Some of you may recall that I wrote last year’s State of the University Address while trekking in Bhutan. At a small village five days walk from the nearest town (for non-Bhutanese), we visited a horse-trader’s house.

I noticed they had a capacitor powered by solar panels, which was being used to charge a hand-phone. I was sceptical about this, so I switched on my own hand-phone. To my
surprise, I saw a text message. It was from Deputy President Joe Mullinix about an urgent construction matter. That night, I tried calling Joe and was astounded we could talk clearly for ten minutes. As we finished, Joe asked where I was and I had to admit I was in a sleeping bag in a tent, 4000 m up a mountain in Bhutan.

It was also around then, that I discovered that Dorge, our young Bhutanese guide, had another job. When he was not leading treks, he was busy with a small IT start-up company which he had founded in Thimpu.
For me, this incident showed in a dramatic way, the remarkable reach and pervasiveness of the information technology revolution. In fact, the IT revolution has had a transformational impact on many businesses, and on the way we do countless things all round the world.
For example, if you know what this is, you are likely to be in your 40’s or 50’s.

It’s an aerogramme. The more senior people here will remember writing messages in very small print as this used to be the cheapest way to stay in touch when you were overseas. But most young people today have no idea what an aerogramme is. The aerogramme was finished off by email, Skype, and smart phones.

Your smart phone is also gradually becoming a sort of medical device.

I was at a Global health innovation Summit in London in August, and one of the buzz words was “m-health”. Mobile Health refers to the use of mobile phones to deliver health care to patients in their homes or communities. The mobile phone is the key to providing information, medical advice, prescribing and monitoring treatments, and in some cases, to make payments.
The point I am making is a familiar one - IT, the Internet and social media are disrupting many industry sectors and radically changing the way we all live and work. But the question is how is it impacting higher education? The answer, it would seem, is some but not very much yet.

Most universities have IT-based educational platforms which make available e-learning resources, lectures and other course materials. Many universities have more elaborate systems that allow on-line discussions, collaboration, and assessments. But in most universities, such IT- learning platforms still play a supportive or supplementary role. Yes, we do read reports of innovative ways in which IT has been used to enhance learning in the classroom. But these have largely remained interesting pilots or small-scale programmes.

In other words, technology-enhanced learning has not really entered the core or mainstream of the education process in universities. Traditional pedagogies and forms of teaching still dominate in most major universities globally. This year, however, there was quite a buzz with many educators and the media alike talking about a new campus tsunami – a digital tsunami. An article in the New York Times in May put it this way:

“Online education is not new. But, over the past few months, something has changed. The elite, pace-setting universities have embraced the Internet. Now online activity is at the core of how these schools envision their futures.... What happened to the newspaper and magazine business is about to happen to higher education: a re-scrambling around the Web.”

The proximate event that triggered this dramatic pronouncement was the announcement by Harvard and MIT to jointly put aside $60 million for their faculty to develop free online courses. This followed on the formation of a new company called Coursera, which provides a platform for universities to develop and offer interactive courses in a wide range of subjects. In August, four months after its founding by 2
Stanford Professors, Coursera reported it had 1.3 million students registered, 33 participating universities, and 1,000 videos online. For schools, the Khan Academy has shown the value of well-designed interactive on-line courses in teaching students the basics of subjects from calculus to Chemistry. It even has a course on Singapore Math!

The special appeal of these programmes is the ease of scaling up, and potential reach, making high quality education available to millions of students across the world. Opinion is still divided as to whether these recent events presage a true disruption in the way universities teach and operate.

I believe that they do. But I would like to stress that the timeframe and the nature of the disruption are hard to predict. We should certainly not respond in a “knee-jerk” fashion to external events. But, they do provide a fresh impetus for us to think even more deeply about the impact of the IT revolution on the way we educate our students. We
should also consider if there are special opportunities here to further differentiate our graduates and our university.

Let me start, not by talking about technology, but about our students and the world in which they will be working, living and striving to make an impact in.

I believe there are three big shifts we must take into account as we think about IT and our educational approaches and desired learning outcomes for the future.

Those of us who are fans of the BBC’s “Yes Minister” TV series, would be familiar with top civil servant, Sir Humphrey Appleby and the Minister's assistant Bernard Woolley. In one episode, Sir Humphrey explained to Bernard: “Ministers should never know more than they need to know. Then they can't tell anyone. Like secret agents, they could be captured and tortured”.

“You mean by terrorists?” Bernard asked, to which Sir Humphrey replied: “No, Bernard, by the BBC.”

Of course, the days that Sir Humphrey referred to are largely gone. Today, information is freely available when you need it, wherever you need it.

So the first huge shift is the increasing commoditization of information.

In 2007, I had to try to catch a boat from Tabatinga in the heart of the Amazon, to Iquitos, a day away by river in Peru. And guess what – I was able to use my Blackberry to surf the net, and to find the name and phone number of the boat company. Information that in the past had been highly inaccessible, is now easily available to all. The internet, smart-phones, Google, Wikipedia and their relatives have resulted in the commoditization of information.
The second big shift is that our students have changed. Today, young people grow up immersed and supported by IT and other technologies. These keep them connected all the time, help them with their work and keep them entertained. When they become our students, they will expect the same of their educational experience at university.

The Director of NUS’ Centre for Instructional Technology Ravi Chandran, introduced me to the term “personal learning ecosystem”. In the past, a student would probably draw the bulk of his or her knowledge and expertise from University sources. But today, each student can have his or her own personal collection of education apps, tools, websites, YouTube videos and e-learning resources drawn from outside the university.

The implications of this change in the students' personalized learning environment are profound. If the university did not teach well relative to available on-line learning resources, this would negatively impact on the quality and relevance of its instruction.
The third key shift is that our world is becoming increasingly complex. Last year, I was chairing a meeting on public health challenges in Asia. A colleague sent me a diagram which is a simplified representation of the factors affecting obesity. Our students after they graduate and start work, will find themselves similarly faced with tackling issues and problems which are more and more complicated. While it is not easy to teach students how to deal with complexity well, nevertheless this will be a key requirement for the future. This is especially vital for a country like Singapore which aspires to be a knowledge and innovation-based economy.

How do these major shifts impact the way we think about teaching and learning at NUS? If I were forced to sum up my views in only one phrase, it would be this: We must redouble our central focus on the “training of critical minds”.

The critical mind encompasses several key qualities, amongst which I would highlight three today:
First, “sense-making”. This is the ability, when presented with masses of data, to make sense of these, to ask the right questions, to identify the most important issues and to frame them appropriately.

Despite the easy access to information, sense-making does require mastery of a sufficient base of foundational knowledge. This is because when deluged with so much information, particularly for complex issues, we often need a solid base of foundational knowledge in order to evaluate, synthesize and curate the data. This foundation has to be broad-based enough, since nearly all complex problems cross disciplines. What this means is that the rigour that typifies NUS’ education today is still relevant. But we have to work harder to ensure that our students are skilled in applying their foundational knowledge to analysing complex problems, and seeing novel approaches and solutions.

Second, clarity of thought and communications. In another episode of “Yes, Minister”, Sir Humphrey is asked by the Minister if he would give a straight answer to a straight question. After thinking for a minute, Sir Humphrey replied:

“As long as you are not asking me to resort to crude generalizations or vulgar oversimplifications such as a simple yes or no, I shall do my utmost to oblige.”

Unless you are like Sir Humphrey, trying to evade a tricky situation, clarity of communication is a vital strength. This in turn requires clear, logical thinking as well as precision and discipline in writing and in speech.

We have long recognized the immense value of nurturing these qualities in our students. Just last year, for example, NUS committed to an ambitious extension of our critical thinking and writing programmes to cover the majority of our undergraduate student intake. Our goal is that even as we scale up these programmes to 30-times the number of students, we will maintain the same high quality and degree of personalized attention.
Third, curiosity and imagination. It is crucial that we help our students to remain curious, so they can broaden their intellectual horizons and continually learn across a wide range of topics. This is because sense-making is not just about rigorous analysis of data. It often also requires understanding of historical and cultural contexts, and the social and human dimensions.

Beyond these, to think more creatively about issues and their possible solutions, a strong sense of imagination is essential.

In the Sung dynasty, artists were selected for the Imperial Academy based on their creativity in composing a painting in response to a poem. For example, for a poem about a horse galloping through a flower-covered meadow, the winning painting did not have any flowers in it. Instead, it showed a galloping horse with two butterflies flying around its hooves.

All these remind us of the critical importance of creating a learning environment where students are encouraged and challenged to think about issues differently, to question assumptions and to explore novel approaches.

Against this backdrop, I return to a key theme of my speech: What should be the role of IT and technology-enhanced learning in NUS? How might it advance our educational goals, while positioning us well for a future where on-line learning will have a larger impact? With our large student intake, can the use of IT allow us to better help every student to reach his or her full potential?

The good news is that we are starting from a strong position. NUS has invested heavily in learning technologies and expertise over the past decade. About 85% of NUS modules have a presence on our Integrated Virtual Learning platform, or IVLE. IVLE is an advanced platform accessible by PC, phone and other mobile devices, which provides a wide range of sophisticated tools and resources which are very varied.
For example, don’t worry if you can’t recognise the NUS students in this picture. These are their robot avatars through which they attend classes in a virtual course run through IVLE. And just to set the record straight, NUS does not own any helicopters!

Over the past decade, several NUS schools from Medicine to Music, from business to engineering, have already taken the lead in developing innovative new pedagogies, many involving the use of IT. Indeed, under the outstanding leadership of Provost Tan Eng Chye, we have done much to enhance the quality of teaching across NUS. Even so, at this year’s senior management retreat, there was strong enthusiastic support for NUS to develop a specific strategic thrust – to make much greater and more creative use of technology to improve learning outcomes.

However, our focus will not be on putting more of our teaching materials online. Instead, we will redesign key classes to promote more active learning by integrating online programmes with changes to face-to-face learning in the classroom.
What technology can do which traditional lectures cannot, is to ensure that each and every student in a class has mastered the foundational knowledge and concepts. This is especially useful for popular courses where class sizes are large.

Well-designed interactive online programmes allow each student to learn anytime, at his or her own pace. In built assessments enable students to monitor their progress, and help lecturers identify areas where students have problems.

The online programmes also free up face-to-face classroom time for much more active learning. Students can work in teams on problems and their solutions. They would need to explain and defend their ideas, and to critique those of their peers. In short, the classroom time will focus on the training of critical minds.

Beyond such “flipped classroom” approaches, we will develop other innovative ways in which technology is used to stimulate interest in a subject, and to promote active and collaborative learning.

In fact, at least six pilots have already been started at NUS. Associate Professor Lam Yulin and Dr Adrian Lee are introducing flipped classroom modules in Chemistry.

In a comprehensive pilot that was recently completed, Assistant Professor Ben Leong from School of Computing re-designed an introductory programming methodology course using game mechanics. In this photo, Dr Leong is the one with the light sabre.
The seven problem sets in the course were divided into 22 smaller "missions" framed around a storyline set in a Star Wars-like universe. There are in-built assessments with rapid feedback from tutors. Students are awarded experience points (or EXPs) for completing missions depending on how correct their submissions are, and for performing various tasks such as participating in tutorials and the course discussion forum. A recent review of the module showed very high levels of student engagement, improved interaction with tutors and enhanced learning outcomes. I guess this imaginative module deserves a Luke Skywalker award!

Over at Engineering, Associate Professor Ang Kok Keng will transform his core module on Statics and Mechanics of Materials, which is taken by 350 freshmen each year. Part of his module will be converted into small Web-based units on fundamental concepts, and a series of web-based lectures which students can access anytime. Web-based tutorials with self-marking capabilities will be used to assess students.
The face-to-face lectures examine how the fundamental concepts are applied to real-world engineering problems. The tutorials will focus on having each class of 20 students, work together to solve complex problems themselves.

For Professor Johan Geertsema’s USP writing module, the whole class has been issued with iPads which contain all the content, apps and tools to enable collaborative drafting and revision of written assignments.

Associate Professor Laksh Samavedham is developing a version of a Massive Open Online Course (or MOOC) which is for NUS-wide implementation only. This NUS-MOOC will be a General Education Module which focuses on modelling to analyse big problems. It hopes to attract a large number of Year one students, who would work in multidisciplinary groups on analyzing some “big questions” involving energy, environment and health. The academic focus would be on developing qualitative and quantitative reasoning skills, through a predominantly on-line platform.
These exciting pilots are each different but collectively, they give us a powerful sense of the great potential of Technology-enhanced learning and where it can lead us as an institution. It is the same exhilarating sense when, in the mountains, the early morning mists rise, and the path up the next peak reveals itself.

Over the next months and years, Provost Tan Eng Chye and his team will work with our Deans and faculty to systematically identify and re-design courses where Technology-enhanced programmes can have a strong positive impact on learning.
To drive this effort, I will be creating a new $5 million funding pool, which we will call LIF-T or “Learning Innovation Fund - Technology”. The fund will support three broad thrusts:

- an annual call for proposals from all Schools in NUS;
- targeted programme re-design of courses with large class-sizes, particularly in the Faculties of Science, Engineering, and Arts and Social Sciences;
- and supporting NUS start-ups with novel educational products to demonstrate how these can enhance learning in our university.

We will also transform our IVLE platform and build academic support teams to provide maximum assistance to our faculty in re-designing their courses.

As we proceed with this, I do realize that as long ago as 1527, Machiavelli had already warned:

"There is nothing more difficult to take in hand, more perilous to conduct, or more uncertain in its success, than to take the lead in the introduction of a new order of things."

We will certainly face many challenges as we integrate technology-enhanced learning into a significant proportion of courses across our university. We cannot do it without the full support of our faculty. We would need to assist our students to adapt to new, active-learning modes. The way assessments and examinations are designed and used would require careful review and change.

We will face many challenges, but it will be well worth the effort. We will be taking a big step forward in helping our students to develop the critical minds so crucial for the future. This in turn will be of value to Singapore’s advancement as a knowledge-based economy and society.
Even as we embark on this technology-enhanced learning thrust, however, we must also remember that there are vital aspects of university education, which on-line programmes cannot replicate.

Experiential learning, through face-to-face interactions and teamwork, is a crucial part of the training of the mind and the development of the whole person, and is part of the unique value of the university experience. Hence, our distinctive global education programmes prepare our students to be effective in diverse cultural settings.

The myriad of co-curricular programmes we offer enable our students to develop key personal attributes such as initiative, teamwork, leadership and integrity.

In this regard, our six Halls of Residence have been playing an instrumental role for decades. As a student, I stayed for five years in the King Edward VII Hall at Sepoy Lines. Rag and Flag was a big thing even in those days, and as freshies, we were all expected to play our part, in my case, dressed as a cockerel.
We played games every evening before dinner, and I spent far too much time in the billiards room. In fact, my fondest memories of my university days are of the Hall, which allowed me to develop as a well-rounded person.

Our Halls of Residence, with their rich history and traditions, therefore have a unique place and role in the educational experience of our students. In recent years, we have invested in improving their physical infrastructure.

Going forward, I have tasked Vice Provost Tan Tai Yong, to work with our Hall Masters and students as well as with NUSSU, to envision the future of our Halls which would enable them to do even more. Even as we consider further enhancements to our Halls, we will also continue to innovate and build upon the rich menu of experiential learning opportunities in NUS.
To underscore our own personal commitment to experiential learning, my wife Evelyn and I decided to hang up our mountain boots this year, and instead spent ten days on a boat in Tonga, to snorkel with humpback whales.

We had seen whales before, from boats in various parts of the world, and had formed the impression that they were majestic but fairly predictable creatures. Surface, blow, dive; surface, blow, dive. But Tonga turned these impressions on their head. We learnt at close hand that whales have a wide range of varied, and often unexpected, behaviours.

Here is a short video-clip I took of a humpback whale “tail-slapping”.

They also slap their fins, and the mother whales have a habit of pushing their babies through the water with their noses. But this young whale takes the grand prize. It is doing the back-stroke!
I couldn’t see its face, but somehow I got the impression, that it was doing so with a gleeful smile. We humans, of course, have a much wider range and variety of behaviours than humpback whales. And unlike humpback whales, human behaviours have a massively greater impact on the state of the world we live in.

Technology and human ingenuity have powered rapid economic growth especially in Asia, but often at the expense of environmental protection and excessive green house gas emissions. The IT revolution is transforming businesses, but it is also contributing to fundamental changes in our societies and social norms.

People around the world are living longer. But the quality of that longer lifespan is threatened by a massive tide of chronic diseases linked to unhealthy lifestyles and behaviours. Hence, human behaviours and social norms, together with business interests, finance and public policy, are of fundamental importance to the large scale, complex challenges facing Asia and the world today, from public health to liveable cities, from sustainability to climate change.

This consideration is highly relevant to us because one of the long-term goals of NUS research is to contribute to solutions to such large scale challenges, and to the advancement of society. We are well-placed to do so as the quality and global impact of our research continues to rise sharply, under the very capable leadership of Deputy President for Research, Professor Barry Halliwell. Today, NUS has a broad base of research excellence, with globally recognized peaks, especially in engineering, science, computing and biomedicine.

We are also making good progress in applying and commercialising our research. Dr Lily Chan and her team at NUS Enterprise have continued to do an excellent job in growing the innovation ecosystem at NUS, and beyond.

Yet, advances in science and technology alone, though crucial, will not solve the large scale problems confronting Asia and the world.
Effective approaches and solutions to these will also require a much better understanding of the human behaviours and changing societal and global contexts, that shape and drive them.

For example, we know that the world-wide epidemic of diabetes will lead to a huge burden of heart disease, kidney failure and blindness. Yet, we cannot arrest the growth in the numbers of diabetics or their medical complications. This is in large part because the prevention and control of diabetes require significant, prolonged changes in behaviour and compliance with treatment. And we still don't know how to do this well.

In short, we urgently need not just innovations in science and technology, but innovations in the ways in which we can work with individuals and communities towards the necessary changes in behaviour, social norms and public policies.

Quite unexpectedly, I came across this same message during my Bhutan trek. After two days of walking, we passed a small but charming building which turned out to be a primary school. What caught my eye first, were these yak hooves lined up on the window sill to dry. Then I noticed this pink handwritten poster.
It summarized the key elements for Gross National Happiness. As you can see, they include cultural diversity, good governance, standard of living, education, health, well-being and ecology. It is a good reminder, that for us to succeed in tackling the large scale challenges that beset us, whether in Bhutan, Singapore or Asia, we will need a more balanced and holistic approach.

At NUS, we have already taken several major steps in this direction, and I am glad to report that we have made excellent progress in building on these. In recent years, we have stepped up our support to develop and recruit top-rate faculty in the social sciences and humanities, with excellent results. In tandem, we have furthered strengthened our research expertise in key areas. Research and scholarship in the humanities and social sciences are of great value in helping us to better understand our world, and the changing nature of the human experience and condition. At the same time, they can contribute powerfully to larger-scale research efforts at NUS.
Last year, we set up the Centre for Behavioural Economics. Under the dynamic leadership of Vice President Ho Teck Hua, this centre has taken off to a flying start.

The Centre conducts novel basic research such as on behaviour game theory. In addition, it has launched several projects on the science of behavioural change with a particular focus on Asians. Field intervention studies are being carried out with several public agencies in Singapore to examine how information, environment and economic incentives can encourage the formation of good habits. This could translate, for example, into better adoption of healthy lifestyles and energy saving behaviours by Singaporeans.

Social sciences and humanities research is also playing a key role in our Integrative Research Clusters, which were set up three years ago, to study large scale complex issues and to develop practical solutions. Allow me to illustrate.
In the Sustainability Solutions Cluster, multidisciplinary teams are tackling a range of key environmental and energy research questions. For example, management of peat lands is one of major environmental and land management challenges of our region. As peat lands are deforested, drained and burnt for logging and agriculture, this results in substantial CO2 release, threatens biodiversity and water resources, and causes regional haze problems. An integrated team from NUS is working with regional partners on research which will be useful for environmental mitigation, conservation and sustainable development of these resources.

Our Finance and Risk Management Cluster is doing valuable work which is influencing academics and policy-makers. For example, the Risk Management Institute, which is part of the Cluster, developed an impressive Credit Risk Prediction System that is able to forecast the chance of default for more than 50,000 firms in 46 economies around the globe.
The research cluster on Ageing is organized around the ageing cell, the ageing body and the ageing society, each involving researchers across many disciplines. Their work has yielded results which have important practical implications. For example, research by the Cluster indicates that the incidence of age-related dementia in Singapore is much lower than would be expected from Western data, and this has triggered much more additional work. Separately, studies by researchers from Psychology have documented the beneficial effects of exercise on cognitive function.

Earlier this year, the Ministry of Education’s International Academic Advisory Panel endorsed a proposal to earmark specific funding to build excellence in Humanities and Social Sciences research. This is a timely initiative which if approved, will provide additional pools of competitive research funding.

These will be crucial for NUS as we work to further broaden our expertise and build new peaks in strategic areas of social sciences and humanities research.
Over the past decade, NUS has made remarkable progress in driving up the quality of our education and setting up highly innovative programmes such as USP, NOC, our University Town Residential Colleges, Duke-NUS Graduate Medical School and the Yale-NUS College.

Our goal of moving Technology-enhanced learning towards the shared centre of re-designed academic programmes will result in a large step-change rise in the quality of education. It will also position us well for a future where on-line learning will play a more prominent and potentially disruptive role.

Building new peaks in our social sciences and humanities research, while investing further in excellence in Science, technology, engineering and biomedical research, will broaden and deepen our intellectual base and expertise. It will also enable us to do even more, through our integrative research programmes, to contribute to solutions to the major challenges facing Singapore, Asia and the world.

Our goals are clear, the path exciting, and the promise great. But, we should not underestimate the challenges we will face in driving these strategic thrusts. Again, I draw insights and inspiration from the whales in Tonga. What struck me about the Tonga whales was their incredible energy and dynamism.
And one incident in particular left the deepest impression of all. One day, I was lucky to snorkel quietly for a few minutes with a female whale with a new baby.

Then suddenly, from the corner of my eye, I noticed the male escort whale coming up fast from below. The escort must have been 15 metres long and with the tubercles and barnacles on its head, looked uncannily like a spaceship from the movie Battlestar Galactica. My excitement soon turned into anxiety, as the male headed straight towards me. Fearful that it would slam into me, I started backpedalling. Yet at the last minute, the whale swerved gracefully and swept elegantly under and around me to join the mother and baby.
NUS is a very large organisation speeding along on a rapid trajectory. We are not a whale - but we can and must, like the example of the super-big whale, be nimble and agile. We must be able to make strategic adjustments despite the speed and intensity of our path of travel.

Challenging as it may be, I am convinced we can do this successfully, and with grace and some elegance.
My conviction is founded on having worked closely with so many members of the talented NUS community - our Chairman, Board, senior management, faculty, staff, students, alumni and friends.

We are different because we are always eager to innovate and are bold in action. We are driven by the same powerful impulse - an unrelenting hunger to excel; an unwavering commitment to pursue fresh heights of excellence. With such spirit and energy, we can create a further upward inflexion in our strong trajectory of growth and development.

Regardless of whether a campus tsunami comes or does not, we will place ourselves strategically for the future, and make NUS, a leading global university centred in Asia. Thank you.

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Note on video clips: viewable in streaming mode only, and requires a Windows Media or compatible player.