GFCC
Global Federation of Competitiveness Councils

Shift: Universities in Transformation

How COVID-19 Shaped the Universities of the Future

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The Global Federation of Competitiveness Councils (GFCC) is a network of leaders and organizations from around the world committed to the implementation of competitiveness strategies to drive innovation, productivity and prosperity for nations, regions and cities. The GFCC develops and implements ideas, concepts, initiatives and tools to understand and navigate the complex competitiveness landscape.

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Letter from the GFCC Leadership

On behalf of the Global Federation of Competitiveness Councils (GFCC), we are pleased to present its University Research and Leadership Forum's extraordinary report *Shift: Universities in Transformation.*

The report captures the experience of 26 universities around the world during the devastating COVID-19 pandemic. It is a true story of crisis, resilience, adaptation, innovation, and transformation—all taking place on the shortest timescale. It provides an inside view of the pandemic's many impacts on universities and how they responded. It also explores the potential long-term implications that this global disruption could have on higher education.

When the COVID-19 outbreak hit universities in March 2020, they joined governments, businesses, and other organizations across the globe in the largest case of "learning by doing" in history. Nearly every aspect of universities' multi-faceted mission has been affected—teaching, research and development, student housing and services, provision of health care, athletics, collaborations with businesses, and engagements in the local communities in which they reside.

Universities made a rapid shift to online learning unprecedented in the global education system to continue educating their students. Faculty and staff got a crash course in using online platforms for teaching, meetings, and collaborating. They rolled out new digital strategies that would have normally taken months or years, put in place social distancing measures on campus to help keep students safe, distributed testing kits to slow the virus spread, and provided mental health assistance to students facing hardship and struggling to adapt to virtual learning and social isolation.

At the same time, universities were pressed into service to fight the virus locally and globally, mobilizing research to understand COVID-19 and how it spreads; developing tests, protection measures, and therapies; providing testing kits for students and vaccine sites for the public; treating the sick in their hospitals; and opening dormitories for first responders and healthcare providers dealing with the public health disaster. We should all be inspired by what these universities were able to do when crisis struck their nations and communities.

Universities have a reputation for resisting change. But, in confronting these unexpected challenges, they were forced to improvise and innovate, and they did, making a wide range of changes in ten months that otherwise would have taken ten years as some have estimated.

This unprecedented experience in disruption and the management of rapid change is converging with a world and future of accelerating global, technological, and labor market change, and need for solutions to a wide range of social and sustainability problems. But the innovations and new approaches they deployed offer a glimpse of how universities could evolve to create the new knowledge, provide education and training, and expand roles within their communities in this evolving landscape of turbulence, more change, challenges, and need.

On the one hand, the pandemic has affected universities financially, reducing investments and stalling plans for campus expansion, physical infrastructure, and classroom renovations. On the other hand, the rapid scaling of online learning points to the real possibility of expanding the university's virtual footprint globally and providing learning at a scale previously unimaginable which could have game-changing impacts. Access and cost barriers to higher education could be reduced significantly for underdeveloped countries, the disadvantaged and disabled, those living in rural and remote areas, and those who are working or have family responsibilities. New tools such as artificial

intelligence and augmented/virtual reality could assist and amplify the learning experience. This is a chance to dramatically expand human capital development across the world.

Universities have long adhered to disciplinary structures. However, during the pandemic, faculty and staff came out of their silos and worked together in new ways to solve problems and develop and deploy innovative approaches to continue their operations. Solving the multi-dimensional challenges confronting society will require researchers and a range of other professionals to collaborate across fields. Universities will need to expand multi-disciplinary research and teaching to address these challenges, advance groundbreaking technologies, prepare students to work in the private sector where cross-functional teamwork is the norm, and to help the communities in which they reside solve a wide range of problems. We urge universities to continue their dialogue across disciplines, and in rethinking how they operate as they frame their future role in knowledge creation and human capital development.

The GFCC is indebted to the 26 universities that gave us an inside view of an unprecedented crisis and insight on the diversity of ways in which they coped. We are also grateful to the authors who produced four University 4.0 thought papers to challenge our thinking about the future of universities, and how they can recover from crisis and build resilience, leverage new technologies as a driver for change, and enable transformation in the communities they serve. These authors include: Professor Colin Grant, Vice President International and Professor Ioannis Kokkoris, Chair in Competition Law and Economics and Dean International both of Queen Mary University of London; Professor Aleksandar Subic, Deputy Vice-Chancellor and Vice President, RMIT University (Australia); Dr. Cate Roy, Senior Policy Analyst, Research Strategy and Integrity, and Professor Jim Metson, Deputy Vice Chancellor (Research), both from the University of Auckland. We also thank our GFCC members from Canada and Brazil that conducted additional interviews with university leaders in their countries.

The University Research and Leadership Forum was organized to serve as a think tank for exploring emerging trends and co-creating new ideas to optimize the critical role of universities in a nation's ability to innovate and compete. While we did not anticipate that a crisis would come to the Forum, we are fortunate to have it as a platform for sharing knowledge, experiences, and lessons learned, and to identify pathways for universities so they may contribute more to a better and more prosperous future for the people and communities they serve.

Charles O. Holliday Jr.
Chairman, GFCC

Deborah L. Wince-Smith
President, GFCC
President & CEO, Council on Competitiveness

Letter from the Leadership Committee of the University and Research Leadership Forum

The Global Federation of Competitiveness Councils' University Research and Leadership Forum is proud to present *Shift: Universities in Transformation, How COVID-19 Shaped the Universities of the Future*, chronicling the challenges universities faced as the COVID-19 pandemic swept the globe, how they developed and deployed innovations to continue their critical missions, and how these changes point the way toward a new paradigm for a transformed 21st century university.

None of the universities interviewed for this report had a pre-existing plan or model for continuing operations during a health or humanitarian crisis. But, beginning in March 2020, URLF members and our counterparts around the world experienced severe disruption in nearly every facet of our operations—teaching and services to students, research, student life, our engagements with businesses, and the support we provide to our communities.

Determined to maintain core missions, our universities faced hard challenges: transitioning rapidly to world-class online learning at scale, deploying new digital infrastructure quickly, training faculty in online teaching, serving student populations across the digital divide, preserving ongoing research in the laboratory and field, instituting social distancing measures in classrooms and student housing, helping students with deteriorating mental health, and financial constraints.

While making every effort to fulfill the education mission, universities were also pressed into service to provide the world the science to unlock the virus and mitigate its spread, and develop the personal protective equipment, treatment protocols, testing kits, vaccines, and therapies that have saved the lives of millions.

Universities have played a critical role in managing this public health crisis. They have provided data modeling to build scenarios to inform policy planning, and national and local leaders' decision-making. Our health and public policy schools have worked with national governments, local authorities, and communities to help develop public safety and containment measures to stem the virus, provide advice during discussions on what to do, and educate the public.

Universities deployed health care resources to help manage the crisis in their communities and nations, treating patients, serving as testing sites, and deploying pop-up vaccine clinics. For example, at the virus's peak, University of Auckland facilities provided about half of New Zealand's testing capacity. When COVID-19 first hit the United States, Arizona State University (ASU) built a testing laboratory on campus with the capacity to test thousands of people daily for free and set up other testing sites around the state. In January 2021, ASU's on-campus testing site was turned into a vaccination site, delivering 8,000 shots daily. By February 2021, more than 300 U.S. government personnel were working on-site and, by March 2021, ASU was vaccinating two-thirds of the state's population. As the pandemic raged in the summer of 2020, Northeastern University opened its unused dormitories for first responders and healthcare providers who needed housing to keep themselves and their family members safe.

Universities' responses to the COVID-19 crisis revealed their institutional capacity to react at speed, adapt, and develop new strategies and approaches. They drew on a deep well of resilience, demonstrated by delivering on their missions brilliantly under dire conditions. They produced and applied new science, technology, and innovations in a timeframe previously thought to be impossible. They found innovative ways to continue their critical role in developing the world's human capital. They

Photo courtesy of the University of Auckland

Jacinda Ardern, the Prime Minister of New Zealand, visited the University of Auckland to discuss Covid-19 vaccine research and development projects at the university. mRNA research and developments are expanding beyond Covid-19 and are being translated to influenza vaccine advancements.

Photo credit: Jerry Gonzalez, Arizona State University

The drive-thru stations were ready for vaccine patients prior to the opening of Arizona's second vaccination site at ASU's Phoenix Municipal Stadium.

quickly made management, organizational, and technology changes that normally take months or years, while faculty worked in new cross-functional ways to solve complex problems. And they served their communities when most in need.

The challenges of the COVID-19 disruption have caused many universities to take a hard look at how they invest their funds, how they provide access to learning, the ways in which faculty and staff from different university departments and different organizational levels work with each other to solve problems and create solutions, and how to measure success as faculty and impact as an institution. This rethinking is a healthy exercise in long-standing institutions that have been comfortable in their ways but must consider their future in a world that promises greater and more frequent disruption and change.

Taking a critical lesson from the history of other sectors that made major transformations, the role of university leaders will be pivotal in applying what we have learned, setting priorities, and creating an environment that encourages innovation. They must collaborate across the institution to co-create and communicate a new vision, develop a culture oriented to the future, articulate the values and principles that can serve as reference points for decision-making and guideposts on pathways toward the future state, empower agents of change and reward innovators, recognize that taking intelligent risks is part of transformation and the management of change, and help people develop new roles as the institution changes. Also, new pedagogy may be needed as we embrace new technologies such as artificial intelligence, simulation, and augmented/virtual reality.

Universities play a vital role in their countries. They educate and train the next generation of the workforce, create new knowledge and technologies that drive new business formation and help their countries compete. They fuel economic and industrial development, and help solve problems in the regions and communities in which they reside. These missions are only growing in importance and ever more critical to the future of society and nations.

Prof. Pradeep Khosla
Chancellor, UC San Diego
Founding Chair, URLF

Prof. Colin Grant
Vice Principal—International,
Queen Mary University of London

Prof. Isabel Capeloa Gil
Rector, Catholic University
of Portugal

Prof. Hassan Al-Derham
President, Qatar University

Prof. James Metson
Deputy Vice-Chancellor,
University
of Auckland

Prof. Dr. Mohamed Ibrahim Abdul Mutalib
Vice Chancellor & Chief Executive Officer, Universiti Teknologi PETRONAS

Letter from the GFCC Executive Director

Bridging Realities

The COVID-19 pandemic has had major impacts across many sectors. Like other organizations and people all over the globe, the GFCC was forced to adapt its agenda to a dramatically changing world. This included adjusting its plans for the University and Research Leadership Forum (URLF).

Over this extraordinary period of worldwide disruption, the URLF carried out two parallel and complementary efforts. First, it took initial steps to develop a vision for the technology-enabled, impact-oriented university—or University 4.0. In parallel, at the height of the pandemic, GFCC university members identified the main challenges and changes taking place in higher education in their countries. This report bridges these two work streams and highlights the main findings of this work.

During 2020 and 2021, the GFCC University 4.0 initiative included a series of online workshops in partnership with university members including the University of Southampton and the University of North Carolina at Chapel Hill. Leaders from Queen Mary University London, the University of Auckland, and RMIT University developed timely discussion papers that captured different views on the future of universities. GFCC staff interviewed these authors, and they presented their ideas during online panel discussions. In addition, our colleagues from the University of North Carolina at Chapel Hill developed an analysis of trends shaping the future of higher education, which they presented and discussed in an online session.

The ideas and insights generated through these activities shed light on the different roles that universities play and on the complexity of challenges they face. Rapidly changing technology is reshaping higher education. Societies have raised their expectations about what universities should do. Education is unbundling, with offers being increasingly fragmented, digitized and available throughout the productive life of all of us. Institutions are called to respond to new and diverse demands. There is a growing variety of universities around the world, new models continue to emerge, and universities face new competition from non-traditional education and training providers. We can expect this diversification to continue. Despite these ongoing challenges, higher education institutions have proved to be highly resilient. They have been around for centuries, faced many historic changes, kept evolving, and are uniquely positioned as trusted players in societies.

Universities are becoming more integrated with economies and societies worldwide. Still, pressure is mounting for universities to take on new roles such as serving as drivers for regional economic growth, stimulating entrepreneurship, establishing global footprints, networking with other universities and the private sector, operating as knowledge translators in the research enterprise, and leveraging technology in research, teaching, and learning. Fulfilling these growing expectations will require leadership, novel organizational solutions, and new management models. Universities must understand the forces shaping the world, envision future roles and prepare to meet the needs of societies and their communities.

Dr. Roberto Alvarez
Executive Director, GFCC

University Leaders Interviewed

Arizona State University
Prof. Neal Woodbury
Vice-president for Research and Chief Science and Technology Officer for ASU's Knowledge Enterprise

Catholic University of Portugal
Prof. Filipe Santos
Dean of Católica-Lisbon School of Business and Economics

Georgetown University
Dr. Spiros Dimolitsas
Senior Vice-President for Research and Chief Technology Officer

Kiev National Economic University
Prof. Dmytro Lukianenko
Rector

Monash University
Prof. Ken Sloan
Deputy Vice-Chancellor (when interviewed)

Prof. Sloan currently is the Vice-Chancellor and Chief Executive Officer of Harper Adams University

Northeastern University
Mr. Michael Armini
Senior Vice-President for External Affairs

Ohio State University
Prof. David Williams
Dean of Engineering (when interviewed)

Prof. Williams currently is Professor of Materials Science and Engineering at the School of Engineering

Okinawa Institute of Science and Technology
Prof. Mary Collins
Provost

Purdue University
Dr. Dan Hirleman
Chief Corporate and Global Partnerships Officer

Qatar University
Dr. Darwish Abdulrahman H. Al-Emadi
Chief Advisor to the President

Queen Mary University London
Prof. Colin Grant
Vice Principal (International)

Prof. Ioannis Kokkoris
Dean for International, Faculty of Humanities and Social Sciences

RMIT
Prof. Aleksandar Subic
Deputy Vice-Chancellor STEM and Vice President Digital Innovation (when interviewed)

Prof. Subic currently is the Vice-Chancellor and Chief Executive of Aston University

Tecnologio de Monterrey
Prof. Joaquín Guerra Achem
Academic Vice-rector for Innovation and Education

Ms. Paulina Campos
Project Coordinator COVID-19

Universidad Nacional de San Augustin de Arequipa
Prof. Rohel Sanchez
Professor (Rector when interviewed)

Prof. Jose Luis Isauro Vargas Gutierrez
Head of International Cooperation
(In memoriam)

University of Auckland
Prof. James Metson
Deputy Vice-Chancellor (Research)

University of California San Diego
Prof. Pradeep Khosla
Chancellor

University of Chicago
Prof. Ka Yee C. Lee
Provost

University of Illinois
Dr. Jay Walsh
Vice President for Economic Development and Innovation

University of Newcastle Australia
Dr. Tony Travaglione
Chief Executive Officer and Board Director

University of North Carolina Chapel Hill
Ambassador Barbara Stephenson
Vice Provost for Global Affairs and Chief Global Officer

Mr. Terry Magnuson
Vice Chancellor for Research

Dr. Todd Nicolet
Vice Provost for Digital and Lifelong Learning

University of South Carolina
Mr. Chad Hardway
Deputy Director Office of Economic Engagement

Mr. William Kirkland
Executive Director Office of Economic Engagement

University of Southampton
Prof. Mark Spearing
Vice-President Research Enterprise

Webster University
Prof. Julian Schuster
President

The Covid-19 Pandemic forced universities to rethink the format of classrooms and adapt in-person classroom layouts. Tecnológico de Monterrey developed a Hyflex+Tec Model that allowed students a hybrid and flexible educational experience. To make students comfortable with in-person learning, the university set up socially distanced and masked classrooms.

Photo credit: Abigail Guzman, Tecnológico de Monterrey

Foreword

Universities are essential growth engines in the knowledge economy. They play a fundamental role in developing people's talents and competencies, training young generations, and reskilling the workforce. But their outreach and mission go much beyond that. In today's world, universities are active actors in innovation ecosystems, engaging with multiple stakeholders to translate knowledge creation into economic and social impact. For that reason, universities are essential players in the GFCC Community.

For more than ten years, the GFCC has been a platform to share experiences, best practices, and strategies to drive innovation, competitiveness, growth, and prosperity. In 2016, the creation of the University and Research Leadership Forum reinforced the GFCC's commitment to catalyze conversations across sectors and elevate talent and education in the competitiveness agenda. Since then, the GFCC has been working with its members to stimulate thinking and the exchange of future-shaping ideas across academia, industry, policymaking, government agencies, manufacturing, and the business sector to advance the university enterprise.

The COVID-19 pandemic has been a significant disruptor that radically transformed higher education. The rapid shift to online learning was unprecedented in the global education system, accelerating digital transformation and driving ten years of changes in a few months. In many cases, universities went through a trial-and-error period, deploying emergency responses to cope with lockdown measures and COVID-19-related restrictions. Between March 2020 and June 2021, universities experienced a learning curve, searching for ways to improve digital infrastructure and pedagogy. Digital systems, networks, and online platforms have been crucial for resilience and successful responses. This digital infrastructure allowed universities to continue operating and engaging students during lockdowns and managing relationships with external partners. But the rapid shift to a fully digital learning environment also brought significant challenges to students, professors, and staff. There have been increased concerns about mental health issues, the quality of remote learning, and soft skills development.

The first part of this report captures the impacts of COVID-19 in the higher education sector on education delivery, research, laboratory operations, and fieldwork. It lays out how universities interacted with non-academic stakeholders during the pandemic, particularly government, industry, and local communities. It identifies positive changes and pitfalls stemming from these experiences. All information is based on a series of interviews conducted by the GFCC with 31 university leaders in eight countries. In addition, it includes information from three interviews with university leaders in Brazil conducted by URLF member Prof. Eduardo Oliveira, Head of the Center for Strategic Technologies in Health at Paraiba State University, and four interviews with university leaders in Canada conducted by GFCC fellow Ms. Lori Schmidt. Information was cross-checked with international databases, reports, and academic articles on the matter. We are thankful to the leaders who devoted their time to helping us make progress in this initiative and advance the university enterprise.

The second part of the report examines the road ahead, the long-term implications of the trends accelerated during the pandemic, and the game-changers influencing universities. During the pandemic, universities have shown their institutional capacity to adapt, react at speed, and build resilient and future-thinking strategies. This experience occurred in a moment of growing expectations about universities' role in society, and increased competition from vocational training institutes, startups, and the business sector in delivering education and training. There are many opportunities arising at the intersection of education and industry, and the digital transformation in higher education has just started. Widespread digitalization of education and training could profoundly alter societies, improving accessibility and scaling learning to reach more people across the globe.

Tackling today's challenges will demand new knowledge creation and cross-sector collaboration. The GFCC Community seeks to develop a body of knowledge with principles, guidelines, and best practices to advance the impact-oriented and technology-enabled university. This report is one step in that direction.

Together, we can build innovative ecosystems with future entrepreneurial universities.

Executive Summary

The COVID-19 pandemic has accelerated changes in the higher-education sector, advancing at least ten years of digital transformation in a few months. Lockdowns and safety measures required universities to react at speed and rethink how they operate. Education moved online at an unprecedented scale bringing new challenges and opportunities for teachers and learners worldwide. This transition represented a paradigm shift, and it will have long-term repercussions on future university models.

In this new report, the GFCC captures the pandemic-related impacts on higher education and the innovative solutions universities put in place to respond to the crisis and explores the long-term implications of the current situation on university models, identifying the game-changers shaping the future of the higher education sector.

This report includes information and data collected through interviews conducted with university leaders in the GFCC Community between November 2020 and March 2021 in eight countries: Australia, England, Japan, New Zealand, Qatar, Portugal, Ukraine, and the United States. In addition, it provides a landscape view of responses in Brazil and Canada based on information collected by URLF member the State University of Paraiba in Brazil and GFCC fellow Ms. Lori Schmidt in Canada. The report also references case studies, other reports, and academic articles. Finally, it provides views of industry leaders from Brazil, Japan, and Malaysia.

Worldwide, universities are diverse in what they do, how they carry out their missions, and their funding mechanisms. Th university members of the GFCC are primarily research universities. They play an essential role in developing innovative solutions, creating new technologies, and advising government and policymakers. During the pandemic, universities drew greater public attention to the important role they play in providing scientific knowledge and informing public debate. The pandemic also increased the demand for universities to foster social impact and be active actors in their local communities to advance prosperity and economic growth.

Key findings from the GFCC Global Scan

The pandemic has impacted universities significantly.

Like all nations and businesses globally, universities were surprised by the spread of the new coronavirus and the devasting effects of the pandemic. None of the universities interviewed had a model for responding to a health and humanitarian crisis. The institutions with digital infrastructure and preparedness to use it proved more resilient. But, even in these cases, the rapid shift to a fully digital learning environment brought multiple challenges. Fieldwork and laboratory operations were seriously disrupted, with the latter resuming in some locations under safety protocols in the second quarter of 2020. Students experienced hardship adapting to virtual learning. The lack of social interaction and community bonding posed a significant challenge, raising alarm about student mental health and trauma. The quality of remote learning has also raised concerns. Finally, COVID-19 seriously affected universities financially, leading to budget cuts and spending restrictions.

Technology will create new opportunities for learning.

Advancements in technology pose both challenges to universities and new opportunities to expand and scale access to learning. Historically, universities have served a fortunate few who could afford tuition costs and had free time available for studying instead of working full-time. Technology enables new models and the potential for providing online access to education anywhere in the world across time zones. Scaling online learning can reduce the cost of education and enable greater engagement with non-academic stakeholders, for example, enriching learning through knowledge and experience from industry and the business sector.

Universities will emerge from the pandemic with new operational models.

Multidisciplinary collaboration and approaches have been a positive outcome of this major disruption that will likely remain once the pandemic ends. Staff and faculty from different departments and hierarchical levels worked together in task forces to solve problems created by the crisis. Learning from the COVID-19 experience, universities will likely adjust models to suit a fast-changing reality in which technology enables new capabilities and more experimentation. It is crucial to engage in ongoing partnerships with non-academic stakeholders and respond to the education and skill needs of the emerging knowledge-based digital economy.

Increased competition will be a hallmark in the future of education.

During the pandemic, the expansion of online learning has driven a boom in non-traditional educational providers. From startups and new EdTech companies to the increased use of MOOCs and other platforms—such as Coursera, Future Learning, and EdX—multiple new business models compete in the education sphere. Big tech companies are also developing career programs and creating special academies with professional courses. Many big tech companies stopped asking for a conventional bachelor's degree in the recruitment process. Candidates can qualify by demonstrating proof of equivalent practical experience.

Sustainability and social impact will become core elements of the university mission.

COVID-19 caused universities to reexamine their mission and impact on the planet. They are likely to expand their mission with the goal of contributing more to sustainability and social gains at local, national, and international levels. This goal will need to be integrated into their research and education programs to achieve these outcomes.

The Search for an Interactive and Open University Connected to Industry

Gianna Sagazio

The COVID-19 pandemic has made the value of science to society indisputable. It also stressed the importance of collaboration and interdisciplinarity to solve problems and reinforced the need for innovation in response to humanity´s challenges. The development of COVID-19 vaccines in record time demonstrated the power of combining these three elements: professionals with different skills involved in projects that resulted in new immunizing solutions for people worldwide.

In light of this success, a virtuous model for universities in the 21st century seems to promote knowledge generation in a collaborative and interdisciplinary way by offering quality education that is plural and emancipates individuals, preparing young people to face national and global challenges. After all, the world needs to foster and embrace diversity in leadership to build a better society in economic, environmental, and social terms.

Universities need to offer more context-based and practical education that makes sense for students in their everyday lives and allows them to use this knowledge to interact in a more precise and more concrete way with the present and the future. One of the most important trends in industry, for example, is the digitization of all activities. With increased automation and data-driven decision-making processes, industrial production becomes less labor-intensive.

This new reality poses numerous challenges for future generations and current organizational models in society. Dealing with such changes requires the constant creation and application of new knowledge. Since universities are the locus of knowledge production and training of new professionals, they play a pivotal role in shaping the future of young people. Therefore, they must offer training that fosters creativity, cooperation, experimentation, multidisciplinary and systemic problem-comprehension, continuous learning, and the ability to develop feasible solutions from a technical, humane, economic, and environmental perspective. These are essential requirements for professional performance and life and citizenship.

Ms. Gianna Sagazio
Innovation Director, Brazilian National Confederation of Industries (CNI)

This brings us to a crucial point: we must bridge the division between disciplines and technological and scientific areas. From the industry´s perspective, the best way to achieve this is to emphasize STEM (Sciences, Technology, Engineering, and Mathematics) education. Arts and Humanities must be integrated into this for young people to perform well in tasks beyond the hard technology areas, which are also essential in product development and problem-solving. Understanding the target audience, for example, and their needs and desires is increasingly relevant in the market. Therefore, critical and comprehensive understanding, design, communication, and teamwork are essential abilities more easily developed in a multidisciplinary approach in education at all levels. That is why adopting a STEAM perspective, including the A as a reference to both Arts and Humanities, has been a growing educational trend globally. This means offering students the opportunity to interact in different knowledge areas and in diverse human settings, which will likely become the norm in their personal and professional lives.

Offering training and education in these terms is not a trivial task. The predominant tradition in higher education systems, in Brazil and other countries, is based on passive learning and the maintenance of a disciplinary division in the way teachers transmit content, with direct impact on evaluation indicators of student performance still highly content-oriented without measuring actual ability to apply knowledge in real-life situations. This produces graduates not necessarily ready to perform professional activities in the productive sector. Breaking this tradition requires profound institutional, pedagogical, and organizational changes to transform the current university culture. More than overcoming resistance from one or more teachers, always natural during changes, we need to build consensus on the need to better adapt to a new world context. In this sense, we believe that a third point to be underlined concerns the crucial role of institutional leaders in conducting this process. Leaders need to be partners in building an academic environment that supports migration to new education and training models. This necessarily involves supporting and preparing teachers in new methodologies and giving them a leading role in this transformation that cannot happen without their engagement. It also involves connecting national universities to their counterparts worldwide to expose them to other pedagogical cultures and practices.

We would add a fourth element to this discussion about the future of the university. For this game to be virtuous, players must understand their different roles and positions. Higher education institutions can and should have different profiles and missions aligned with the characteristics of their specific communities and be recognized and evaluated by external actors for their excellence in fulfilling their manifest mission and role, instead of aiming at performing well against indicators of one-size-fits-all stimulated by current evaluation practices. Across the higher education landscape, there is much space for institutions that carry out teaching and research (whether basic, applied, or both), but also for those more focused on quality professional training, beginning with a collective understanding from society and national evaluation systems that the specialization in teaching over basic research is not less valuable or important to society, as is the case today. It is counterproductive to deny students the opportunity to access a quality educational experience, be it the training that prepares students to apply knowledge wherever their chosen career paths may take them. Therefore, policies and leadership must allow diversity in higher education models to live up to the role expected of universities in a knowledge-based society.

In Brazil, MEI, a movement of business leaders coordinated by the National Confederation of Industry (CNI), is stimulating this debate through the work of its "Human Resources for Innovation" agenda, especially with the work carried out by its working group on "Engineering/ STEAM." Created in 2016, the group contributed to defining the new "National Curriculum Guidelines for Undergraduate Courses in Engineering" that have to be followed by all educational institutions in Brazil. The new regulation incorporates the various demands of the productive sector, such as the need for more practice-oriented training, the idea of continued education (where everyone is a lifelong learner), and the need for solid interaction with the external community, more specifically with the industrial sector. The emphasis placed on these dimensions of the learning process is meant to prepare young people better to face the present and future challenges they will encounter in their chosen professional careers, be it as company employees and leaders, as entrepreneurs, as researchers, or as teachers in a more academic setting.

In our rapidly changing world, increasingly digital, opportunities for cooperation, be they local, national, or international, emerge from new educational arrangements integrated into society, with the potential to reshape not only higher education but the future of humanity.

As part of this agenda, CNI/MEI and GFCC organized the first Industry-University Partnerships for Impact Forum in March 2022 in Brazil. The event had participants from different parts of the globe to discuss not only the importance of the partnership between these sectors for innovation process, but also trends and good practices of cooperation. In this sense, the event reinforced at least two basic aspects. On the one hand, the importance of building agendas that combine the interests and demands of companies and academia, and on the other hand, the need to expand partnerships to encourage the emergence of startups to have a more innovative and collaborative ecosystem.

In summary, the university we want should rethink itself to offer quality training through a more interactive, open, and collaborative educational model, whatever the particular vocation or mission of the institution may be (more research-oriented or not). In our rapidly changing world, increasingly digital, opportunities for cooperation, be they local, national, or international, emerge from new educational arrangements integrated into society, with the potential to reshape not only higher education but the future of humanity. Therefore, the cutting-edge university we desire is open to debating its ideas and certainties with society, listening, adapting, and anticipating crucial trends and changes, serving as a privileged space for building a better and more prosperous future for all.

Decoding the Now in Education and Research — Why it Matters to Decode the Now

Maria Norton and Peter G.R. Smith

The COVID-19 global pandemic has changed the world — and its effect on education and universities cannot be underestimated. This piece looks at why it is so important to reflect upon where we are today before seeing how the future can and should develop for higher education.

This thought piece was written in March 2021, based on two GFCC sessions on education and research led by Ms. Maria Norton and Prof Peter G.R. Smith, held on November 12, 2020, and January 21, 2021.

Ms. Maria Norton
Senior International Partnerships Manager, International Office, University of Southampton

Prof Peter G.R. Smith
Associate Vice-President, International Projects, University of Southampton

Which narrative best describes COVID-19: Hollywood or Hindenburg?

The film narrative — What part did you play in the COVID-19 pandemic? Were you an actor? Were you in the audience? Were you writing the script? Were you directing your future?

The disaster narrative — More akin to a tragedy? Are you still in shock? Were you in the crash? Were you a bystander? Were you a first responder? Were your loved ones in the tragedy?

Whichever standpoint you prefer, what is clear is that the world of education and research in universities is changed forever. Looking back at the 'pandemic pause' 2020 bequeathed us, will university leaders classify it as a disaster, or is there a more positive narrative that will shine through? Our intention in crafting this piece is to provide a framework we might reset, creating a new script for higher education.

The goal of the Decoding the Now sessions was to create an opportunity for university leaders to pause and reflect on the reality of today, recognizing that our institutions are still in the middle of the crisis facing significant financial implications and an uncertain future. This piece shares learnings from the two sessions and will be a key input to the GFCC University 4.0 initiative.

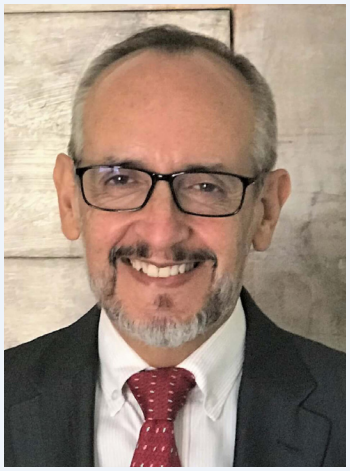
The most powerful message from the Decoding the Now in Education and Research debates is that universities can change and, indeed, the appetite for change is growing at pace. While change might trigger 'fight or flight' as your typical human response, the pandemic-related restrictions in many countries meant that we had to find workarounds and, much of the time, we turned to information and communication technology (ICT) tools for solutions.

The live laboratory of 2020 pushed us to go remote and adapt, ushering in a rapid uptake of digital technologies; a much-quoted figure is that we advanced ten years in ten months in this realm. One obvious advantage of ICT is the potential for scale and the tremendous reach they afford. However, it also became apparent that the COVID-19 pandemic was an inequity amplifier, and the digital divide that beleaguered the 'have nots' hampered their remote learning during the lockdown. Neither owning devices and/or a reliable internet connection was a guarantee of undisrupted education; many educators had scant training in providing good teaching that is technologically mediated. In the reimagined education space, we would advocate for universal access to digital technologies.

The disparity of access highlighted the need to enable a more accessible higher education system — rather than simply supplying all with Zoom University sweatshirt merchandise! How might we engage with industry and government — forming the Triple Helix — to provide more scholarships and initiate broader funding models?

The new education script would also ensure a modality that fosters community building at the heart of the learning experience; with the majority of university students aged 17-24, socialization with their peers is critical at this coming-of-age developmental stage. Therefore, the ICT employed needs to facilitate relational interaction - not the transactional content transmission of the lectures of yore.

Learning is emotional, and this human experience needs to be provided with tools that enable the 'safe spaces' conducive to growth for a more humane ecosystem that can evolve naturally, organically. We must acknowledge that our educators require support to develop their online teaching repertoire. We cannot take it for granted that a great lecturer can transform themselves into a fine online teacher, nor can we underestimate the importance of involving learning designers in the mix.



One of the big challenges I see is that for many institutions, unfortunately, there is this attitude of just waiting for the thunderstorm to be over, assuming that they will go back to business as usual. And I think they are wrong, honestly. So the big question that I have for institutions is: what are you doing? Are you just watching the movie, are you in the movie? Are you, being, acting, you know, proactively or are just emulating what others are doing?

Francisco Marmolejo
President of Higher Education
Qatar Foundation

In matters of research, how we measure success is shifting from "publish or perish" — to amplifying our social purpose. This is important for the impact-ambitions of our early career researchers and the notion of being a good citizen seeking favorable outcomes for their community; this aligns with the civic duty of the university.

There is a groundswell heralding the opportunity to change what we measure; while more of a narrative is being sought on researcher CVs by funders, the KPIs for promotion within higher education institutions are still grant- and publication-driven.

As the rules of engagement are being re-written, more equitable and sustainable models will provide the way out of the crisis as we accelerate our ability to improve the quality of life for our communities. The activities driven by the COVID-19 response redefined groupings and impact in a range of spheres, including technology, public health, and the private sphere. We are developing a common language to foster greater interdisciplinary research that sees us flexing our (multiple) identities, co-creating in new groupings, and for further engagement. The challenge for academic leadership is NOT to allow us to return to our silos.

We must reimagine the future, and we dare you to take up the gauntlet with us.

It's a massive opportunity to bounce back in a new way, a much more collaborative, sustainable way of working with a smaller carbon footprint, that's blended…This is the opportunity of a lifetime.

Prof. Rachel Mills
Former Dean of Environmental and Life Sciences
University of Southampton

The Impacts of COVID-19 on Universities

Introduction

The COVID-19 pandemic deeply impacted universities, accelerating existing trends with several implications for the future. In the context of the rapid change that occurred in a short timeframe, it is crucial to understand short-term effects, the strategies universities adopted to respond to the crisis, and the main challenges they faced.

First, this section describes the impacts of COVID-19 on internal operations, covering online education, research and laboratory activities, fieldwork, student life, and budget cuts. It then moves to how government and industry partnerships changed during the pandemic and how universities responded to the needs of communities. Finally, it discusses immediate and long-term challenges identified during the interviews conducted for this report: growing mental health issues, cuts in research funding and laboratory-based research, lack of internationalization, and faculty readiness. But there have also been many positive changes at universities, such as increased communication and multidisciplinary collaboration.

Internal Impacts

Online Learning

The COVID-19 pandemic began seriously impacting higher education institutions in March 2020. During the first months, universities deployed primarily emergency responses. Even though none of the institutions interviewed had a plan for operating during a possible global pandemic, most were able to switch their mode of operation in a couple of weeks or as short as a couple of days.

The most immediate and dramatic change was the rapid shift to distance learning, either online or hybrid learning. The first response was to move everything online as fast and seamlessly as possible. For many universities, this meant crash courses for faculty and staff on using online platforms and providing extra resources for students to participate in their education from a remote setting.

During the period between the end of spring 2020 and beginning of fall 2020, universities had a chance to evaluate what worked, what did not work, and what would be possible for the short term. For many, this meant deciding what model of learning they would implement: online learning, hybrid learning, or in-person learning. This was also a time to reallocate funds and budget for operations during the pandemic.

In fall of 2020, the situation started to change in some locations with massive testing. Universities that could have a large number of students, faculty, and employees on campus had to figure out COVID-19 testing, tracking students and their health, safe social distancing in the classroom, what to do if students tested positive, and how to manage students and faculty who were on-campus or teaching and learning remotely.

Universities that operated with online learning only had to ensure that all offered courses were transferred to virtual platforms, and that faculty were trained on online delivery and online pedagogy. It was crucial to evaluate the students' experience, their engagement and involvement with the university, and if they were getting a quality education.

As universities continued to experiment with online and blended learning during the pandemic, they made minor changes to fine-tune their approach as time went on. These changes included perfecting syllabi for online courses, increasing in-person teaching and learning, and adopting an appropriate mindset and expectation for what higher education would look like during a global pandemic.

Making the most of online learning during the pandemic proved challenging but doable. The resilience of the university—its staff, faculty, and students—proved that higher education can persevere in a crisis when it's able and willing to adapt.

Research, Laboratories, and Field Work

Universities faced difficulty continuing research, laboratory work, fieldwork, and performing arts courses compared to other subjects such as the social sciences and humanities, which are more adaptable to a virtual environment and less reliant on in-person activities. Most universities had no reasonable alternative for remote laboratories, and often lab courses were put on hold. One immediate response was having professors execute and record various experiments for students to watch and study. However, this created much more work for professors, and did not provide the same quality of education to which both students and professors were accustomed.

To resume lab work, teaching spaces had to be adapted to comply with government guidelines, which created new work for staff to prepare classrooms to be COVID-19-safe for use. Different criteria were used to determine if all or just some labs would be resumed. For example, how much money had been invested in the research, if the experiments had already been started before the pandemic, and if the research was COVID-19 related. Many universities switched some research to center around the new coronavirus, including vaccine research, antiviral research, and infectious diseases research.

The University of North Carolina at Chapel Hill is a leading American research university and became a top COVID-19 research university during the pandemic. During the early stages of COVID-19, as the university was shutting down and its research ramping down, to have the least research repercussions as possible, an evaluation and approval process was established to determine which research projects got priority and could continue in a limited capacity.

In the case of fieldwork—which is required for graduation in teaching, business, engineering, and medicine—transitioning to an online setting was crucial. Virtual fieldwork gave students some of the skills needed for and understanding of their future careers. For example, students needing to complete teaching fieldwork could virtually teach, which could be a new reality going forward. However, university leaders evaluated it as non-equivalent to the richness of an in-person experience.

Qatar University tried to make the most of fieldwork and internship opportunities by providing virtual experiences. With the help from industry partners, some engineering students could still complete their fieldwork requirements.

Photo courtesy of Monash University

Top: Researchers from Monash Institute of Medical Engineering and clinicians from Monash Partners Academic Health Science Centre collaborated to develop and test snorkels turned masks, to help slow the transmission of Covid-19.

Bottom: Two unique vaccine candidates created by the Monash Institute of Pharmaceutical Sciences and the Peter Doherty Institute for Infection were in Phase 1 clinical trials.

Students return to the Webster University campus masked for the 2021–2022 school year.

Photo credit: Inocencio Boc, Webster University

Student Life

When choosing a university, students consider more than just academics. They consider the campus, the surrounding community, extracurricular opportunities, the student body, school spirit, and student-to-faculty relationships. All these elements complete a student's education, and many offer opportunities to develop soft skills, in addition to those developed in the classroom. Soft skills are crucial to a young person's development, and often essential for success in the workforce. It was challenging to find opportunities for students to learn soft skills and be connected to a community in an online environment.

At Georgetown University in Washington D.C., a significant change for students was the lack of access to alumni network. Even though alumni interaction is not part of the traditional academic curriculum, it is becoming increasingly important as a differentiating factor when choosing a university. Students at Georgetown expect a high level of communication and interaction with alumni as part of their education. With COVID-19, engagements between current and graduated students slowed and were not the same as before. Virtual networking was possible but was not an equivalent experience compared to in-person networking on and near campus.

One of the biggest shakeups in higher education was realizing that universities provide students with a safe and productive learning environment. When students had to leave campuses on short notice, the hope was students could return to a home where there was access to the internet, a computer, and space to learn. This hope was not a reality for many students. Universities provide students with essential tools for learning that are often overlooked, and COVID-19 revealed these university resources that are taken for granted. Due to different government regulations and different stages of the COVID-19 pandemic, universities had to approach this problem differently.

One solution was opening the university campus to a select community facing various hardships. These hardships included not having a safe family environment, economic hardship at home, no access to the internet, and no personal computer. Webster University made sure to keep its dorms open to students who needed a safe space to learn and live. Webster did not have a hard close of their campus but instead understood from the students' perspectives that not all at-home environments were safe or conducive to learning.

Another solution was giving resources to students so they could afford to learn from home. For example, Monash University created a Hardship Package program for students going through economic hardship or who could not access the curriculum. The funding for this aid package came mainly from donations from faculty and staff who saw these hardships and wanted to help their students.

Budget Cuts

COVID-19 contracted the global economy with financial impacts on virtually every university, affecting all revenue streams. Before COVID-19, many institutions had already adopted crisis management models, following the Global Financial Crisis in 2008 and terrorist attacks, particularly in the United States and Europe. But no university anticipated a global health emergency. The unexpected economic downturn required institutions to review budgets in a moment of increased spending directed to adapting buildings and infrastructure to COVID-19 safety protocols and regulations.

During lockdowns, revenues from dormitories, school catering, and boarding fees were cut off. Grants and research funding shrank due to economic instability. In parallel, some institutions temporarily reduced tuition fees to make up for the forced transition to online learning, which affected total revenues. Universities in destination countries, popular with foreign students,

and reliant on their tuition—such as Australia, the United Kingdom, New Zealand, and the United States—lost revenue streams due to travel ban restrictions and border closures.

Many universities responded with a comprehensive budget review and a package of restrictive financial measures. Cost-containment mechanisms included freezing staff and professor hiring and replacement of retiring professors, reducing senior leadership pay, suspending contributions to retirement accounts, and stopping merit increases.

To operate in a fiscally responsible manner, the University of Auckland instituted a voluntary leave scheme until 2023, turning into a smaller university with reduced research, teaching, and professional staff. Australia's RMIT arranged voluntary departure schemes readjusting workforce size in line with the number of students. In the United States, Northeastern University found an alternative to cover budget cuts and expenses. The institution launched a fundraising campaign and received more than 100 million USD in donations to cover their tuition losses.

Generally, university leaders evaluate financial emergency plans as unsustainable and agree on the importance of diversifying revenue sources in the future.

External Forces

Government Partnerships

The crisis brought about by the COVID-19 pandemic strengthened ties between governments and universities. Historically, government authorities have referred to academic expertise and past studies to inform their policymaking. However, the urgent and immediate need to develop strategies to manage the devastating health crisis required specialized expertise and scientific evidence as soon as it could be generated. The dire need to contain the virus and develop therapies to save lives brought virologists, vaccinologists, and epidemiologists to the center of local and national responses. Academic departments, particularly Health and Public Policy schools, coordinated their efforts with multiple stakeholders, working closely with hospitals and local authorities. Universities developed COVID-19 tests, performed virus research and vaccination studies, and manufactured personal protective equipment. Universities have also actively informed the public debate and provided scientific and policy advice for developing virus containment and mitigation strategies.

New Zealand's University of Auckland played a significant role in the national COVID-19 response. Before the pandemic, the country already had a robust system of scientific advice. New Zealand is located on a small island with less than 5 million inhabitants and limited degrees of separation among powers. Since the pandemic started, the university has analyzed real-time data to model possible COVID-19 scenarios and the government plan accordingly. Government agencies used research from the university as a basis for making decisions on lockdown restrictions. University infrastructure and laboratories also served the national strategy. At the virus's peak, the university's facilities provided about half of the national testing capacity.

The pandemic prompted a significant stretch of the university's operational role with academic institutions actively participating in the planning, logistics, implementation, and management of local strategies responding to the virus. In the United States, Arizona State University (ASU) has been a significant player in the state's response, carrying out different operations as the pandemic evolved. When COVID-19 first hit, the university built a testing laboratory on campus with the capacity of testing thousands of people daily for free and was responsible for setting up other testing sites around the state. In January 2021, the on-campus testing stadium was turned into a vaccination site, delivering 8,000 shots per day. Later, the operation involved the Federal government, with President Biden and Vice President Harris virtually visiting the ASU vaccination site and offering federal support to the effort. By February 2021, more than 300 federal personnel were working on-site. One month later, the university was responsible for vaccinating two-thirds of the state's population. ASU has also worked in partnership with state epidemiology agencies on data collection and curation to optimize the response.

Ohio State University has integrated its schools of Health Science, Medicine, Nursing, and Pharmacy into a significant medical operation involving multiple hospitals, other colleges, and the government of Ohio. The university uses data analysis to model the virus spread curve, predict its behavior, and design mitigation strategies, working directly with the local governor's office in this effort. The project has had a $4 billion annual budget, and included patient care, COVID-19 virology research, and vaccine exploration and development. The university has also set up a pilot program with pop-up vaccination clinics that change location around the state depending on local demands in response to outbreaks.

Industry Relationships

The rapid development and manufacturing of personal protective equipment and other products needed to fight the virus has been a striking outcome of industry and university relationships during the pandemic. Higher education institutions shifted their research priorities to help contain the spread of the virus, supplying the science and technology industry needed to create masks, face shields, alcohol sanitizers, and antibody and PCR tests. Relationships in other academic areas, such as business and engineering, continued and adapted to a virtual format. Overall, the lack of in-person social interaction following travel bans complicated networking and engagement with external partners, particularly for negotiating and launching new initiatives. Some academic programs also endured reduced funding as private institutions and companies reviewed their finances and reduced spending.

SPOTLIGHT ON BRAZIL

How Brazilian Public Universities Reacted to COVID-19

Based on interviews conducted by Dr. Eduardo Oliveira

The GFCC partnered with one of its members in Brazil, Paraiba State University, to conduct a series of interviews focused on the unfolding effects of the COVID-19 pandemic on higher education institutions in the country. Brazil has a mixed system of public and privately funded universities. Public universities are financed and maintained by the Federal or State governments and offer high education to students free of charge. Private schools can be for-profit and not-for-profit and charge students monthly tuitions and enrollment fees.

Dr. Eduardo Oliveira, Head of the Center for Strategic Technologies in Health at Paraiba State University, gathered information on the effects of the pandemic at three publicly funded universities during the period between March and December 2020: the Federal University of Itajuba (Unifei), the Federal University of Minas Gerais (UFMG), and the State University of Campinas (Unicamp). The Federal government finances the first two, and the São Paulo State government funds the third.

Before the pandemic, the public universities conducted primarily in-person classes following directives from the Ministry of Education (MEC) that did not authorize online learning. When COVID-19 broke out, MEC issued a decree authorizing universities to replace in-person classes with remote learning for 30 days, a measure that was later extended.

Like other higher education institutions globally, public universities in Brazil quickly adapted their operations and learning to an online environment. One of the biggest challenges was guaranteeing that students from socially disadvantaged backgrounds had the infrastructure to participate in the lessons. Many students faced connectivity issues or did not have the essential devices for accessing online learning.

UFMG expanded a digital inclusion program issuing loans to students who could not afford personal computers and provided data packages. In indigenous and quilombolas2 communities, the university improved local internet signals.

COVID-19 particularly disrupted courses that required lab experiences, such as engineering, odontology, medicine, etc. At Unifei, the electronics laboratory created educational kits and sent them to students to conduct exercises at home. However, other engineering courses had to develop specific protocols to receive students in their labs. Unicamp implemented a resumption plan, and resumed in-person classes in December 2020 at 30 percent of its total student capacity.

Overall, faculty often reported difficulty adapting to the new technologies used to create a virtual learning format. Universities had to conduct specific training for teachers who were particularly unsatisfied with online exams.

Nevertheless, university leaders interviewed believe that the consolidation of online learning in Brazil will increase the number of slots available for students and staff. Currently, the number of students accepted at Brazil's public universities is extremely limited, and candidates need to undergo a highly competitive exam to get in. Online education can reduce costs and today's constraints in physical infrastructure, creating new opportunities for expansion and inclusion, and even creating new courses and disciplines.

Finally, universities leaders agreed that the pandemic may have accelerated long-overdue changes in the Brazilian university model. For them, technology is unlikely to replace face-to-face classes since the pandemic experience demonstrated that students miss the interaction with colleagues and the school community. But technology can enhance today's teaching model.

SPOTLIGHT ON CANADA

Canadian Publicly Funded Colleges

Based on interviews conducted by Ms. Lori Schmidt

The GFCC partnered with its Distinguished Fellow, Ms. Lori Schmidt, President of Loral Management Group, in Canada to understand the fast, drastic changes that institutes of higher education went through throughout 2020 and 2021. This was partly because Canada had relatively strict government regulations that severely limited in-person learning.

Ms. Lori Schmidt interviewed Colleges and Institutes Canada (CiCan), College of the Rockies, MacEwan University, and Southern Alberta Institute of Technology on the impacts of COVID-19 on educational institutes in Canada between spring and fall 2020.

The Canadian institutes that were interviewed are publicly funded community colleges and technical institutes, a college membership organization, and an undergraduate university.

When the pandemic first hit, these higher education institutions responded similarly to those in the rest of the world and went online immediately and indefinitely. All the institutes interviewed experienced the most significant impact on technical and hands-on courses. The community and technical colleges were particularly challenged due to their many practicum and apprenticeship requirements. These requirements could occasionally be completed online but typically were postponed until some form of in-person learning could resume.

To address some of the difficulties of online labs, colleges made investments in online learning platforms and tools such as AR/VR headsets. Investment in the most recent technology and learning tools will be a long-lasting impact Coivd-19 will have on the learning institutions. CiCan anticipates that, in the future, there will be a focus on digital platforms and exploring the use of "cool tools" such AR/VR to assist student learning during in situations such as a pandemic and to enhance the student experience overall. Investment in online learning tools will continue to increase after realizing the gap in the use of modern technology during the pandemic.

Micro-credentialing is a unique feature of community and technical colleges, and gave people new opportunities during the pandemic. When Canada needed more talent in the healthcare industry, community colleges changed course to offer micro-credentials and training for young aspiring healthcare professionals to prepare them for the professional world quickly. The College of the Rockies has seen an uptake in the requests for micro-credentials and has tried to offer more flexibility in micro-credentialing by mixing and matching hard and soft skills.

As with many universities globally, the pandemic altered faculty and staff's ability to do their jobs. Universities needed to offer training and resources to faculty to continue teaching to their best ability during the pandemic. Burnout and frustration of faculty were common at many universities due to the impacts of COVID-19 both professionally and personally. MacEwan University tried to find a bright side in these difficulties by encouraging and leaning on a new generation of thinkers and doers. When the university's leaders could, they embraced faculty that were looking for a change and offered openings to a new generation of academics.

The consensus among those interviewed was that Canadian education institutes were hit hard but responded by relying on the community when they could and making quick, effective adjustments along the way. Those interviewed were very interested in the potential for change in the university landscape and excited for the renewed focus on student and faculty welfare.

In the face of this challenge, universities worked with industry partners using cutting-edge technologies to continue operating existing programs. In the United States, the University of South Carolina (USC) adapted its on-campus Digital Transformation Lab to a virtual environment using digital twins. This tool simulates a representation of physical objects, systems, and processes on the desktop. The technology was created in 2020 in a partnership with Siemens, which funded the initiative.

Before COVID-19, the Digital Transformation Lab operated as a research facility for companies to showcase new products and technologies, such as robotics, visual inspection, autonomous drones, and smart home applications. The idea was to have a 'trade show' for companies to engage with students, researchers, and entrepreneurs. Other companies partnering with the institution—such IBM, Samsung, and Yaskawa—now use the digital twins to continue working with students and researchers during the pandemic.

Increased digitalization also facilitated accessibility, allowing more time for working professionals to participate in meetings and online conferences with students and faculty. There is also a potential for building diversity and international collaboration. Australia's Monash University switched its entrepreneurship program that supports early-stage ventures, "The Accelerator," to an online format for the first time in December 2020. Before COVID-19, the program was focused only on the Australian population of innovators and entrepreneurs. But engaging online allowed the institution to accept program participants from its campuses in Malaysia, Indonesia, India, China, and Italy. This transition enabled the university to access different populations and innovative ideas from multiple backgrounds.

Community Engagement

The pandemic reinforced how tightly universities and local communities are intertwined, with a growing appetite in higher education institutions for fostering a positive impact in their communities. This concept of the university as a service gained momentum as universities mobilized their resources to help and support their communities' responses to the pandemic. They developed COVID-19 testing, vaccination, and hygiene kits, and engaged in knowledge-sharing, communicating, and informing their communities on COVID-19 risks and impacts.

Globally, the COVID-19 pandemic's health and humanitarian crisis called on many people and institutions to fulfill their public citizenship. It was no different for universities, which responded to the pandemic's economic and social impacts on multiple fronts. When food security became a pressing matter in the community around The University of Chicago in the United States, the institution partnered with the Greater Chicago Food Depository and local catering companies to provide 300,000 meals to city residents in need. Other charity activities included $800,000 in emergency bridge grants to help 200 South Side small businesses and $400,000 to provide capacity-building for local non-profits.

The pandemic showed that university knowledge and expertise could also advance local initiatives and improve the local community's quality of living. The University of Chicago startup hub launched a new initiative to help small businesses understand and adapt their operations to a virtual environment. Students and teachers in the Business School offered a portfolio of courses to the local community, ranging from digital marketing and startup fundamentals to negotiating with commercial landlords during the pandemic. By the end of 2020, more than 12,000 entrepreneurs had attended virtual events (an increase of 187 percent compared to 2019).4 This situation created an opportunity for universities to leverage local partnerships outside of the emergency context, reducing institutional barriers to advancing future regional development projects.

Founded in 2011, the Okinawa Institute of Science and Technology (OIST) had, from its inception, the mission of promoting collaboration with local partners, industries, and government to develop a sustainable future for the Japanese island of Okinawa. OIST aimed to boost local scientific literacy, hosting science fairs and open discussions on campus before the COVID-19 outbreak. The institute also has had a policy of extending access to its facilities to other Japanese universities that wanted to conduct experiments with their equipment.

Since the pandemic began, research priorities at OIST have been redirected to address COVID-19 in the local community. At first, the institute worked with industry partners to manufacture supplies for city hospitals, such as face shields and masks, lately engaging on RT-PCR and antibody testing. In 2021, there were more than 12 engineering research projects ranging from low-cost microchips for detecting antibodies, ultraviolet C sterilization units, PCR and antibody testing to COVID-19 mapping, and 3D printed face shields. OIST developed public campaigns to educate the population on hygiene and created a platform for children to learn science from home during the pandemic.

Another example of solidarity with and commitment to with the local community was an initiative led by Northeastern University in the United States. In the summer of 2020, Northeastern opened its unused dormitories for first responders and healthcare providers who needed housing to keep themselves and their family members safe. The dorms were going largely unused, so Northeastern found a way to repurpose their facilities to help those around them.

In Europe, the Catholic University of Portugal (UCP) supported their community through a We Stand United initiative, which addressed topics relevant to its surrounding community in weekly knowledge seminars. Some of the topics covered were

Photos courtesy of the University of Chicago

The University of Chicago partnered with the Greater Chicago Food Depository to provide meals across nine different neighborhoods throughout 2020. This is just one portion of the University of Chicago's Covid-19 Community Support Initiative, which addressed food insecurity and provided emergency bridge grants and other support to the surrounding communities.

Photos courtesy of Okinawa Institute of Science and Technology

Okinawa Institute of Science and Technology (OIST) collaborated with the Okinawa Prefecture Government (OPG) to develop PCR testing for COVID-19 at an OIST controlled laboratory. As of September 2021, the OIST PCR team administered over 52,000 PCR tests.

adjustment to the crisis and the overall disruption, vaccine effectiveness, and how to measure the impact of the healthcare crisis. UCP also provided community activities like career services and employability seminars to help those facing hardships due to the economic downturn.

Challenges

Mental Health

The COVID-19 pandemic has escalated mental health problems across populations, increasing concerns in the higher education sector. Self-isolation, fear for the health and well-being of loved ones, financial issues, and uncertainty about the future are multiple stressors contributing to mounting anxiety levels among students and staff. Universities worldwide are developing resources and programs to raise awareness on mental health issues and help the university community cope with the pandemic. Mental distress can impact students' concentration, motivation, and ability to commit to their studies and careers. But the stigma still associated with mental health issues often imposes a social challenge for people looking for help. Discussing mental health and well-being across the university is crucial to ensure staff, teachers, and higher committees understand its relevance and learn to discuss the topic. Institutions are also rolling out frequent health surveys to measure the well-being of their communities. Furthermore, the transition to online education has generated concerns about the mental health of the older generation of teachers many of whom struggle to follow the pace of the digital transformation.

Photo credit: Erik Jepsen, UC San Diego

At the University of California San Diego, the installation of COVID-19 test kit vending machines distributed up to 2,000 tests per day. The COVID-19 test kit vending machines' self-administered tests were the primary method for screening among students.

Open communication channels, virtual activities focused on creating a sense of belonging, and holistic approaches have been rolled out to reduce the distress caused by the pandemic. In Mexico, Monterrey Institute of Technology and Higher Education offered multiple activities online, such as mindfulness sessions, yoga classes, and meditation techniques to improve concentration and relaxation, open to the whole community (students, parents, and staff). The Mexican school created 24/7 communication channels available through website, phone, and chat to talk about mental struggles. In the United Kingdom, the University of Southampton implemented online community gatherings, such as coffee morning meetings and virtual tea. Both institutions run surveys to assess the pandemic's effects on their students' and staff's mental health. Queen Mary University London trained student counselors in online counseling to deliver help.

At the University of California San Diego (UCSD) in the United States, mental health resources are being reevaluated and redesigned to include cultural sensitivities and training. UCSD provided mental health consultations through telehealth visits and expanded the number of health care providers available to faculty and students. The expansion of medical providers included people with multicultural training who could more effectively help students and faculty with diverse backgrounds. This new format of mental health resources increased confidentiality because students and faculty members were not physically going to a site but could effectively get help in their own homes at their own convenience.

Quality of Education

During the pandemic, the rapid switch to online learning challenged universities to deliver quality education in a virtual or blended environment in many cases for the first time. Universities responded by implementing strategies on different fronts. A key pillar involved investments in digital infrastructure and IT systems to facilitate students' virtual learning experience. Many schools delivered IT resources (internet hotspots, laptops, and webcams) to students who did not have them for remote learning. Universities also conducted frequent assessments to systematize best practices and create solutions better suited to students' needs.

On the upside, online learning allows more flexibility and greater accessibility. It can create a more enriched learning experience by bringing in different expertise, experience, and views since professors can log into a virtual platform from anywhere in the world to participate in a class. However, there is a recurring

concern about the impacts of online education on soft skills development and the potential for mental health degradation resulting from the lack of face-to-face interactions. Moreover, practical curricula disciplines—such as laboratory-based courses, engineering experiments, visual and performing arts, and clinical practices—also imposed a challenge.

Many universities already used cloud-based systems for delivering materials, lecture streaming, and recording before COVID-19. These platforms are essential for online learning and must be coupled with other infrastructure investments to provide a fulfilling online learning experience. Arizona State University in the United States placed multiple cameras and microphones inside lecture theaters to enable students from home to interact with teachers and people in the classroom in a synchronous hybrid learning model. They equipped a group of students to assist teachers in operating new digital tools during the classes. The university also designed software integrating multiple third-party tools for remote work and communication among students, teachers, and staff. Other universities, such as Tecnologico de Monterrey in Mexico, used virtual and augmented reality to simulate laboratory work.

However, a significant gap remains in pedagogy and models for virtual classes. University leaders stressed that online education is more than just translating lectures through a virtual platform. Tecnologico de Monterrey has used adaptative learning, which combines artificial intelligence (AI) and machine learning algorithms to adjust the learning process to students' needs based on task performance and understanding of the content. The algorithms can evaluate student performance and redesign the learning modules as needed, inviting students to proceed to the next lesson or redirecting them to previous materials for review. Tecnologico de Monterrey has also developed workshops for teachers and staff to share best practices in assessments and teach how to create videos and other digital resources to improve the learning experience. In the United States, the University of Chicago has frequently reviewed student and staff assessments on the university's pandemic-induced pivot to new programs and best practices for online learning, such as synchronous and asynchronous learning for international students abroad.

There is concern that the current model is not sustainable, mainly due to the lack of campus experience and sense of community that in-person classes create. Initiatives such as 'The Daily Health Check' at Arizona State University, which monitors students' COVID-19 symptoms during the pandemic, have enabled more students to participate in on-campus activities, limiting transmission of the virus, while providing the in-person experience crucial for students' interpersonal skills development.

Impact on Internationalization

Internationalization drastically changed during the COVID-19 pandemic due to the lack of travel between and within countries. The halt on international mobility reduced the exchange of ideas and knowledge on various cultures and lifestyles as study abroad programs, fieldwork, in-person academic conferences, and collaborative research were postponed or canceled.

Canceling ongoing study abroad programs was one of the first things universities had to deal with as international borders closed. Students were brought back from foreign countries and had to finish their study abroad experiences similarly to students studying domestically.

Once universities had time to plan a more comprehensive response to the COVID-19 disruption, they began offering virtual and domestic exchange programs. The University of North Carolina at Chapel Hill (UNC-Chapel Hill) has a three-pronged approach to internationalization: study abroad, international at home, and presence of international students on campus. During the pandemic, both study abroad and international students on campus were severely curtailed, so UNC's global team invested in and enhanced international at home through three programs: Collaborative Online International Learning (COIL), Virtual Study Abroad, and International Dialogues. These three initiatives gave UNC students access to globalization in a creative and cost-effective way.

Monterey Tech launched a similar program, Global Classroom, that will remain after the pandemic. This program uses virtual tools to link Monterey Tech classes with one or more classes at universities in other countries to connect students, foster collaboration, and facilitate learning in intercultural environments. Through Global Classroom, 9,467 undergraduate students from 124 universities in 31 countries have been connected.7

International student enrollment was down almost everywhere and, even where it had not been reduced, the students were not on campus. International students benefit both the university and its students. Engaging with students from other countries helps students learn to avoid stereotypes, gain a better understanding of international issues, and gives them cross-cultural experiences and challenges them to be active listeners. Universities rely on international student tuition to keep revenue up and rely on international students to maintain full classrooms. During COVID-19, most of these benefits were lost.

Faculty Readiness

Among university faculty and staff, there was an overall lack of preparedness for teaching during a global pandemic. When the COVID-19 outbreak forced universities to teach online, a generational gap among faculty emerged as a big differentiator. Although not always true, younger faculty tended to have an easier time teaching online than older faculty. This was mainly

due to prior and more consistent exposure to teaching using technology. However, no one was prepared for the increased workload that accompanied going online. Not only did professors have to change the delivery of their classes, but the content as well.

Some professors had more work than others depending on the subject taught. Also, professors who are parents or have other family members reliant on them had to balance dealing with the pandemic, working from home, and being a part- or full-time care person for the family and children whose schools were closed and attending virtual classes from home. This strain on faculty and staff is difficult to isolate from their work for universities.

Most universities offered extensive training focused on online delivery and online learning content. In the United States, Georgetown University offered staff and faculty training through its Center for New Designs in Learning and Scholarship. This center was created 20 years ago to bridge the gap between pedagogy and technological advances, and was adapted during COVID-19 to provide an inclusive pedagogy toolkit specific for the new challenges brought about by remote learning. The center aimed to be an in-house resource easily accessible and usable for faculty and staff to learn how to optimize the learning experience for students.

Training at the University of North Carolina at Chapel Hill (UNC-Chapel Hill) extended beyond just offerings for current professors and staff. In the summer of 2020, UNC offered a two-week intensive training program for teaching assistants. This was a way for teaching assistants to make money while furthering their professional development as graduate students. UNC also offered additional training to professors who would teach the highest volume of courses. This training involved more than 100 faculty participants and focused on investing extra time in classes that reached the most students.

Positive Changes

Increased Collaboration

The COVID-19 pandemic unleashed a multidimensional crisis impacting all spheres of society, disrupting economies and many aspects of regular life. Universities experienced an upheaval in operations, teaching, and research, increasing concerns about their communities' social and financial stability. The need for a comprehensive response to this complex situation fostered collaboration across disciplines. University leaders reported the ability of people from different departments to work together as a positive surprise. Professors and staff worked together to find solutions across the board to the COVID-19 crisis, proposing coordinated strategies to solve multiple challenges that emerged as the pandemic evolved. Increased communication channels and digital tools were vital in supporting collaboration and engagement, enabling a closer connection between senior leadership and staff.

Universities formed multidisciplinary taskforces to coordinate operations, strategies, decision-making, and management of situations stemming from the pandemic, such as campus access or closure, the transition to online teaching, etc. Before the pandemic, the University of Auckland operated in a similar team system for addressing crises or disruptions in areas such as security and infrastructure. Team membership was defined depending on the nature of the crisis and incident controllers. The pandemic created a crisis at scale, prompting the university's president to regularly hold virtual meetings open to 5,000 participants, allowing senior leadership to engage and communicate with far more university staff than in previous incidents with more limited impact.

The University of Chicago established a COVID-19 response structure divided into working groups covering nine areas: research, education, housing and dining, workplace, N-12 education, national laboratories, arts, community, and athletics. The university has kept open communication channels through its website, direct mailing, videos, and town hall meetings to inform staff and society on state guidelines and recommendations, and to disseminate information to fuel cross-disciplinary strategy efforts. Since April 2020, the institution has also maintained a weekly leadership call with all department chairs and administrative unit leaders. Similarly, in Australia, RMIT adopted a new governance and operational model to manage COVID-19, with regular meetings, briefings, and sessions on safety measures. RMIT also introduced new ways of communicating through virtual forums and support groups. This moment of increased communication and collaboration can pave the way for breaking down remaining silos within universities, and bridging academic divides.

SPOTLIGHT ON MALAYSIA

The Malaysian Higher Education Response to COVID-19 by MIGHT

To date, there are twenty public universities, 434 private institutions, thirty-six polytechnics and 104 community colleges in the Malaysian higher education landscape. The unprecedented COVID-19 pandemic has proven to be a major disruptor that caused a massive impact on the education ecosystem due to closures caused by the Government's Movement Control Order to curb the virus from spreading, like most countries around the globe. These institutions were forced to replace conventional teaching and learning with various e-learning delivery methods while many of the private higher education institutes struggled to sustain with the decreased enrollment during the pandemic era. The government has made incentives for online education available, including the Smart Automation Grant under the National Economic Recovery Plan (acronym PENJANA in Malay) to support the adoption of technology and innovation in teaching and courses offered. In addition, the Ministry of Higher Education (MOHE) has initiated various strategic responses to help the higher education sector rise above the challenges of COVID-19. These initiatives are focused on the following:

1. Students' well-being such as special aids and allowances (including laptops), especially for B40 students.[1]
2. Marketability and employability, including strategic partnerships with industry, and strengthening higher education institution governance, especially in managing emergencies such as COVID-19.
3. Encouraging innovations and services in these institutions to overcome COVID-19 and strengthening university teaching hospitals to support the medical needs of the country given COVID-19.
4. Private higher education institutions as a strategic economic growth industry to ensure sustainability and growth

While these closures have undoubtedly affected R&D and other vital hands-on disciplines, the government continues to encourage research and innovation as the core of higher education. To date, 115 innovative products and 27 COVID-19 management apps have been developed by universities that benefit the community. Apart from the service-oriented innovations, MOHE also offers special COVID-19 themed research grants in twenty critical fields closely related to the country post-COVID. This has received a great reception from the universities, with 404 applications received.

In response to the spikes of the second and third waves of COVID infections, the healthcare sector were overwhelmed. Thus, a significant budget were approved to strengthen existing university teaching hospitals in administering COVID-19 tests and treatments. Another four are on the way to further support the healthcare sector in facing the pandemic via public-private partnerships.

Moving forward, Higher Education Institutions (HEIs) also have stepped up with various initiatives, including community outreach and intervarsity collaborations nationwide, such as facilities sharing, to support each other in facing these challenging times.

COVID-19 has been a revelation. Critical lessons to be learned include the importance of risk management and preparedness, supporting mental health, the need for sustainable development, implementing digital reform to hasten recovery, and leaping forward as an agile, dynamic, and innovative institution.

The Prime Minister of Malaysia instructed the ministries to accelerate the national education digitalization program to help educational institutions face unprecedented challenges such as COVID-19, minimize the impact of these disruptions to the education sector, enable the continuous teaching and learning process, and provide access to quality education for all regardless of geographic location and status.

1 According to the he Department of Statistics' (DOSM), Malaysians are categorised into three different income groups: Top 20% (T20), Middle 40% (M40), and **Bottom 40% (B40)**. Below are the categories for reference. **For the record, majority of students in public universities are from the B40 bracket**

The Malaysian higher education has now moved into blended learning to accommodate various educational needs of the people. While move to strengthen infra and infostructure is on-going via various initiatives and projects by the Government, the realization of the importance of the academic and non-academic members to be equipped with the much-required skills for blended learning and beyond has become prominent. The Ministry also continues to address the big questions of employability and marketability of the graduates upon entering the future job market.

Vigilance and agility prove to be key elements in staying afloat in challenging times. Hence, MOHE also ramped up its efforts on entrepreneurial and skills, such as the Technical and Vocational Education and Training (TVET), to develop highly skilled future talents as key elements.

This text was contributed by the Malaysian Industry-Government Group for High Technology (MIGHT).

Early Insights on Future Trends

Introduction

COVID-19 has been an accelerator of trends shaping the future of higher education. The use of new technologies and digital transformation has pushed new boundaries, opening up the possibility of experimenting with new models and scaling up access to learning. The report identifies four game-changers for the future:

- Increased competition
- Sustainability
- Changes in the regulatory environment
- Improved digital learning and pedagogy

The use of new technologies may lead to universities losing their solo status as education leaders and increased competition from new education and training providers. COVID-19 also affected research, with a growing trend towards impact-oriented missions. Finally, the report highlights sustainability as a key distinguishing factor in university missions, playing a growing role in grant-making and the decisions of financial donors.

Trends

Hybrid Education

Hybrid learning, blending online and in-person learning, became a common form of delivering education during the COVID-19 pandemic. Universities implemented different types of safety measures to allow students, faculty, and staff on campus. These measures included but were not limited to testing protocols, tracking COVID-19 cases, social distancing rules, COVID-19 infection control protocols, and outlining what types of activities were allowed. These steps took immense amounts of planning and were constantly changing due to the uncertainty of local and national regulations.

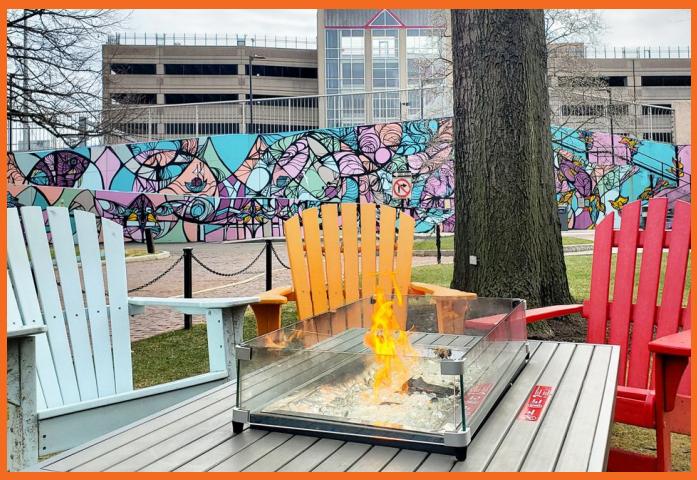
Hybrid education often involved both synchronous and asynchronous learning.[1] Some benefits of synchronous learning are class engagement and instructor-student interaction. Disadvantages of synchronous learning include rigid scheduling and potential technical difficulties. Asynchronous learning has content available online for students to access when it best suits their schedules. This means pre-recorded lectures and assignments with deadlines set ahead of time. The benefits of asynchronous learning are flexibility for both students and faculty, and self-pacing by the student. Downsides of this learning model are lack of engagement and no live interaction with other students or professors.

Northeastern University, located in the northeast of the United States, realized it needed to provide some form of safe outdoor space for student interaction year-round. Due to the climate, it is challenging for students to gather outside in the winter months. To solve this problem, Northeastern brought fire pits, propane heaters, and outdoor furnishings to campus to allow for safe, comfortable outdoor gatherings. This is just one-way universities implemented creative solutions to make hybrid learning more "normal" for students.

Innovation Learning Models

Active and practical learning are among the trends accelerated by the rapid transition to online education during the pandemic. For years, university leaders and professors have discussed ways to better engage students in the learning process and develop the skills needed in the workplace. But passive content delivery, in which a professor explains and transmits information with little involvement of students, has remained mainstream.

1 Synchronous learning is a form of online learning that happens in real-time, often with a set class schedule, and requires live online interaction. Synchronous learning mimics in-person education in that a class meets all at once at a designated time for a virtual lesson.



Photos courtesy of Northeastern University

Northeastern University installed fire pits around campus to offer lower-risk ways for students to socialize on campus during the winter months.

In this model, universities built big lecture theaters to hold 300 to 500 students. Part of this infrastructure could not be used during the pandemic. COVID-19 health and safety protocols made it impossible, and digital platforms proved to be an equivalent substitute, often providing better opportunities to accommodate students' needs. For universities, the forced rethinking of the lecture space and ways to deliver content can build momentum to advance new pedagogies and methodologies.

Multiple student-centric methods have been developed to improve the learning experience and foster a deeper understanding of subject matter. These models are based on reflexive knowledge, group and paired discussions, problem-solving, role playing, case studies, structured team-based learning, and individual activities. Active learning strategies create a co-participative environment that encourages students to be proactive and responsible for their own development. Students are encouraged to take a central role in acquiring knowledge and professors act as mediators, offering support and guidance.

Practical or experiential/hands-on learning is simply learning by doing. It includes a mix of tutorials, practical workshops, simulations, interdisciplinary forums, and problem-based learning activities. There is growing support for these methodologies considering their multiple benefits. Active and practical learning improves critical thinking, helps develop interpersonal and soft skills, promotes tacit knowledge, and increases information retention. These strategies also enable students to apply and transfer knowledge, and take greater degrees of responsibility throughout the process, facilitating their transition to the workforce and stimulating life-long learning. Universities that partner with employers can develop part of their program to apply to real-world practices, further developing the necessary skills for future careers.

Transdisciplinary Research

Transdisciplinary research is another trend that accelerated during the multifaceted crisis propelled by the pandemic. It is the integration of academic research from different fields of knowledge with the participation of multiple stakeholders to achieve a common goal.8

While single discipline projects remain the dominant model of university research, multidisciplinary and interdisciplinary research has gained ground as highly complex global and domestic challenges transcend disciplinary boundaries, and with a growing need to better integrate natural sciences, humanities, and engineering fields to solve many problems and develop innovations. The idea is to co-create new knowledge from out-of-the-box thinking relevant to the world, create a positive impact, and facilitate information transfer.

Universities and research institutes have promoted transdisciplinary research, engaging directly with the production and use of knowledge outside academia. The University of Auckland established transdisciplinary research as a top priority within its strategic plan, developing new programs with industry partners and transdisciplinary pedagogy focused on research and education relevant to the world.

Digital Transformation

With the widespread shift to online learning during the COVID-19 pandemic, market demand for digital tools to teach and learn remotely soared. This new demand for technology is expected to accelerate digital transformation in higher education to improve service development and delivery.

One of the most significant changes in higher education is the high demand for and popular use of video conferencing platforms and tools such as Zoom, Microsoft Teams, BlueJeans Meetings, Cisco Webex Meetings, and GoToMeeting. However, a real digital transformation must go beyond just using video conferencing tools for education content delivery. It depends on developing innovative learning spaces and transforming pedagogy for remote learning.

COVID-19 helped bring about a new normal for what it is like to learn and teach. Teaching a class remotely effectively will become necessary for teachers, and learning remotely will be required for students. Expectations about what technology students and professors can operate will continue to develop and advance. Augmented and virtual reality (AR/VR), modeling and simulation, and artificial intelligence (AI) will continue to develop and impact higher education. Bandwidth capacity will need to increase, and digital inequalities across the globe will need to be addressed.

The Thinking

The pandemic's disruptive effects in the higher education sector and the quick transition to online education convinced many university leaders that change is overdue. Universities need to adjust their models and rethink academic program creation, delivery, and assessment to suit a changing society in which technology can enable a greater diversity in education and training options. In the future, competition in the education sector will increase, powered by the legitimization of online education worldwide and new educational offerings from the business sector.

During 2020, universities proved to be resilient institutions adapting to operating under unexpected challenging conditions and uncertainty. A call for new models has gained momentum. Although there has been a lot of talk about change and a growing interest in discussing alternatives, there is no consensus on what new models should resemble. Concrete solutions and proposals remain scarce.

Creating and operating new models in the future will depend on the involvement of faculty, staff, students, professors, and non-academic stakeholders. The pandemic experience strongly suggests that going back to business as usual is not an option for universities if they are to remain competitive and relevant in the global arena. Digital transformation across the board is inevitable, considering its benefits for learning continuity, efficiency, and reach. New models must prepare students for a changing work landscape and meeting ever more complex global challenges. Higher education will have to respond to changing community and industry needs with more agility and less bureaucracy. It will need to expand its programming beyond formal education to attain a degree to include options for acquiring multiple skills. Universities must develop key attributes for operating successfully in a future of rapid change: resiliency, agility, collaboration, efficiency, accessibility, and responsiveness. Social responsibility and sustainability will be integrated into university strategies and programs, paired with frequent internal assessments and evaluations with students and other stakeholders. The higher institutions willing to experiment and succeed in systematizing the lessons they learn will bring greater value to their students and the communities they serve.

Impact Oriented Research and Education

Research and education are changing in purpose, content, and delivery. COVID-19 amplified universities' role in the greater community and opened up new opportunities for the future. During the pandemic, local communities and regions relied on their universities for support, for example, testing the resident population at scale, and employing university resources to help and train those hit by the declining economy. In the future, universities will be expected to play a greater role in the community and world outside of the campus. During COVID-19, it became apparent that universities can supply more than just education. Their research and teaching can go beyond the classroom and help address problems that impact a broader community and issues that will affect people worldwide. Universities should be extrospective when planning research endeavors and consider the larger impact of their research and education.

Accessibility and Scalability of Learning

Historically, higher education has been for a select few but, with hybrid learning and online learning becoming more mainstream, access to education will be greater. Forms of hybrid learning can allow people who, for various reasons, could not get a higher education to get one. Entry barriers to education including working full time, taking care of a family, physical distance from a school, or financial stress. These challenges can start to be addressed using hybrid learning models. Not only will higher education become more accessible, it will also become more scalable. The number of students that can be reached via an online platform is much greater than if all students must be physically present in one place at one time. Especially with asynchronous online learning, large numbers of students can watch prerecorded lectures at anytime, anywhere. Professors will be able to reach a higher number of students, which would not have been possible prior to the normalization of online learning.

Workforce Distribution

COVID-19 has driven a paradigm shift in work culture, with companies worldwide moving operations online and many allowing employees to work from home permanently. This transition is coupled with online education's potential to expand human capital development across nations; it is scalable and more accessible. It can enable different populations to enroll in leading universities without paying the financial and social costs of moving to a different city or a foreign country. This could translate into unique career paths and employers expanding their footprint of employee recruitment and hiring. For decades, students have migrated to seek prestigious degrees and jobs. The possibility of enrolling and getting a degree from anywhere in the world through synchronous and asynchronous learning can redesign the global economy. Businesses and organizations recruiting for open positions could hire qualified professionals virtually anywhere. A new workforce distribution will most likely require an expansion of English as an international work language and favor high-skilled professionals with niche specializations.

Redesigning University Infrastructure

COVID-19 pushed universities to rethink their infrastructure to meet social distancing challenges and reduce infection risks. During the pandemic, it became impossible to conduct lectures in big theaters built to accommodate up to 500 students. At the same time, digital platforms proved to be an effective tool for delivering content at scale, signaling the possibility of abolishing big halls indefinitely. The transition to remote work and its increased acceptance among professors and staff have allowed universities to re-evaluate the need for permanent individual office spaces. Work from home proved efficient and more sustainable than building individual offices for every professor. Many institutions decided to repurpose individual offices and other spaces into laboratories and research areas. Overall, investments in physical infrastructure and classroom renovation dropped significantly during the pandemic due to budget cuts and cost containment, and universities have held back on campus expansion plans. In the future, university buildings are likely to have more tutorial spaces and outdoor areas with fewer individual offices and big lecture theaters. Development of physical infrastructure will parallel the hybrid learning trend as it unfolds with fewer staff working on campus daily.

Massive investment in boosting online capacity and capability was the most significant infrastructure change during the pandemic (see Digital Transformation on page 35). In the future, universities will rely heavily on IT infrastructure, with a larger budget for technology that enhances the learning experience in a virtual or digital campus. This deep integration of the physical and digital campus will enable a cutting-edge learning environment for students.

Game Changers

Increased Competition

Learning experiences co-hosted by universities and industry partners can transform the higher education sector, exposing students to the world of work and providing opportunities to develop their soft skills and critical thinking while responding to industry needs on time. Regulatory barriers and academic culture have kept industry and universities operating on different timelines, despite the urgent need for workforce development and skills training to meet labor market demands in a rapidly changing economy and workplace. It is crucial to decrease learning cycle time and make universities more responsive. Big technology companies—such as IBM, Amazon, and Microsoft—have developed their own academies, courses, and certificate and certification programs for skills in high demand. Also, universities have established micro-credentialing courses to fill existing skills gaps. During the pandemic, the legitimization of online learning drove a boom in educational offerings from businesses, new EdTech ventures, and other non-academic providers, such as national laboratories. Increased competition will mark the future of the educational sector.

Sustainability

The integration of sustainability into university operations and programming could become a criterion for financial and other donations and capital allocation in the future. The pandemic's impacts on economies and livelihoods worldwide raised the red flag on the importance of avoiding major man-made disruptions, including climate change. Universities worldwide have used the period of social distancing and remote work to invest in strategies for a green recovery that could reduce their carbon footprint. Many institutions have taken a few steps towards reviewing buildings and other infrastructure on campus and permanent individual office spaces. New policies may also regulate business travel and international conferences to reduce carbon emissions. In the future, it is likely that sustainability will be integrated into all university education and research programs.

Regulatory Environment

The normalization of online learning will bring a new era of regulations on the education and industry sectors. When technology alters the higher education landscape, regulations will need to match the new environment. These regulations might revolve around privacy, ownership of content, and data sharing. Not only will there need to be various forms of government regulation, increased competition among university and industry-funded education programs will help self-regulate the sector. The new regulatory environment can be an opportunity for universities to offer timely training, degrees, and courses relevant to the quickly evolving regulatory environment.

Digital Learning and Improved Pedagogy

Expanding digitalization of education and training will drive improvements in online pedagogy and learning technology. Vast application of new technologies could launch higher education into a paradigm shift in which technology does the majority of teaching and engagement. For example, artificial intelligence could play a larger role in students' lives, potentially acting as a tutor, mentor, or teacher. A personal digital tutor is just one possibility for integrating AI into higher education. Augmented reality and virtual reality could play a bigger role in the setting and delivery of learning. Virtual classrooms could become the new normal for students worldwide, offering a realistic classroom simulation without traveling to a campus physically. Data analytics, modeling and simulation, and virtual worlds could also enhance teaching and learning.

Innovation at an Academic Institution
Hiro Nishiguchi

Although the pandemic has forced us through massive degrees of change in nearly every aspect of our day-to-day lives, the changes did not arrive at our front door without warning. In fact, we have been going through a drastic change process as human beings during the past decades. The pandemic has accelerated the pace of transformations and crystalized both their positive and negative impacts in a most sensational way. Since the entire civilization has been forced to go through this process, the necessity of our reckoning with it, which was overdue, is now blatant.

Mr. Hiro Nishiguchi
Former CEO, Japan Innovation Network

A professor at a leading university in Japan, Tokyo University, saw these changes coming a decade ago and started working on a new education program. In his view, the focus of education should be shifted from traditional knowledge transfer to knowledge creation. Indeed, in Japan, the purpose of education was regarded as "teaching" the past knowledge to students for them to acquire and apply. If some professors might have implicitly expected them to create new knowledge, it was not a major focus of the past programs.

In 2009, Professor Horii created a new innovation education program called i.school at Tokyo University. Professor Horii is a pioneer professor who created the first-ever comprehensive innovation education program in Japan. He worked with many leading institutions worldwide to first design and implement this program among students and, later, by inviting businesspersons into the classrooms, thus displaying his clear focus on diversity.

Several years later, other professors started joining his efforts at several universities. Professor Horii shared his knowledge and experiences with other professors as he believed in the value of open innovation for education programs. Many professors learned valuable lessons from i.school.

Years later, the Ministry of Education, Culture, Sports, Science, and Technology (MEXT) noticed such dynamics in the field and joined the movement as well. Eventually, in 2014, MEXT created the funding program called EDGE, which stands for Exploration and Development of Global Entrepreneurship, to spread and foster such developments. Once MEXT became part of this initiative, it was rather easy for other professors to follow in Professor Horii's footsteps with authority and funding to support such efforts.

In essence, this was an innovation of an education program. The learning experience offered is to learn through non-linear knowledge creation experiences.

We observe three important lessons to share with the global community.

1. An education program can be innovated, and it can keep evolving itself.
2. Academic professors can be lead innovators to create and implement such innovation.
3. Governments can be institutions to scale up such an innovative program into the next stage.

Innovators are needed more than ever in every corner of our lives. However, this is particularly true for higher education institutions, which should be the hotbeds of knowledge transmission and knowledge creation.

Bridging the Past and the Future of Universities

GFCC university leaders recognize the significant potential of digitalization in research, as explored in the University 4.0 discussion papers (learn more on pages 43-45). However, early signs of this opportunity came primarily from non-academic stakeholders. Companies and governments have used digital tools to virtualize laboratories for different purposes, from education to R&D.

For example, IBM launched a tool to automate and virtualize chemical synthesis. The RXN digital tool integrates different technologies: cloud computing, artificial intelligence (RXN for Chemistry[2]), and automation (RoboRXN[3]). With its use, a scientist can virtually design a new material or molecule, get suggestions from an algorithm on the best path for its synthesis, and have the material synthesized in a remote lab based on parameters generated by the algorithm. It enables research and discovery to be performed remotely, geographically dispersed, and in a shorter period of time.

In other examples, companies such as LabsLand and Labster, and initiatives such as the Government of India's Virtual Labs aim to digitalize labs to expand access for researchers and learners. This type of solution has appeal for emerging countries, as it increases utilization of research assets, and enables more schools and universities to access laboratory capabilities. It also has potential in advanced economies. It expands access to certain facilities that are not widely available, similar to the benefit for developing nations. And it will enable the decoupling of STEM education from geography.

Bridging Short- and Long-Term Changes

Universities were forced to address structural issues in response to changes brought about by the pandemic. It is natural to imagine that such changes may have long-lasting implications. A fundamental question is how the trends and moves captured in this report connect with the University 4.0 agenda.

Developments and changes universities made during the pandemic and the University 4.0 agenda converge on various points.

- **Technology:** the pandemic has shown the potential of digital technologies and raised awareness of their importance for the future of higher education. However, applications of digital technologies beyond e-learning still lag behind those envisioned in the University 4.0 papers. Institutions can build a competitive edge by taking technology to a new level.
- **Education:** the pandemic fundamentally changed how education is delivered. In any scenario, digitally enabled learning has become an essential part of higher education, and progress in the area will continue, allowing universities to increase access to education and reach new populations of learners, both geographic and demographic. This trend will shift and redefine the markets of higher education institutions and further require adjustments in pedagogy and faculty training.

2 https://rxn.res.ibm.com/.

3 https://www.ibm.com/blogs/research/2020/08/roborxn-automating-chemical-synthesis/.

University 4.0 Discussion Paper
Technology as a Transformation Enabler

Prof. Aleksandar Subic
Deputy Vice-Chancellor and Vice President
RMIT University

The COVID-19 pandemic amplified the need for universities to embrace digital transformation more rapidly and embed digital technologies across the entire enterprise, including education, research, and operations. The fourth industrial revolution has been harnessing the potential of disruptive technologies, such as Cloud, Big Data Platforms, Internet of Things, and Artificial Intelligence in economies and societies. These tools have significantly altered how organizations capture and translate value to customers and stakeholders, and are driving major change in the nature of work, with many jobs becoming obsolete. A positive balance between new jobs and lost jobs without societal pains depends on how effectively key stakeholders within the larger ecosystem (including policymakers, educational institutions, employers, and unions) collaborate to respond to the impact of technology disruption on the workforce and manage the transformation of workplaces. The higher education sector has a crucial role in facilitating a successful transition to the future of work. For that to happen, universities must undergo transformative change simultaneously with technological change which requires innovation in education models and research.

- **Markets:** advancements in technology and education delivery have allowed universities to serve local communities during the pandemic. Going forward, they will enable universities to explore new markets and non-academic stakeholders such as private sector providers to access the communities traditionally served by universities.
- **Engagement:** the pandemic demonstrated the value that universities provide to local communities. But this relationship could still evolve in a more structured way (supported by processes, tools, and management models), as suggested in the University 4.0 papers, and is still a critical are for advancement in most countries, especially in emerging economies.
- **Roles:** universities played several roles in supporting their communities during the pandemic, for example, translating knowledge into hardware, software, services, expert advice, and policy recommendations. The University 4.0 papers underscored that there are new expectations about the roles of universities, including knowledge translation. It will be important to follow how these developments give momentum to post-pandemic change.

The experiences described in this report do not encompass the whole spectrum of the university world. They reflect only the experiences of research universities, and most from advanced economies. A broader sampling of universities, including those in emerging economies, would capture a fuller picture of disruption, impact, response strategies, and change.

University 4.0 Discussion Paper

Universities of the Future: Adaptation and Transformation to Better Serve the Global Community

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Universities face multiple challenges, such as changing student demographics, financial burden, evolving stakeholder demands, and rapid technological change. The COVID-19 pandemic further accelerated existing trends, pushing universities to adapt, transform, and innovate. Although COVID-19 gave some clarity on the potential future of universities, it also raised lots of questions and concerns that universities need to address if they are going to stay relevant. Some of these issues include the growing internal and external pressures of the reset of the global economy, shifting geopolitics, rapid advancement of new technologies, and digital transformation. New technologies offer potential to strengthen research performance, enhance teaching and learning, and expand access to higher education. A closer alignment with industry and government partners calls for reform in regulatory policies between partners. The rise of for-profit education models and providers will challenge universities to stay relevant. Universities of the future will be looking to innovate policies, engagement strategies, and technologies. The challenge will be the ability to do this while not losing their core purpose.

What Should Come Next?

Universities, governments, and international organizations need to evaluate what was done during the pandemic, internalize the lessons learned, and take action. The importance of such an effort cannot be overemphasized for three key reasons. First, there will be more and, perhaps, more frequent extreme events; boosting resilience and preparedness is critical for all organizations, including universities. Second, universities adopted new technologies, made many changes, and exercised new roles during the pandemic. They can accelerate their journeys into the future through actions that build on the lessons learned. Third, they will be better prepared to respond to external demands and a changing landscape.

The agenda for the future of universities is broad and complex. The GFCC University 4.0 discussion papers and associated discussion sessions provide food for thought about the matter and outline some key issues to address, even if new models are just emerging and evolving. Universities can use their experiences during the pandemic as a springboard into the future. To do that, they will need to expand their focus and interventions beyond the education function, and elevate initiatives related to technology to the highest level of university leadership.

As we emerge into the post-pandemic period, the time is ripe for universities to ramp-up their drive into the future. They can accelerate their transition to a future state by rethinking their models and designing a strategy for change – a key takeaway from the University 4.0 papers.

Universities are critical growth engines for economies worldwide. From a GFCC perspective, the more we catalyze learning about future university models, the more we will contribute to innovation, growth, and prosperity.

University 4.0 Discussion Paper

Drivers of Resilience, Prosperity, and Recovery

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The ability of universities to drive prosperity, prepare a well-trained labor force with advanced-level skills, and address social and environmental challenges has become increasingly relevant in recent years. Now, in the aftermath of COVID-19, alongside resilience and prosperity, universities will play a vital role in recovery and addressing its physical, psychological, economic, and social issues. Universities will be relied on to help reinvigorate communities and engage with all stakeholders to better their institution and the surrounding society. This can be done through their established role as an engine of economic growth, attracting local and global talent, as a space that fosters creativity and inclusivity, and as a mechanism to address societal challenges. With their set of values and the importance of openness to knowledge and impact, universities are uniquely well-placed to rebuild and drive inclusive and sustainable growth. Multi-faceted resilience will be the foundation stone of this effort.

Concluding Remarks

The pandemic pushed organizations of all types, including universities, into a compressed period of rapid change and transformation. But change was uneven across geographies and university functions. While most GFCC university members quickly and successfully converted their educational operations to an online mode, as widely reported in this report, that was not the case for many universities in the developing world, such as those in Brazil.[4]

The contrast between the education and research functions was also clear. While education was, to a great extent, digitalized, it was much more difficult for universities to do that in the research realm. As seen in many industries, digital technologies have dramatically changed how work is performed. This includes changes in the way research is conducted and, even before the pandemic, science was being digitalized and becoming more big data driven, as highlighted in an OECD report.[5]

The exploration of how research was affected by the pandemic is informed by diverse cases and results.[6] While some organizations and universities have managed to update their toolkits and processes, and build new capabilities to advance creativity, research, and innovation in a predominantly digital world, others have not succeeded. The need for laboratory infrastructure may pose additional challenges to digitalizing research activities, but does not constitute a barrier that cannot be overcome. Societies may soon see all scientists soon becoming digital scientists.[7]

The contrast between how some industries are leveraging digital technologies to advance innovation and the relatively slow pace of digitalization of research in universities raises important questions. Will universities be able to adopt new digital tools and processes pioneered in the business world? What are the barriers to adoption and changing processes, and how can they be overcome? What are the emerging trends identified about the digitalization of laboratories and research?

Universities rose to the challenge during the COVID-19 pandemic, providing crucial support and valuable contributions to societies. They leveraged their resources and capabilities to deliver novel products and services to the communities to which they belong, beyond what they traditionally provide, and filled gaps in supply chains and the provision of public services. But there is still a long way to go to reach a future state. The path to the new university most likely includes continuous updates in business models and roles.

4 https://www.timeshighereducation.com/news/brazilian-universities-struggle-go-online-amid-covid-denial.

5 https://www.oecd.org/science/inno/the-digitalisation-of-science-technology-and-innovation-b9e4a2c0-en.htm.

6 https://www.ft.com/content/27364b27-6c0c-4dec-b109-17c054b49465.

7 https://www.frontiersin.org/articles/10.3389/fcomp.2021.710972/full.

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