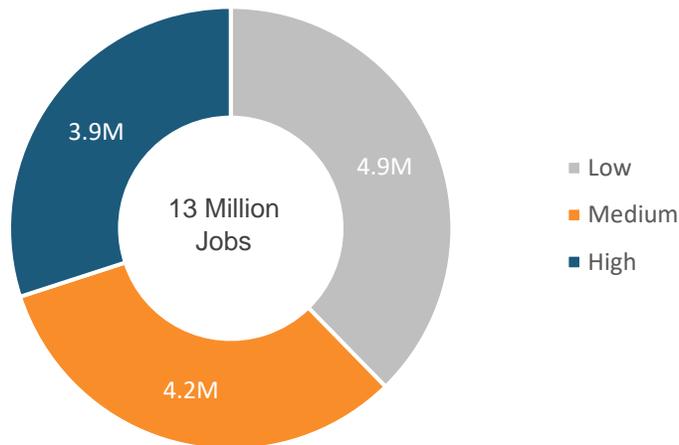


Figure 5: U.S. jobs created by digital skill level, 2010–2016³²

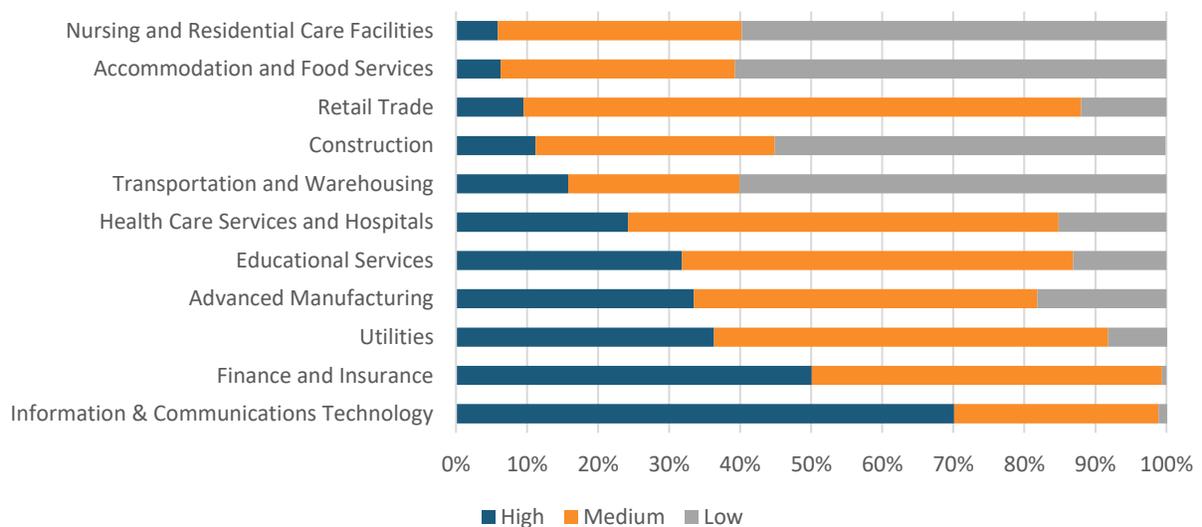


The extent of industry digitalization varies widely, with jobs in the ICT industry—where 70 percent require high levels of digital skills and 29 percent medium levels—unsurprisingly leading, followed by jobs in the finance and insurance industry and the utilities sector (See

Figure 6.) Perhaps most notable are the digital skills requirements of occupations in advanced manufacturing. Whereas, in 2002, 47 percent of jobs required only limited digital skills (and just 15 percent required advanced skills and 38 percent middle-level digital skills), by 2016 the share of advanced manufacturing jobs requiring high levels of digital skills increased to 34

percent, those in the mid-tier increased to 48 percent, and those needing only the least digital skills shrank by nearly 30 percentage points, to a mere 18 percent share.

Figure 6: Share of sector employment by digital score, 2016³³

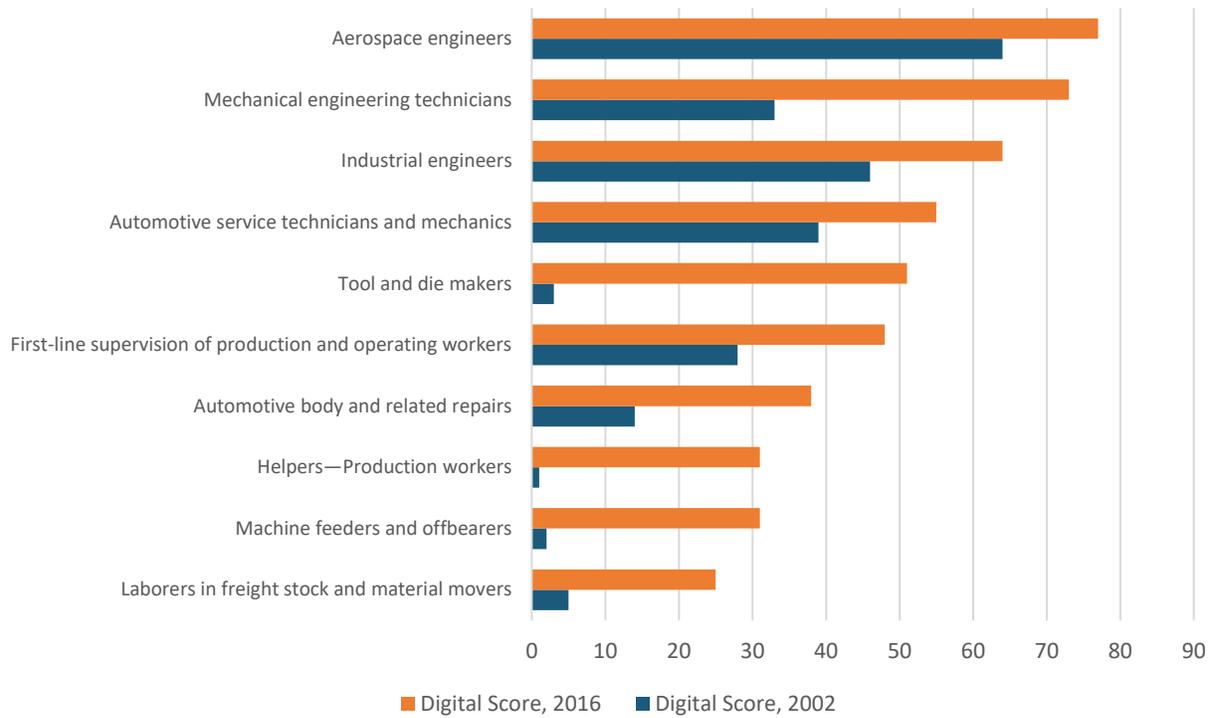


Moreover, across virtually every occupation in advanced manufacturing, the need for digital skills increased from 2002 to 2016. For instance, whereas for tool and die making the digital component of the job was virtually nil in 2002, by 2016, this had changed to become a job with a medium level of digital skills content relative to other jobs in the U.S. workforce. And for advanced manufacturing jobs that required a medium level of digital skills in 2002—such as

for automotive service technicians and mechanics, industrial engineers, and mechanical engineering technicians—by 2016, this had jumped to requiring a high level of digital skills. (See

Figure 7.)

Figure 7: Digital skill ratings for occupations in advanced manufacturing³⁴

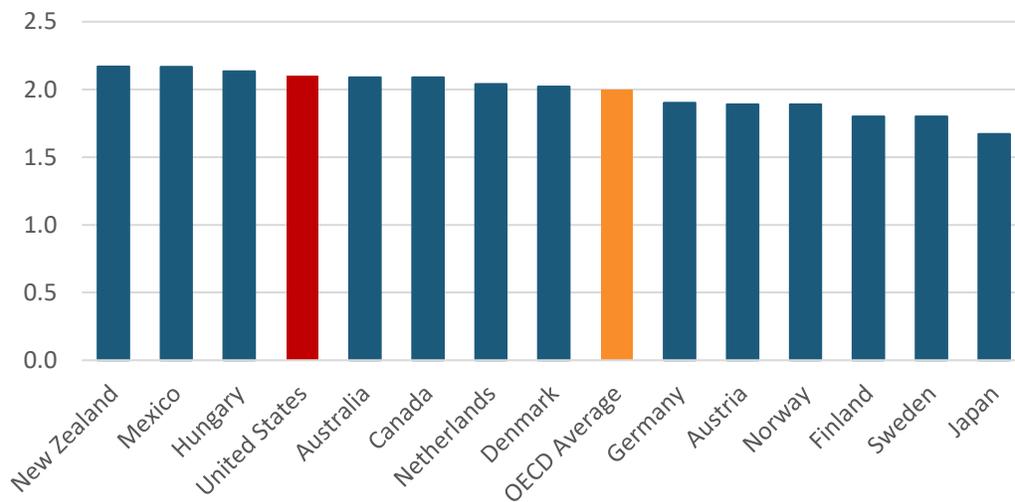


Assessing U.S. Workforce Digital Skills in International Comparisons

The United States performs mixed, and increasingly underwhelmingly, in international comparisons of digital skills. The PIIAC survey measured “use of ICT skills at work” across 14 OECD countries in 2012. On this index, the United States ranks fourth with a score of 2.1, which is ahead of the OECD average of 1.99, yet behind leaders New Zealand (and surprisingly, Mexico) with a score of 2.17. (See

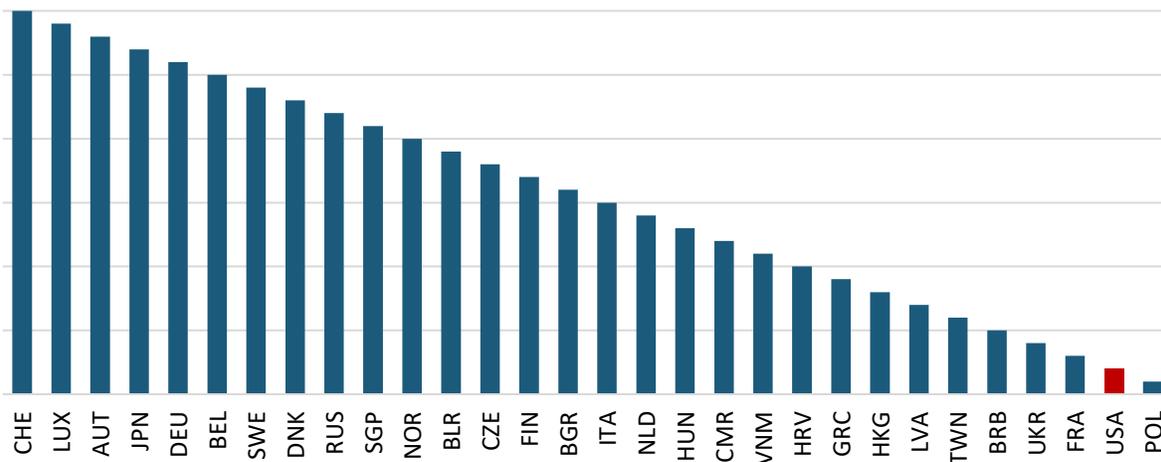
Figure 8.)

Figure 8: Use of ICT skills at work in OECD PIIAC survey, 2012³⁵



A much more recent study, the “2021 Global Skills Report” conducted in 2021 by online education provider Coursera, finds that “despite the rapid rate of digital transformation, U.S. digital skills proficiency falls behind that of many economies in Europe and Asia.”³⁶

Figure 9: Top-30 Economies in Coursera’s 2021 Global Digital Skills Rankings³⁷



The study, which measures learners on the Coursera platform from 100 economies across the business, technology, and data science domains, ranks the United States 29th globally, trailing behind the two world leaders from Europe (Switzerland and Luxembourg) and third-ranked Japan.³⁸ (See

Figure 9.) Relative to learners from the 100 other economies in the study, Coursera found U.S. learners lagged behind across a number of digital economy skills, including operating systems, cloud computing, and mathematics, but “show room for growth” in business skills such as communication, entrepreneurship, and leadership and management.³⁹

Best Practices in Teaching Digital Skills to the U.S. Workforce

This section examines some of the best programs and practices across America seeking to teach digital skills in both K-12 education and to the broader workforce. Women constitute an underrepresented asset in America’s technology workforce. Nationally, women represent approximately 49 percent of the U.S. workforce, but only 26 percent of “tech occupations” (as defined by CompTIA, as previously explained).⁴⁰ Brookings found similar results, noting that “women remain significantly underrepresented in such highly digital positions as computer and mathematical occupations (25.5 percent) and engineering (14.2 percent).”⁴¹ In fact, in 1995, 37 percent U.S. of computer scientists were women, and that figure has fallen to just 24 today.⁴² This concurs with ITIF research finding that while U.S. women today receive the majority of bachelor’s, master’s, and Ph.D. degrees from U.S. universities (59, 62, and 51 percent, respectively), they are seriously underrepresented in STEM fields, earning just 21.7 percent of Ph.D.’s awarded in computer science for industry.⁴³ In 2018, women accounted for an even

smaller share of bachelor’s degrees awarded in computer science, just 19.9 percent. Low enrollment numbers for women in STEM fields such as computer sciences is one reason why ITIF found in a 2016 report that women represent only 12 percent of U.S. innovators.⁴⁴

A number of initiatives have been launched to attract more women, especially young girls, into the digital technology world. For instance, the mission of TechGirlz is to inspire middle school girls to explore the possibilities of technology to empower their future careers.⁴⁵ TechGirlz has shared its curriculum with companies, organizations, and schools in over 20 countries, and more than 25,000 girls have attended its hands-on TechShopz, resulting in 82 percent of participating girls changing their mind positively about pursuing a career in tech.⁴⁶ Elsewhere, Girls Who Code is a nonprofit organization whose mission is to close the gender gap in technology and computer science, seeking to inspire more girls to become computer scientists and engineers. Girls Who Code has taught over 450,000 young women through its in-person programming—including its Summer Immersion Program, Clubs, and College Loops—and reached hundreds of thousands more through its online resources, campaigns, books, and advocacy work.⁴⁷ A separate program, Black Girls Code, builds pathways for young females of color to embrace tech jobs by introducing them to skills in computer programming and technology.⁴⁸

Another notable, broader effort to teach young students digital skills is the Microsoft Imagine Academy, which gives students and educators the curricula and certifications they need to succeed in a technology-driven economy.⁴⁹ Imagine Academy has programs around computer science, IT infrastructure, and data science designed variously for young students and mid-career professionals alike. A number of U.S. states, including Arkansas, Iowa, and North Carolina, have partnered with the Imagine Academy to develop curricula accelerating development of career and technology education skills.⁵⁰ Separately, Microsoft has created the Microsoft Professional Program, which offers certifications in data science, AI, AI applications development, and data-analyst roles. These certifications help individuals gain technical, job-ready skills and accrue real-world experience through online courses, hands-on labs, and expert instruction.⁵¹ “The Digital Workforce Succession in Manufacturing” report provides an excellent guide to occupations and skills requirements in digital manufacturing roles.⁵²

Policy Recommendations

Public policy can play an important role in helping individuals—and thus an economy’s broader workforce—develop digital skills, as the following section elaborates.

Double the Number of STEM Charter Schools in the United States

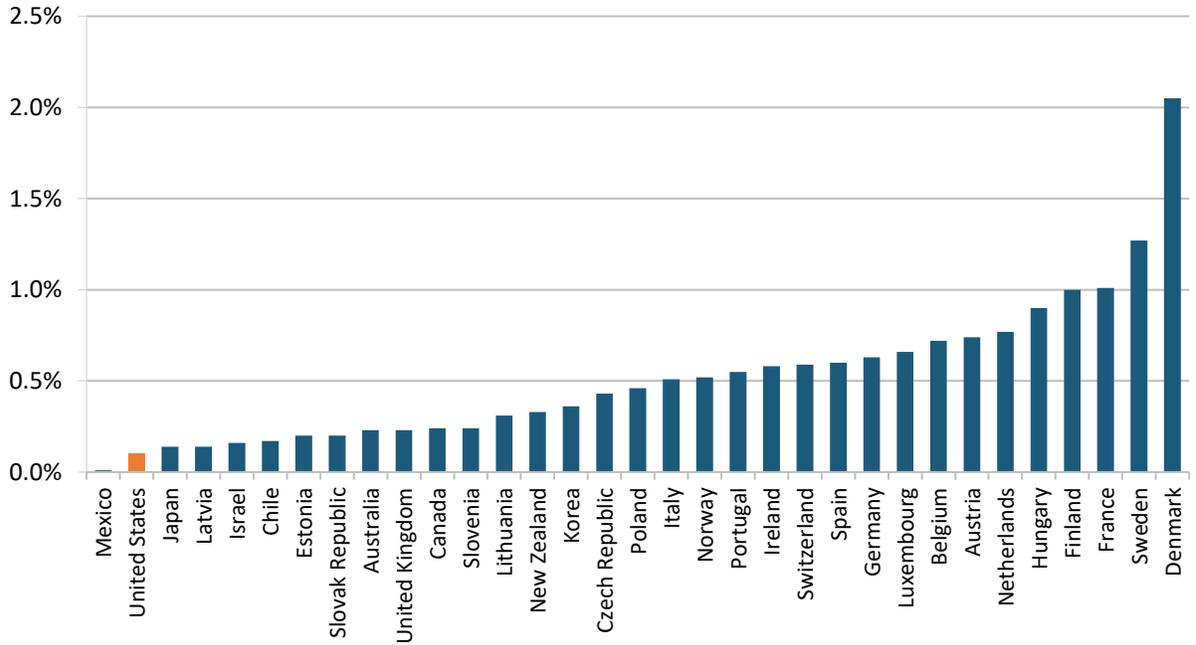
There are approximately 100 STEM-focused high schools in America. Most of these public STEM high schools can provide a deep dive into computer science for interested students and have been proven to be effective in including minorities and students from socioeconomically disadvantaged areas in high-quality STEM education.⁵³ Doubling the number of STEM high schools would allow more students with a passion and deep ability to excel in computer sciences. Moreover, efforts should be made to ensure that all existing STEM-focused high schools provide a deep and rigorous curriculum in computer science.

Increase Federal Investment in Workforce Training and Reskilling Programs

The United States significantly underinvests in workforce training programs, dedicating just 0.1 percent of GDP in active labor market programs compared with the OECD average of 0.6 percent of GDP, meaning America's OECD peers such as Austria and Germany invest six or more times more in their workforce training and support programs.⁵⁴ (See

Figure 10.)

Figure 10: Public expenditure on active labor market programs (% of GDP)⁵⁵

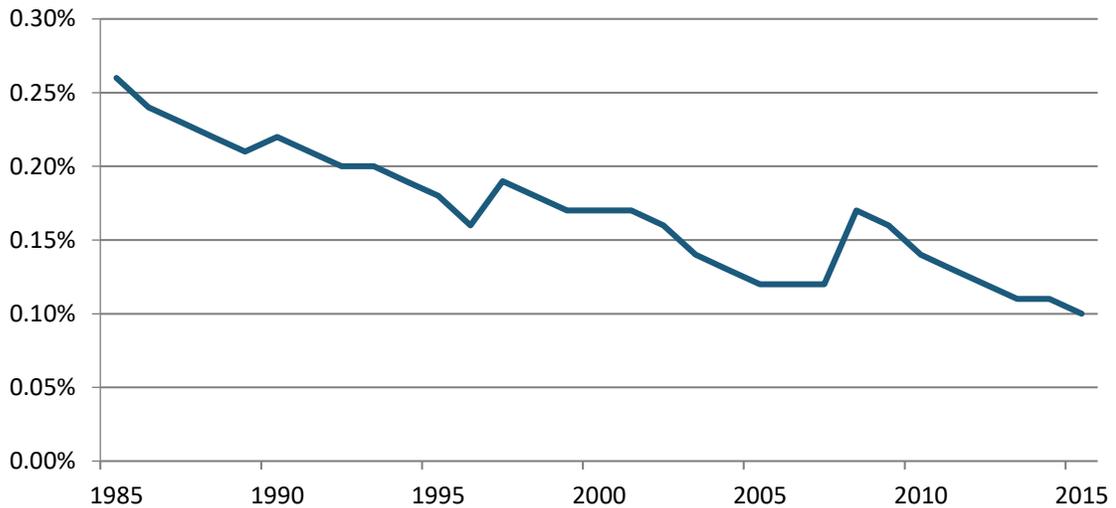


Note: Data for New Zealand and Estonia is from 2014. UK is 2011. All others are 2015.

Such “active labor market policies” refer to government initiatives to help unemployed workers effectively transition back into the job market by addressing structural issues (rather than cyclical trends) caused by changes in the business model, such as recessions.⁵⁶ Moreover, the United States now invests less than half of what it did in such programs 30 years ago, as a share of GDP. (See

Figure 11.)

Figure 11: U.S. public expenditure on active labor market programs as percent of GDP⁵⁷



Expand Section 127 Tax Benefits for Employer-Provided Tuition Assistance

Section 127 of the federal tax code allows employers to provide employees up to \$5,250 per year in tuition assistance; the employer deducts the cost of the benefit but the employee doesn't have to report it as income.⁵⁸ While it's an important benefit, Congress has not increased the eligible amount since 1996. Congress should increase Section 127 to at least \$8,700 (per the rate of inflation since 1996) and index the amount to the annual rate of inflation going forward.⁵⁹ As the *2015 Economic Report of the President* finds, the proportion of workers that received employer-sponsored training dropped by 42 percent from 1996 to 2008.⁶⁰ Expanding the Section 127 benefit could help address this challenge, especially considering U.S. corporate investment in workforce training (including for digital skills) as a share of GDP fell by 30 percent from 1999 to 2015.⁶¹

Establish a Knowledge Tax Credit That Would Allow Firms to Take a Tax Credit for Expenditures on Both R&D and Workforce Training

While firms invest less in R&D than would be optimal from a societal or economic perspective—because the benefits spill over beyond their ability to capture all of them—the same can be said of their investments in workforce training. Thus, just as there's a compelling rationale to incentivize firms' investing in R&D through R&D tax credits, there is an incentive to encourage investment in workforce training. Accordingly, Congress should turn the research and experimentation credit into a knowledge tax credit by allowing qualified expenditures on both R&D and workforce training to be taken as a credit, and expanding the rate from 14 percent to at least 20 percent.

Conclusion

As the modern economy becomes increasingly digitalized, a facility with digital skills becomes ever-more imperative for individuals wishing to make productive, value-adding contributions in their occupations. At the economy level, the broader quality of a workforce's digital skills base becomes a key determinant of enterprises' and industries' competitiveness and innovation capacity. A broad range of stakeholders—from individuals themselves to education systems across the K-12, community college, and university levels to businesses and nonprofits to government agencies—play important roles in developing a society's digital skills. Government policies can play catalytic roles in supporting funding for programs that teach digital skills and for getting the incentive environment right to stimulate corporate and individual investment in digital skills. The United States has clearly led the global digital revolution and certainly still has world-leading digital enterprises with highly skilled technologists in ICT fields.

However, in terms of broader workforce digital skills across the entire economy, the United States is increasingly faltering at the very time when those skills are becoming ever-more important across an increasing range of occupations and industries, a phenomenon that bodes poorly for long-term U.S. competitiveness if such trends aren't quickly rectified. As such, the United States needs to redouble its efforts here, and recommit itself to being a world leader in workforce-level digital skills.

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4. Report: Smart School Alliance

Jose Cheng, Director of International Cooperation, Institute for Information Industry

Overview

In 2013, the Institute for Information Industry (III) established the “Smart School Alliance” (SSA) project and since then has continued to run this program. Through live distance learning and collaborative learning, III has integrated the technology and education solutions of Chinese Taipei's smart learning providers and introduced learning resources to small schools in remote areas. The SSA breaks regional restrictions, makes learning free from borders, and gives equal rights to practical education.

The global outbreak of COVID-19 in 2020 has driven "online learning" from only an option or assist of our education environment to an irreversible new norm of education and learning. In addition, "cross boundary talents" has also become an important direction of education and cultivation in the post-epidemic era. In the face of a changing and unpredictable world, we need more flexible and adaptive education models and methods.

How can children in small and remote schools be given access to a new generation of education?

Smart School Alliance

In many economies, school principals often struggle to find the best teachers to educate students in remote areas. Because their schools are isolated and often very small, it can be difficult for students to make friends and develop a global view of the world. It is also tricky for rural school teachers to receive training for continuous professional development.

Smart School Alliance, founded by the Ministry of Economic Affairs and executed by the Innovation Learning Center, Digital Education Institute and Institute for Information Industry, consists of many small schools who become part of one big online and offline (O&O) school. The alliance provides innovative education services through the use of live webcasting, in addition to bringing the abundant resources of museums, the publishing industry, training agencies, technology companies and NGOs to create an exciting, well-rounded, globalized curriculum connecting students' learning to the world.

The aim is let students study locally but learn globally. Smart School Alliance invites top teachers from metropolitan areas to instruct students of outlying islands online, in order to build up their abilities. The alliance also invites students worldwide to share their local cultures, encouraging students to know themselves, understand others and explore the world. This model supports international interaction and improves cultural understanding, encouraging positive exchanges between different regions.

For educators, Smart School Alliance hosts meetings and provides O&O live classroom courses, training in distance teaching skills, interactive seminars and workshops. In addition, the alliance supports educators to co-prepare lessons, co-share equipment and offer the latest trends in learning technology, augmented and virtual reality courses and business.

Since 2013, Smart School Alliance has integrated the resources of over 70 companies from industry, developed over 100 programs, included over 750 schools and shared its work over 10 economies.

We use the DESC (Digital Elite Study Cube) and CoreLab (A learning management system for ICT courses, which provides the competency-based precise learning with hands-on coding exercises. system in distance learning in teacher training) to enhance the learning environment.

Introduction to the Live Interactive Cross-Boundary Courses

In this course, students from two Chinese Taipei's rural schools (Daluguan Junior High and Elementary School and Taichung Dong Yang elementary school) will learn English and Coding together through live streaming classrooms using Three-Way Interaction methods. In the online classroom, teachers will use the content of English picture books to create a teaching atmosphere. Then they will set goals with PBL (Problem-based Learning). Children can solve tasks by operating T.Robot, while increasing their interest in daily English learning at the same time.

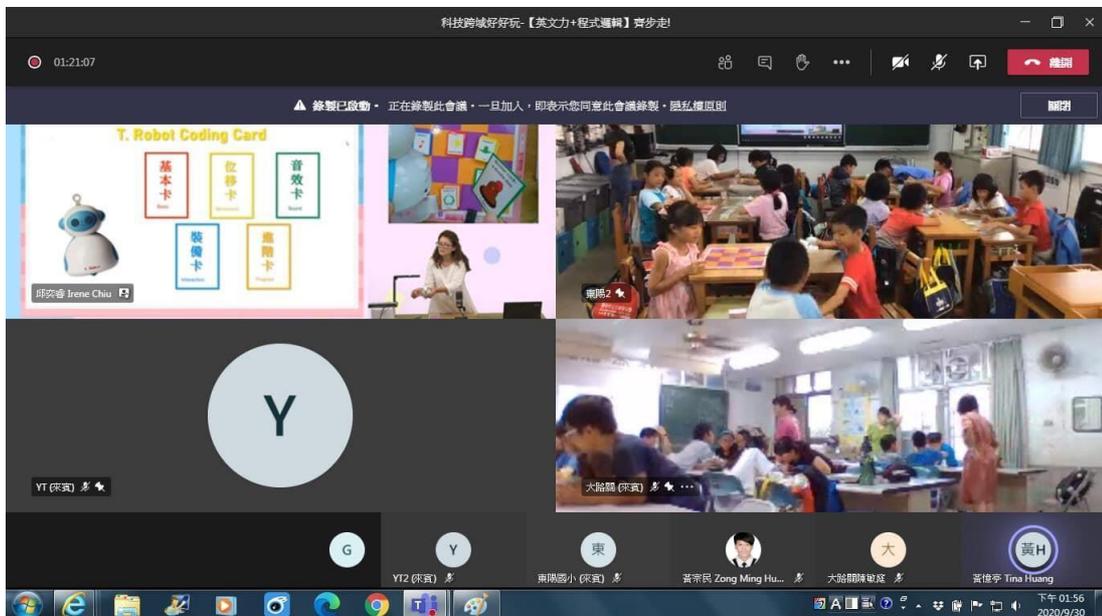
When designing cross-boundary courses' content, we particularly emphasize the integration of learning with daily life situations. Therefore, students can actually understand the steps to finding solutions of the problems they encounter. From planning, debugging, correcting, and verifying, operating the T. Robot machine and completing tasks, the ability of "computational thinking" gradually increases.

Table: Course planning

Unitary section	Summary
Talk to T. Robot	How do you communicate with robots? How are robots connected to our lives? Let's find out!
Brown Bear story	Learn how to change sound and color
Madas & the Tiger	Know your directions and play with T. Robot
T. Robot's driver's license	T. Robot is getting a driver's license
Hurry and wait	Life is very busy, stop and observe the world around you
Loop of programming	To simplify and find the pattern in programming is a very important skill, let's see what we can do with "Loop"
T. Robot takes a bus	What happens when a pigeon drives a bus?
The peace book	Introduce 12 zodiacs and categorize them
The peace book	Make your own unique pizza
If you are a Robot	Know the body parts of T. Robot and see how they are different from us
If you are a Robot	Connections between our body parts and movements.
Veggie garden	Understand how plants grow up
Veggie garden	Let's learn the nutrition of each fruit and vegetable then categorize them.
The red hen bakes a cake	The red hen found a recipe and wanted to make a cake. Let's help her!



Pic: The teacher in the virtual studio classroom



Pic: Live distance learning and co-learning mode's process

Introduction of Participating Schools

Located in Gaoshu Town, Pingtung County, "Daluguan Junior High and Elementary School" is the first Private Management of Public Schools in Pingtung County which has survived downsizing and organizational mergers. Their philosophy of running a school is based on farming and food, people-oriented, and life education. Therefore, the local students can enjoy a diversified learning environment with experimental spirit and share social resources.



Pic: Daluguan Junior High and Elementary School

The next school is located on the eastern side of the hillside of Dajia District, Taichung City. "Taichung Dong Yang elementary school" is located in a district that has been in a closed state due to the inconvenience in traffic. Therefore, the proportion of disadvantaged children is higher than other schools. In order to provide disadvantaged children with more opportunities in access to high-quality learning and to achieve educational justice, besides also strengthening the academy's ability, we actively promoted resources from multiple smart learning providers.



Pic: Taichung DongYang Elementary School

Introduction to the Course Provider

This course is especially grateful to Chinese Taipei's smart learning providers: Reading & Rhythm Co., Ltd with T.Robot; AVer Information Inc with Document Cameras; Ezoom Information, Inc. with Cooc Teaching Platform; and etc., for introducing learning resources into rural primary schools to promote the smooth development of this course.

Reading & Rhythm Co., Ltd

T.Robot is a set of teaching aids that combines the concepts of "Computational thinking" and "Gamification". Through the graphical instruction card or Mobile App, the robot can complete tasks according to instructions. This course uses English picture

books to design different themes and uses immersive situations combined with T.Robot to complete tasks. Students can simultaneously develop their English and program logic skills across different fields.

AVer Information Inc – Opaque Projectors

In order to reduce the difficulties of distance teaching in practical courses, teachers are required to receive training in both schools (Daluguan Junior High and Elementary School and Taichung DongYang elementary school) before the formal courses. Through training, the teachers can solve on-site teaching problems immediately. During the course, through opaque Projectors, students will be able to see how the teacher operates the robot while they are learning how to operate the robot, planning the command card, and displaying the robot's walking track.



Pic: Teacher training



Pic: Using opaque Projectors from AVer Information Inc. to display the teaching process

Ezoom Information, Inc.

In order to completely record the students' learning process, increase classroom interaction, and improve learning achievement, this course will use Cooc Teaching Platform. Through this platform, teachers can conduct before and after tests to observe the learning results and verifying evidence. They can also design classroom quizzes, use the platform's functions on the tablet to easily write, draw or design fun games. Even if they participate from online classroom scenarios, these functions can maintain the students' interest and improve their learning effectiveness.



Pic: Students operating Cooc Teaching Platform



Pic: Live interactive courses - The teaching scene in Taichung DongYang Elementary School

Learning Results

Quantitative Indicators

Through the functions of the CooC Teaching Platform, we conducted a before and after test at the beginning and end of the semester to observe the students' learning progress of online courses. Results show that students of a certain level did not see a decrease in learning performance in this course (their score still remained at 80 points), but there was a significant 25% improvement in the performance of the students with lower levels.



Pic: Students taking after test after the course on COOC Platform

Qualitative Description

This course was designed to stimulate the students' learning motivation, enhance learning interests, and ultimately improve individual performances. The course design uses English picture books with interesting stories about daily life situations, such as pizza production, plant growth, nutritional value of foods, taking the bus, and other topics. It can also integrate English words into popular cartoons or dances which are the favorite topics of Grade 3 and Grade 4 students. This method not only deepens students' memory, but also makes students excited to learn more.

On the students' learning list, it is evident that students are engaged by the teacher's selected topics as well as loving the teaching ways through the Cooc Teaching Platform. Teachers can ask them to finish drawing activities through online drawing on the tablet because it not only allows them to express their creativity, but also allows them to present their own work immediately or see how other distant students complete their work. The teachers in the local schools also shared with us that the students could assist the teachers after a few lessons. Live distance learning courses need preparation with some equipment in order for the classes to proceed. Students' initial assistance can improve students' active independence in assisting the teachers. Furthermore, they can learn how to operate technological equipment, which is part of the purpose of the courses.



Pic: Students learning process

Learning Results Presentation

As the course is conducted through Three-Way Interaction, students and teachers from both schools (Daluguan Junior High and Elementary School and Taichung DongYang Elementary School) only get to know each other online during live streaming classrooms. In order to increase learning motivation, we have provided meaningful lessons and encouraged students to compete in friendly competitions. We predetermined a final result presentation at the beginning of the semester, so that students know clearly what they have learned in the online classroom. We also held a competition with physical activities to let students and teachers see each other in person and show the result of their learning.



Pic: Second Activity – Fast Reaction

The presentation was held at the COME TO LEARN-BRAIN GYM CENTER by Digital Education Institute, III. The students and teachers of both schools (Daluguan Junior High and Elementary School and Taichung DongYang elementary school) started to meet each other through the "ice breaking activity", then the cross-school interactive competition was led by three teachers who came from both schools and III, where students attempt to complete the teacher's mission using T.robot. During this competition, the students could experience teamwork and brainstorm activities together. In addition to the results of the course, students could also experience the multi-application of information into education through the use of many educational research and development equipment. Such as: entering the virtual green studio, playing games using brainwave mind control, AI facial recognition and VR immersive learning, and etc.



Pic: VR immersive learning experience



Pic: Virtual Green Studio Experience



Pic: Brainwave games

Specialty Programs

1. Indigenous and New Immigrants Languages: For example, we have a full-time lecturer from Vietnam to teach Vietnamese. The teachers lead the children to learn Vietnamese step by step from traditional Vietnamese costumes, festivals, food, greetings, weather, transportation and other daily topics.
2. International English Theatre: Students are divided into groups according to their English ability, and the group members have to work together to complete their learning tasks.

3. Remote Digital Reading: In the course, children are guided to read many thought-provoking books and picture books, and the key is to let them develop good reading habits.
4. Robotics assembly learning: In addition to leading children to manually assemble robots, children are also taught to control their own robots through program editing to develop logic skills.

https://www.youtube.com/watch?v=hVOL_saXNb0

Program Features and Benefits

The primary goal of the SSA is to reduce educational inequality through the use of science and technology. Now, in the face of a global pandemic that has not been fully controlled, it is not only a trend, but also necessary for future learning to acquire the way of live distance learning mode or adapt to online courses. The success of this case can be shown in three different aspects that differs from the past:

1. Cross boundary learning: The interdisciplinary design of the course combines the two main axes: English and computational thinking, and is led by three different teachers in stages, depending on the content. In addition to the cross-disciplinary and adaptive abilities needed to develop future generations of talent, the combination of contextual stories that students like and hands-on robotics will greatly increase interest in learning and reduce the worrying distractions associated with distance learning.
2. Multiple applications: This course uses a number of educational science and technology resources such as: Virtual studio, Document Cameras, T.Robot, use of tablets, online platforms, editing software, and etc. These resources allows online course content to be smooth; screen of the teacher' operation is clearly seen; attendance can be done during the class and kept to record the data; video recorded files are also provided, which are convenient for students to review after every class. After all, the fluency and effectiveness of online courses are close to or even better than those of physical courses.
3. Humanity care: Children from rural areas are simple and lovely, but generally lack diversified experiences or peer stimulation. We have specially selected the Educational Research and Application as a place to publish their learning results and hoped to plant a seed of science and technology in their hearts through the experience of gamification technology equipment, so as to keep them up with the pace of learning of future generations. Cross-school co-learning allows them to interact with students in the same grade, get to know each other's local specialties and learn to cooperate and help each other. Among them, the tablet used by a class in Pingtung Daluguan Junior High and Elementary School was combined with the

equipment borrowed by Taipei municipal Nanhu Elementary School. Because of the curriculum, two schools from Chinese Taipei's north and south, can enable the circulation of teaching resources and enables children to learn how to cherish and be grateful.

The "Smart School Alliance" (SSA) project continues to integrate Chinese Taipei's high-quality education industry solutions, to provide more innovative digital learning courses in K-12 stage, while bringing resources into small rural schools and shortens the information gap, to train students with cross boundary capabilities and ultimately hope to overcome education inequality with technology.

Innovation and Revolution of Education

After the social transformations imposed by the appearance of the COVID- 19 virus and the pandemic that spread in the whole world, at the global level, besides imposing health safety measures, it has been necessary to implicitly create innovative educational models which focus on new aspects of distance social, as well as on the transition of all educational activities in the online environment, using methods and means of education different from those used in the educational act carried out face to face.

COVID-19 virus has radically changed the face of humanity, because it spreads at a worrying rate across the planet and has completely changed the way of life for ordinary people. The onset of the pandemic has forced authorities around the world to impose health and social measures on the population in order to protect the population from the disease and to slow down the spread of the virus. Against the background of this situation, many of the companies has sent their employees to work from home, others closed completely.

In the world, the isolation of the population has also determined the closure of schools, and the solution to continue education is to move the educational act online. Education is one of the basic links of society and although it has no tangible results, materialized in finished products. In reality without education, society is subject to collapse. The closure of schools has led to a forced decline in economic engines in all economies of the world, because the stay of children at home has also required the stay at home of at least one parent, thus causing disruption in all other areas of the economy. Also, the dimensions of social inequities have deepened with the pandemic. The disadvantaged areas, subject to poverty located mainly in rural areas, have become even poorer and the impact of students' staying home by closing schools caused students in most cases to break completely from school. The transition to digital teaching has

highlighted problems related to the lack of ICT training among both students and teachers, as well as the lack of internet connection, laptop, desktop, tablet, and printer.

What will be the next context? Certainly, for the return to school, in the next school year, additional hygiene measures will have to be ensured, social distance, wearing a mask will become a permanence, ensuring a framework with specialized medical training at the level of each school and especially in developing economies, the numerical resizing of students in a class by organizing staff with a maximum of 10-15 students, constant groups of same students, thinking about line flows in schools, different breaks for students and rethinking school programs by carrying out educational activities in open spaces.

All these aspects will be easier to accomplish in developed economies with a modern school infrastructure and ample funds as well as with a more flexible education system. Developing economies will encounter difficulties where schools may have unsanitary conditions with a toilet in the school yard and without being connected to running water, where the education system is always underfunded. Some schools' curricula may be rigid and not adapted to the needs of today's society, relying more on the transmission of information and less on the training of skills and competencies needed in the trades of the future. With the advent of the pandemic, education systems have undergone major transformations, as they have had to reinvent themselves and create or implement new models of education, models that can be developed without access to the traditional model of education developed face to face and rely more on technology, digitization and online education. Before we talk about innovative education models, we need to understand the current state of development of smart education.

Global Smart Learning Market

According to Research and Markets, the global smart learning industry covers three major areas: teaching hardware, teaching software, and teaching services and content. Teaching hardware mainly includes various interactive displays (e.g. interactive projectors, smart devices, interactive whiteboards, etc.); teaching software includes LMS, LCMS, adaptive learning platforms, assessment systems and others; teaching services and content include content materials (including audio-visual, text and audio-based content) and services (training, consulting and hosting services, etc.), showing that the smart The learning industry covers a wide range of areas. According to Technavio's survey, the global smart learning market will grow at a CAGR of 16% from 2018-2022, with an estimated market size of US\$72.66 billion over the next five years.

The increasing popularity of smart devices for learning (e.g., smartphones, e-readers, notebooks, digital learning applications, etc.), improved Internet environment, and increased demand for smart learning from enterprises and academic institutions have driven the development of the global smart learning industry. From the perspective of learning models, smart learning products and services can be divided into Social Learning, Blended Learning, Virtual Instructor Led Training, Collaborative Learning, and Simulation Based Learning. Simulation Based Learning and Adaptive Learning. The rapid advancement of network technology and environment (e.g., 5G communication) and the development of emerging technologies and applications (e.g., AR and VR) will drive the development of simulation teaching and learning services. Therefore, it is predicted that from 2020 to 2027, analog teaching services will be the fastest growing learning mode.

In addition, the outbreak of COVID-19 has also affected the smart learning market. According to the United Nations Education Scientific and Cultural Organization (UNESCO), more than 90% of students worldwide are affected by COVID-19 and are unable to attend school. In order to solve this problem, governments, organizations and educational institutions are offering online distance learning solutions to minimize the disruption of students' learning and their right to education.

Overall, the market will be driven by two main factors in the next few years, digital infrastructure and innovative learning applications. Digital infrastructure, the improvement of the network environment on campus and the popularity of learning devices (e.g. smartphones, e-readers, tablets, etc.) are the key, providing a friendly environment and channels to support digital, interactive and even personalized learning; innovative learning applications. In terms of innovative learning applications, schools and enterprises are concerned about pursuing more cost-effective, efficient, and high-quality learning experiences. Therefore, the demand for applications that optimize the learning process through collaboration among content, software, and hardware will gradually rise in the coming years, and the future development of smart learning is expected. For example, learning technologies that incorporate interactive elements (MOOCs, mobile, game-based learning, micro learning, adaptive learning, etc.) and teaching aids will be used as alternatives or supplements to traditional one-way teaching.

Chinese Taipei's Smart Learning

Chinese Taipei's smart learning industry consists of four main areas: Digital teaching materials, platforms/tools, learning services, and learning hardware. In 2019, Chinese Taipei's smart learning industry consisted of the teaching industry, software industry and hardware industry, with a total annual output value of NT\$133.58 billion.

With the outbreak of the COVID-19 pandemic, online learning has become the only option for students to avoid clusters and cancel their attendance at school. From the operation of the hardware and software, to the exploration of online real-time teaching, to the evaluation of students' learning effectiveness, teachers, students, and parents have all experienced a period of pain. After the longest summer vacation, students have returned to campus to attend classes, but the online learning model takes place hand in hand with the physical teaching. In the future, the use of online tools to replace some of the learning content and achieve multiple learning objectives will be a constant trend.

With the advancement of software and hardware technology, learning is no longer limited to traditional paper textbooks. Many schools have built "smart classrooms" or installed smart devices in classrooms to increase students' enthusiasm for learning through multimedia applications, and even added AR/VR interactive experiences.

The "smart classrooms" are of great help to both teachers and students. In the age of information technology, if students can get familiar with the technological devices early in school, it will do more good than harm to their future career development. In addition, compared to traditional textbook teaching methods, teaching through multimedia devices or interesting interactive experiences can increase students' interest in learning and their concentration in class, making learning more effective.

The impact of the epidemic has brought about two major changes in the education sector: firstly, there has been a significant increase in online courses, which has loosened the learning locations; secondly, teachers have changed from a single role of imparting knowledge to a multifaceted advisory role.

Nearly 43,000 smart classrooms at elementary and junior-high schools have been built or updated under the Forward-looking Infrastructure Development Program, according to the statistics of the Ministry of Education. The program's digital infrastructure project was designed to achieve a "digital economy". According to a survey conducted by the Ministry of Education, eighty percent of all students think that the integration of digital technology has made lessons more interesting, about 70 percent of students said that they are able to concentrate better in a smart-learning classroom, and more than 60 percent said that they feel a sense of accomplishment when using the new equipment to present their assignments.

Future Trends in Learning Styles

Courses Come to Life

In contrast to the past when teachers could gather students in the same place for learning through the constraints of the school or classroom, students are more likely to be less willing to learn because of the difficult and rigid curriculum, and then lose their motivation to learn and leave the classroom. Therefore, teachers will re-evaluate the learning materials and design challenging and interesting lesson plans to create a connection between learning and life, so that students can understand the "meaning of learning".

Learning to Personalize

Online learning, through watching videos and submitting online assignments, may seem to make learning unidirectional and lack interaction between teachers and students and peers, but in fact, when "all learning is online", it can actually enhance teachers' understanding of individual students and help promote learning towards personalization. Online education gives teachers the opportunity to analyze data to determine what students are good at, what subjects they prefer, what topics they are particularly interested in, and what stage of learning they are at, so that they can design differentiated teaching methods and move one step closer to the vision of teaching to the individual. COVID-19 has led to a global experiment in distance learning, further accelerating the growth of large open online courses such as Coursera, edX, and Udacity. Even after the epidemic is over and campuses are reopened, the future of teaching will still be an OMO (Online-Merge-Offline) model that combines online and offline.

The future of education will shift to "learner-centered" personalized learning. And in the big data analysis, artificial intelligence (AI) and other digital technology, students can not only learn in accordance with their own level, pace, interest, the content and progress of learning, the teaching system can also be based on student preferences, pushing students interested in learning topics to improve learning motivation or reduce the possibility of dropping out of school. Teachers can also refer to the learning progress of students, for different individuals to give suitable teaching. "The focus of learning is to learn through customized learning, and the past teachers only rely on the same speed teaching is completely different.

Cultivate Independent Learning Power

During the period of non-stop schooling, Chinese Taipei's students have begun to try and learn "self-discipline and autonomy", learning to plan their own learning progress and enter the classroom at the right time when they are away from school and unaccompanied by their classmates, reversing their past habits of having to attend classes and take exams due to the academic structure. We have also observed that the number of online learning platform users has increased by 62% in a single month since May, and the number of questions asked by students has also increased by more than 60%, indicating that students are gradually taking ownership of their learning, not only using digital tools to assist their learning, but also actively addressing their learning blind spots. How to help students maintain their enthusiasm and motivation for independent learning after they return to school will be an important issue for future teachers.

Teacher Role Change

With the development of education technology, 50 children can be taught in 50 different ways, and teachers can grasp students' learning status and data analysis in real time through the online teaching backend to provide different teaching directions. However, there are still challenges to overcome in online education. The lack of two-way communication between teachers and students on the Internet may cause learning obstacles, and secondly, we need to pay attention to the digital learning gap between different ages and regions of use.

Conclusion

The COVID-19 epidemic is a serious one, affecting the world economically, politically, and medically. The epidemic has affected 1.5 billion students worldwide, and physical campuses around the world have been closed, with courses being taught online in order not to interrupt learning. Chinese Taipei's schools have also stepped up their efforts to discuss online teaching. Through this pandemic, the world is experiencing a "digital learning revolution" that is accelerating the integration of technology with higher education. With the development of Internet technology and artificial intelligence, learning is no longer limited by time and space, and teaching and learning are taking on a different shape. In response to this new wave of pandemic, how education should change and whether digital technology can be used to enhance the appropriateness of education and the effectiveness of learning have become important issues that educational institutions are actively concerned about, committed to solving and promoting. In the face of the rapid social environment and policy guidance, educators should use digital education to innovate teaching strategies, integrate teaching, diversify teaching, deepen teaching, and cultivate the key competitiveness of students' employment and Chinese Taipei's overall digital economy. This is the most important issue of the day.

Technology cannot replace teachers, but it can increase innovation in education, especially as technologies such as virtual reality, AI, and blockchain are used in teaching, assessment, and personal learning applications, and many curriculum designs will need to change in the future. It is suggested that the secret to success in education is no longer just to impart a lot of knowledge, but to encourage students to discover their own dreams and passions in learning, and then to support them to become independent learners by setting their own learning goals, designing experiments, identifying problems and finding solutions, just like scientists and historians, and creating personalized learning. Personalized learning will be the future trend of education.