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SUSTAINABILITY AND THE FUTURE OF EDUCATION

CJ Koh Professorial Lecture Series No. 12
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Sustainability and the Future of Education
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FOREWORD BY SERIES EDITOR

DR TRIVINA KANG

ON BEHALF OF the CJ Koh Professorship secretariat and the publication team, it is my pleasure to present to you the twelfth issue of the CJ Koh Professorial Lecture Series — "Sustainability and the Future of Education". This is a consolidated report of the National Institute of Education (NIE) Faculty and Students Seminar and the Professorial Public Lecture delivered by Professor Justin Dillon, who was appointed the 16th CJ Koh Professor from 23 September to 4 October 2024. The main objective of this report is to share the rich and insightful with key stakeholders within the NIE, at the Ministry of Education (MOE) and the wider local and global educational fraternity.

The CJ Koh Professorship has been made possible through the generous donation of S$1.5 million to the Nanyang Technological University Endowment Fund by the late Mr Ong Tiong Tat, executor of the late lawyer Mr Koh Choon Joo's (CJ Koh) estate. Mr Tan Hsuan Heng, the nephew of the late Mr and Mrs Ong Tiong Tat, is the current executor of the CJ Koh estate.

In the Seminar entitled "Rethinking Scientific Literacy in an Era of Pandemics, Conspiracies and Climate Emergencies" held at NIE, Professor Dillon explored how recent events have highlighted concerns about the inadequacy of science education in schools, suggesting

the need to rethink how science is taught and to better leverage museums and other resources to address societal challenges and rebuild trust in science. In the Public Lecture titled “Sustainability and the Future of Education”, held at the NTU@One North Auditorium, Professor Dillon explored how education can adapt to the challenges of sustainability and climate change, preparing young people and teachers for a world facing significant environmental changes by 2030 and beyond.

I would like to take this opportunity to thank all who have contributed to this report in one way or another. Special thanks go to our NIE Director Professor Liu Woon Chia for her support in the CJ Koh Professorial Lecture Series and to Professor Justin Dillon for sharing valuable insights with us during his appointment as the 16th CJ Koh Professor.

This consolidated report would not have been possible without the excellent secretariat support from Ms Adeline Seow and the publications team which supported the writing from the first drafts to the final product. In this respect, our thanks go to Seeret Kaur.

We present to you the twelfth issue of the CJ Koh Professorial Lecture Series — “Sustainability and the Future of Education”.

Dr Trivina Kang
Chief Strategy and Partnerships Officer
National Institute of Education, Singapore
Nanyang Technological University, Singapore
December 2024

PREFACE BY NIE DIRECTOR

PROFESSOR LIU WOON CHIA

It is with great pleasure that we present this distinguished lecture series delivered by 16th CJ Koh Professor of Education at NIE, Professor Justin Dillon. As Professor of Science and Environmental Education at University College London and a Guest Professor at Zhejiang University, Professor Dillon is strategically situated to engage in the theme of sustainability and the future of education.

This theme reflects both the urgency of our current moment and the transformative potential of education to address humanity's most pressing challenges. Today's primary school students will complete their education during the critical climate milestones approaching 2030. This temporal reality compels us to examine fundamental questions about education's capacity to prepare future generations for a rapidly changing world. The global imperative to reduce greenhouse gas emissions is not merely an environmental mandate — it is an educational one.

Professor Justin Dillon's inaugural lecture in this series provides a compelling framework for understanding how educational systems must evolve. His analysis moves beyond the traditional paradigm of knowledge transmission to advocate for education as a driver of

informed action and sustainable practice. Students, he argues, require not only comprehensive knowledge but also the critical skills and agency necessary to navigate the environmental challenges that will define their lifetimes.

For sustainable change, critical examinations of our pedagogical approaches, emphasising relevance, engagement, and practical application in science education is needed. However, teachers cannot do it alone. There is an essential complementary role of informal educational institutions such as museums, science centres, and botanical gardens in strengthening scientific literacy and environmental awareness.

This lecture series charts a clear path forward: the systematic integration of sustainability into educational practice. The vision presented aligns closely with NIE's commitment to developing values-driven, future-ready learners equipped to address global challenges. Through interdisciplinary approaches and innovative pedagogies, education can prioritise sustainability while empowering students as agents of transformative change.

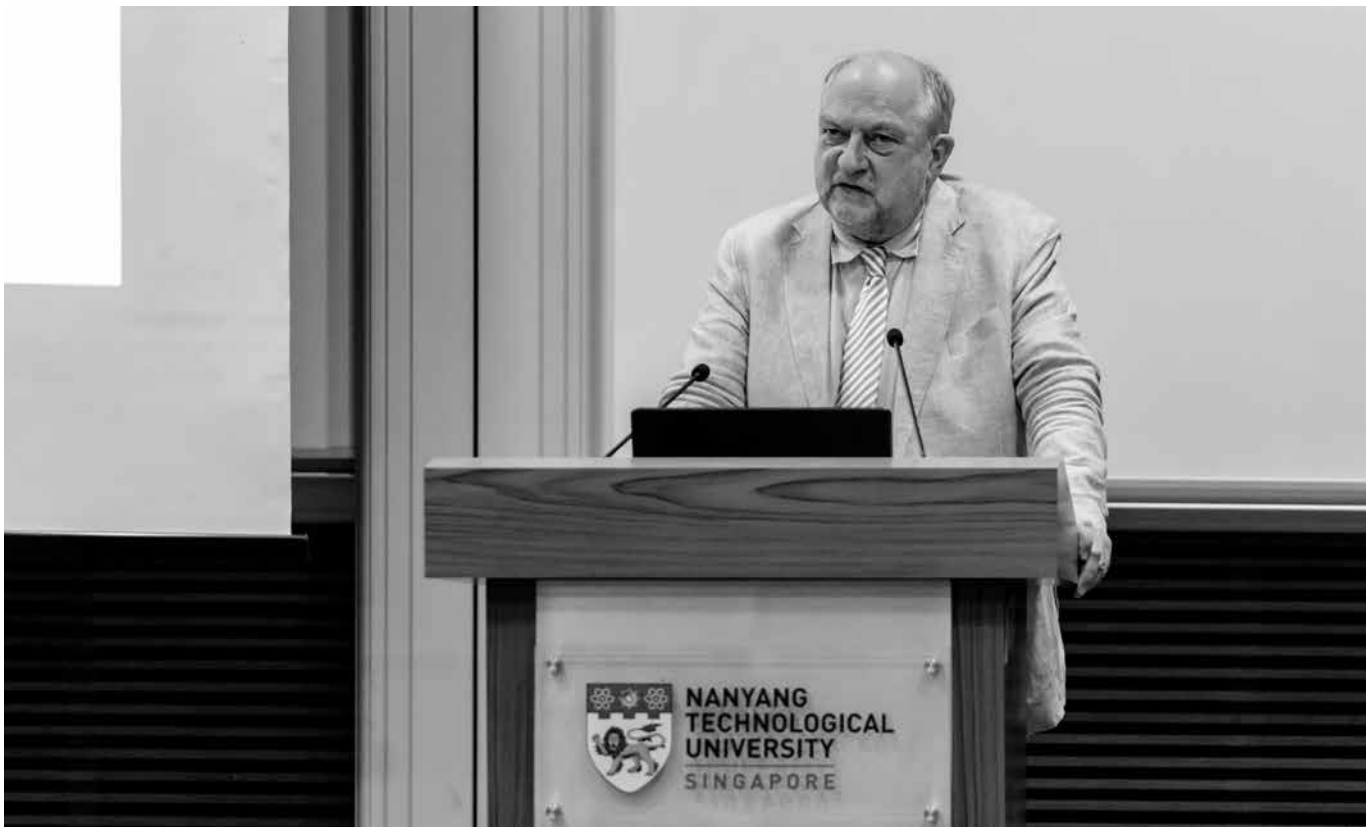
We invite educators, policymakers, researchers, and community stakeholders to engage with the ideas presented in these lectures. Preparing future generations to confront environmental challenges is our collective responsibility. By placing sustainability at the centre of educational philosophy, we can develop learners who are both intellectually rigorous and deeply committed to building a sustainable and equitable future.

The CJ Koh Professorship is proud to facilitate this critical discourse and looks forward to the ongoing conversations these lectures will inspire.

Professor Liu Woon Chia
NIE Director
National Institute of Education, Singapore
Nanyang Technological University, Singapore
December 2024

ABOUT THE CJ KOH PROFESSOR

JUSTIN DILLON



Professor Dillon is Professor of Science and Environmental Education at University College London and Guest Professor at Zhejiang University, China. His research interests are in learning in and outside the classroom, climate change and sustainability education. After studying for a degree in chemistry, Professor Dillon trained as a teacher and taught in London schools for 10 years. He joined King's College London in 1989, where he worked as a researcher and teacher educator being appointed professor in 2009. In 2014, Professor Dillon was appointed Head of the Graduate School of Education at the University of Bristol. He then joined the University of Exeter in 2017 where he was Director of Research in the School of Education. He returned to London to take a chair at UCL. Professor Dillon was President of the European Science Education Research Association (ESERA) from 2007-11. He was also President of the UK National Association for Environmental Education. Previously he was Chair of Trustees of the London Wildlife Trust and Bankside Open Spaces Trust. Professor Dillon edits the journal, Studies in Science Education, and is an editor of the International Journal of Science Education.

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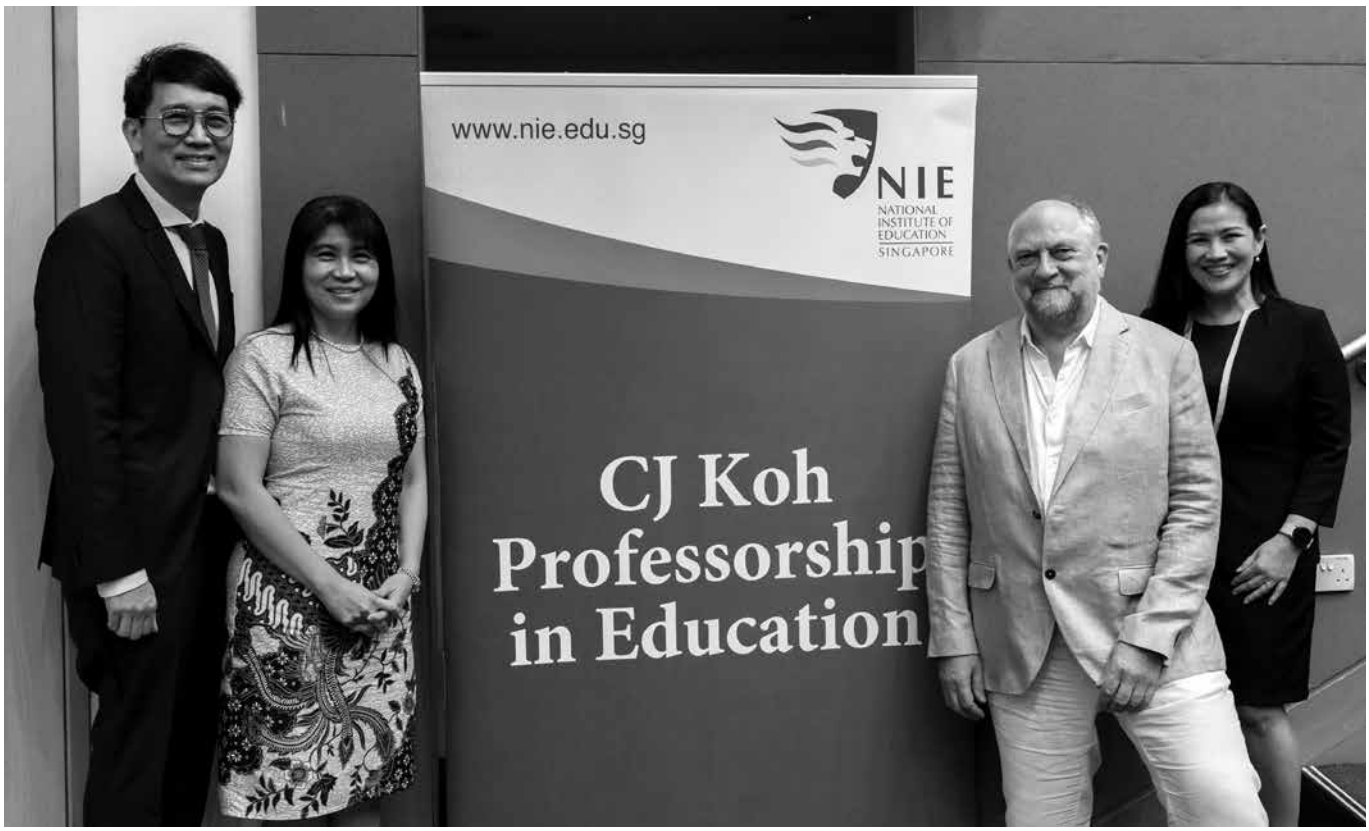

Synopsis

IN THIS SEMINAR, Professor Justin Dillon describes how recent events have called into question the adequacy of the science education offered in schools. The evidence suggests that, despite studying science at primary and secondary school, significant numbers of the public seem unfamiliar with some basic but important facts. A related issue is that trust in science and scientists is not as strong as might be expected in many countries. Rather than carry on as though there is not really a problem, the talk will argue that we need to rethink what and how we teach science in schools. We also need to value what places like museums, science centres and botanic gardens can do to help. Fundamentally, we need to examine what a convergence of science and environmental education offers in terms of addressing the wicked problems facing society.

Introduction

We need a transformation of education generally because society faces a series of wicked problems including poverty, climate change, inequality, food security, water security and biodiversity loss. Horst Rittel and Melvin Webber, from the University of California, Berkeley, coined the term 'wicked problems', in the 1970s, because they realised that urban planners could deal with 'tame' problems, such as isolated incidents but not with a range of social policy problems. These problems they termed

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'wicked' and among their distinguishing features are the fact that they cannot be 'solved' in the conventional sense of the word. My argument is that our current education system has not been successful in teaching young people to cope with these wicked problems, so we need to foster transformation of education towards responsible citizenship and action taking. I also think that we must teach with, and for, hope.

There is hope. I can look back at the changes that I have seen in my lifetime which leads me to be optimistic. When I was a child, there were electric vehicles but they were slow and only used to deliver milk to houses close to a depot. Nowadays, electric and hybrid cars are commonplace and the technology is improving all the time. From my living room window, I can see solar panels on a railway station and a huge green wall on an office block. We have come a long way but there is still a great journey to be made.

The need for change

COVID-19 changed the world in a number of ways. What became abundantly clear in the months after the disease was identified in China was that many members of the general public and, perhaps even worse, their political leaders did not understand some basic scientific ideas. Even more alarming was that it became clear that significant numbers of people, including journalists and politicians, actively denied the scientific evidence presented to them. This latter phenomenon led to countless unnecessary deaths.

Science educators, myself included, have devoted many years researching children's ideas about concepts such as combustion, climate change and cells. Whether we see them as misconceptions or alternative conceptions, they allow us to see how we might teach more effectively. What COVID showed us was that despite years of what we hoped was effective teaching, many people did not have a basic, potentially lifesaving, understanding of disease prevention, of the difference between vaccination and inoculation, of the characteristics of viruses and bacteria, etc.

Science and scientists find themselves in the spotlight as both potential saviours or as untrustworthy puppets of the pharmaceutical industry in ways that would have been unthinkable some years ago. A question that I asked back in 2021 was "How well has the science curriculum prepared the world's public for COVID-19?" The answer is clearly "not very". Fortunately, the science education of the numerous medical researchers who quickly came up with a number of vaccines was clearly very good. The same could be said of the even larger number of medical practitioners who had to cope with the worst excesses of the disease. However, far too many of the general public and their political leaders displayed a fundamental lack of understanding of basic science and, in many cases, a lack of trust in science and the scientific process.

We might laugh or shake our heads at those people who do not believe that humans landed on the Moon or who think that aircraft are pumping out chemicals ('Chemtrails') across the planet, but their distrust of science, of experts and of governments, helped to create a climate of uncertainty among many of their fellow public to the extent that many people refused medical treatment that would have kept them alive. Indeed, there was a case of a Wisconsin pharmacist who tampered with vaccines because he was a conspiracy theorist. Sometimes even scientific qualifications do not mean that you automatically trust the science, rather, the

evidence suggests that your political views may well be a good predictor of how much you deny the scientific consensus, although the link is not as simple as was originally thought.

In summary, the public's response to COVID-19 strongly suggested that science education had failed to provide the public to cope with a pandemic. The lack of understanding was compounded by a lack of trust in science and scientists – a phenomenon that also applies to the public's attitudes towards climate change.

Time for curriculum change

A national curriculum was introduced into England and Wales in 1989. Science was identified as one of the core subjects alongside English and Mathematics. Over the years, the content of the curriculum has changed, partly as a result of political influence and partly because there was too much content in the original version. In 2011, the curriculum specifically mentioned climate change, however, things were about to change. The Conservative politician, Michael Gove, was appointed Education Secretary in 2010. He commissioned a review of the curriculum led by the director of research at Cambridge Assessment. In Gove's opinion, the national curriculum was "too long [and] patronising towards teachers and stifled innovation". Gove was, and probably still is, convinced that the curriculum is fundamentally a collection of knowledge to be passed on to the next generation. A number of educators, scientists and environmentalists advocated for more inclusion of climate change in the revised curriculum. The review director resisted these calls. In the end, attempts to remove climate change from the curriculum foundered, partly due to internal disagreements in the Conservative Party. Some of its members realised that being 'green' would be a popular move with young people so removing climate change from the curriculum was seen as being counterproductive.

What has become clear over recent years is that many young people are dissatisfied with their education in terms of climate change and sustainability in the UK and elsewhere. A large-scale survey of UK school students found that 72% of respondents would welcome the opportunity to learn more about climate change in school and nearly seven in 10 felt that climate change education should be included across all subjects. The survey identified a real desire for more climate change education. This sense of frustration is echoed around the world. School strikes, also known as Fridays for Future, and Youth Strike for Climate, the movement associated with Greta Thunberg, have involved more than a million students striking in more than 120 countries in March 2019. A few months later, somewhere between four and six million (depending on whose counting you believe) young people took action. In the UK, a number of initiatives have focused on changing the curriculum so as to increase the amount of climate change education. In 2019, a "Teach the Future" campaign was launched at a Climate Emergency Conference organised by the National Education Union.

A number of surveys have been carried out to gauge teachers' opinions and experience. Rather surprisingly, perhaps, 86% of US teachers (n=488) surveyed thought that climate change should be taught in school – given the level of denial in the US, one might have thought that figure would be lower. A survey of over three hundred UK teachers, carried out about the same time, found that 69% of participants wanted to see more teaching about climate change in schools (it is already in the curriculum

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in Science and Geography). Indeed, 70% of respondents wanted to see radical change in the curriculum. While 89% of the teachers agreed that UK students should always be taught about climate change, its implications for environments and societies around the world and how these implications can be addressed, fewer than one in five said that they had received adequate training to teach about climate change and its impacts.

Towards more effective climate and sustainability education

We know from research that effective climate change education involves some or all of the following: engaging in deliberative discussions, interacting with scientists, addressing misconceptions, and implementing school or community projects. So, we know what seems to work is the challenge is to educate teachers in how to use them more effectively.

A number of resources are available for helping students to discuss sustainability in the classroom. The Inter-Climate Network organises workshops in schools where students can choose what actions they want the school to focus on such as getting more people to travel by bike or on foot or reducing their fuel bills. A number of scientists take part in outreach activities visiting schools and there are a number of online resources showing scientists and how they work.

One opportunity for students to interact with scientists is through citizen science. While the approach has been around for many years, the advent of Information and Communication Technology tools, such as identification apps, offers a number of affordances for rich engagement. Of course, there are different levels of citizen science ranging from crowd-sourcing of data to much more empowering involvement. The latter type is likely to be more impactful on young people. The citizen science approach is used as part of the latest sustainability and climate change initiative in England.

Recent policy initiatives in England

In April 2022, the UK government published Sustainability and climate change: a strategy for the education and children's services systems. The policy only referred to England, although it was noted that the UK government and the devolved governments (Northern Ireland, Scotland and Wales) are committed to climate action, and will work together. The Strategy, which is not mandatory, encourages each school to appoint a "sustainability lead", who will receive carbon literacy training with a view to developing a climate action plan. The physical education estate will be redesignated as a National Education Nature Park. The strategy involves a citizen science approach with students being involved in improving some part of the school grounds. Many teachers and environmentalists regarded this as a positive but rather unambitious initiative which failed to address the key issues in sustainability and climate change facing the world.

Is there hope?

Over the years, I have travelled to many countries and witnessed how they are addressing climate change and sustainability in and out of schools. Occasionally, I have come across schools and teachers who are carrying out outstanding work. Here are three examples which I found to be inspirational. I visited the Odyssey School in Denver, Colorado in the Spring of 2010. The school leadership were committed to organising the students' experience around the 'Learning Expedition'. Children at the lower grades participated in short excursions out

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of the classroom; those in higher grades participated in longer, residential visits. What was impressive about the school was the fact that evidence of these educational experiences could be found everywhere, in the classroom and on the walls of the corridors. The quality of the students' work, and their interactions with us as visitors, was exceptional. This is not a school that is set in an affluent part of the city.

Turning closer to home, the XP Academy in Doncaster, England, which I visited in 2023, was inspired by a US school, San Diego – Hi Tech High, a similar school to the Odyssey School in Denver. The students are organised into groups of 12 to 13 students who meet with a member of staff for 45 minutes every day. The curriculum is organised around learning expeditions which start with a guiding question, then focus on up to three case studies – from humanities (English, history and geography) or STEAM (science, technology, engineering, arts and mathematics) perspectives. An example of a guiding question is "Are protests worth the cost?" Expeditions always have a fieldwork dimension and expert input. Each module of work takes around 12 weeks and there are three a year. As with the Odyssey School, the quality and interdisciplinary nature of the students' work was exemplary.

Finally, on a recent visit to China, I was invited to go to Haidian Experimental Number 4 Elementary School in Beijing. The school is close to a botanic garden and some of its scientists have been involved with building the school's capacity. The school takes sustainability seriously in everything that it does, and its facilities are extraordinary. The fact that these schools exist suggests that there is hope. The schools have one thing in common – committed leadership with vision and drive. If they can succeed, so can many more schools.

Towards a convergence of science and environmental education

The schools that I have seen making great strides work within the existing curriculum. Particularly in secondary (high) schools, the rigid system of subjects makes interdisciplinary working difficult. To address wicked problems effectively, schools need to work in much more interdisciplinary ways. Whole-school approaches to sustainability and the creation of eco-schools, where different forms of learning (e.g. inquiry-based, disciplinary, and social learning) blend with the use of ICT, citizen science, and community engagement involve redesigning school grounds using knowledge from [science education] to give such spaces a more central place in teaching about health, food, and ecology as well as using [environmental education] to strengthen community involvement and develop a sense of place.

Science | Environment | Health

Another model for interdisciplinary work emerged when I worked with two Swiss colleagues on a new pedagogy for science education. We realised that the overlaps between science, the environment and health were much greater in real life than they are in the curriculum. We conceptualised a much more integrated approach which we called Science|Environment|Health. Ideally, the line between the words would be shown as dotted to show the permeability of the division. The new notation is not meant to suggest that health and environmental education should be swallowed up by science education. Rather, there is a role for both beyond a reimagined science education. The label highlights a situation of mutual benefit between science education, environmental education and health education, three educational dimensions that have yet

to be established in a transdisciplinary dialogue. Work in this area continues and the European Science Education Research Association (ESERA) has a S|E|H Special Interest Group.

Museums and science centres

So far, I have focused on schools but much of my work has been with museums, science centres, botanical gardens and aquariums. Such institutions have more flexibility and more resources than schools and can educate and influence huge numbers of visitors. I was very impressed with the Natural History Museum in London who created an award-winning exhibition “Our broken planet”. A number of curators were invited to select one specimen and then explain why it was important in telling the story of climate change and sustainability.

Of course, such institutions, host substantial numbers of school visits and can reinforce the learning that takes place in school. Some schools take the partnership with museums exceptionally seriously. One such is the Langley Academy, near Slough in Berkshire, south east England. The school has museum quality display cases and looks more like a science centre than a school with a model dinosaur close to the school canteen. Staff are encouraged to museum pedagogies including teaching through objects and specimens.

Conclusion

I have argued that we need a transformation of education generally because society faces a series of wicked problems. I have tried to explain why this is the case and suggested some possible ways forward from radical reform of the education system down to individual pedagogical strategies. I live in hope.

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Professor Chang Chew Hung: You seem to say that scientific literacy is key to addressing wicked problems like climate change. One of the things teachers and students always think about is if you want to integrate scientific literacy, would you need to do more, and will that overload the students and teachers? This question is open to all panellists. What do you think?

Professor Justin Dillon: Well, I question the value of scientific literacy altogether. I am not entirely convinced that the scientific literacy is a healthy term. But what I am arguing is that we need to do things differently to address the wicked problems people are facing and prepare them for. People often say the curriculum is overloaded.

So, two or three possible answers are: Firstly, we need to exploit the time children spend outside of school and find attractive ways for them to do independent learning. Instead of being on Instagram, they will be motivated to find out more about the world, their environment, and their futures independently. Naturally, Instagram continues to do that.

Secondly, the current curriculum is overloaded with material that people do not make much sense of or use. Just because it is there, it does not mean we should not change it. We should update the curriculum to include more useful content.

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Thirdly, there are probably ways of teaching that do not require a drastic curriculum change but instead allow for more multidisciplinary approaches. By shifting the pedagogy, we can connect things better and give students valuable insights without needing an entirely different curriculum. Pedagogical adjustments can happen even within the existing framework.

Associate Professor Tan Aik Ling: You mentioned earlier that scientific literacy might not be a useful construct? I think scientific literacy is a useful placeholder to discuss the notion of science. In your talk, you mentioned that ministers and politicians need a science background. My question would be: What do you mean by having a scientific background? To what extent must one learn science to have that background? I feel that the literacy component is a good starting point to talk about having a science background. For example, the Singapore science curriculum is designed around three pillars of literacy. The first is personal scientific literacy — how to engage with science artifacts in everyday decisions. The second is community literacy — how a scientifically literate person interacts with others. The third is professional or economic science literacy — about people in STEM careers. Hence my point is that scientific literacy could be useful.

Dr Tricia Seow: For me, the main point is considering how to integrate and coordinate across different curriculum subjects. Scientific literacy is a kind of disciplinary knowledge, but what about the things happening in other subjects? In geography, there is the idea of human-environment interaction across scale. In social studies, it is about engaging with people in power to enact change.

We currently lack clarity about what is happening in various subjects for students' development. If we coordinate better, there will be less load on any particular subject or teacher. National curriculums, like in Singapore, need an oversight on sustainability education to align efforts across subjects.

Professor Justin Dillon: Do you teach student teachers here to work in interdisciplinary ways?

Dr Tricia Seow: Geography is already interdisciplinary. It could start conversations about coordination. However, we lack enough information or data about what is happening in schools. Professor Chang Chew Hung and I are researching sustainability education across subjects, levels, and tracks to inform this integration. Projects can serve as a mechanism to integrate disciplinary knowledge and skills for problem-solving. However, we must also go beyond problem-solving in projects to develop empathy, compassion, and wise decision-making — capabilities often beyond a project's scope. We need to broaden this approach to address these wicked problems fully.

Associate Professor Tan Aik Ling: For instance, I think we talk about the fact that knowledge does not reside in a single person, right? The 21st-century competency, one of which is collaboration — how do you collaborate and work with others?

For instance, I know of a school here in Singapore where the students pick their areas of strength. The wisdom of this school is that not every child needs to reach the same learning outcomes at the end. They have several different master classes. What do you want to be a master of? Some children will pick, "I want to be a master of empathy," so they engage people to teach them how to build empathy. Others choose to be a master of

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technology. After a semester of learning these skill sets, the kids are put into teams to solve problems. They have to choose members, one from each master class, hence they become a team with collective wisdom to solve the problem. I thought that was an interesting approach to integrated learning. It shows that even if I do not have a specific skill set, I can work with someone who does.

Professor Justin Dillon: The frustrating thing is that we know some schools are doing fantastic things. The question is, how do you scale this up? Why is it that only a small number of schools are doing wonderful things while the majority are not? Whose fault is that? What can we do about it? How can we move forward in six months or five years? Where do we want to go?

Professor Chang Chew Hung: You raised another question that I wanted to ask the panel here. There are many ways to approach this and many good examples in schools. In your talk, you raised several strategies to think about such as discussion, fieldwork, hands-on activity, correcting misconceptions, and so forth. Quite a lot of pedagogical approaches. Do you think it would be helpful to suggest a signature pedagogy? Would there be one?

Professor Justin Dillon: Probably yes, but I do not think we have enough evidence yet to say what it might look like. There was a monk that said, "Lord, I do not know what pleases you, but I know you value the fact that I want to answer that question." And I think that is the case — wanting to answer a question is as important as actually finding the answer.

Dr Tricia Seow: If you put a gun to my head and said, "Think of a signature pedagogy." I think the ones I would pick would be inquiry-based learning combined with case-based learning. These are important because inquiry-based learning gets students to understand how knowledge is constructed in disciplines. It helps them grasp nuances of data collection and analysis, showing how things are done in the real world. Taking action adds other elements, like deliberation, where students learn to take perspectives, consider others' views, and develop nuanced solutions.

Case-based learning would also be key for two reasons. First, it helps students understand context, which is essential for creative solutions. Second, it helps develop a sense of place — socially, emotionally, and environmentally. Professor Aik Ling once wrote a commentary that said if we don't know what's there, we won't be motivated to conserve it.

Professor Justin Dillon: If you have not read it, you should look at our piece in Science from about seven to eight years ago. The piece emphasises inquiry-based and case-based education combined with technology to make education transformative.

Dr Tricia Seow: Transformative education is difficult because it requires many things to align. For instance, in my own research, I found that while teachers try to do this, they often lack the knowledge to make it meaningful.

Professor Justin Dillon: In the UK, many teachers do not live where their students do, so they lack a sense of place to engage deeply.

Dr Tricia Seow: In Singapore, geography makes it compulsory to take students out of the school for place-

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based learning. Unfortunately, it happens only once a year, which is not enough.

Associate Professor Tan Aik Ling: From our research, we concluded that students need weekly experiences to remind them of the environment's importance. For example, during a project, we tested students' connectedness to nature before and after a field trip to St. John's Island. Post-trip, there was significant improvement, but a delayed test four months later showed it had returned to the original state. This suggests the need for frequent and sustained engagement.

Dr Tricia Seow: Different subjects should share the responsibility of taking students out. For instance, science, geography and history could all aim towards shared goals.

Associate Professor Tan Aik Ling: I would like to pick up on another point you mentioned earlier. You talk about children deciding, "I want sustainability education because this is my future". This notion of environmental activism is often antagonistic, it is either you are or you are not. I am a peace-loving person, so how can we educate kids to understand the problem of climate change and take action without resorting to hostility? When we wrote a commentary on conservation in Singapore for the national newspaper, I received hate mail the next day from people disagreeing with my points. That affected me deeply and made me stay away from discussions for a while. The backlash came not because of an alternative viewpoint but because someone denied the existence of nature in Singapore altogether. I feel like teaching about the environment is important, teaching about climate change is important, and taking actions is important. But how do we communicate these ideas in a less antagonistic manner?

Professor Justin Dillon: Well, I mean, the fact that you have got hate mail suggests that the education system is not working for that person. In some ways, you could argue that the fact you are getting hate mail suggests you are doing something right from people who have an extreme point of view. But it is a utilitarian argument. You have to do what benefits the majority of people most of the time, and you will always get some opposition. You cannot be guided or restricted by a very small minority of people who say otherwise. You need to do what you think is the right thing to do. For young children, we need to find ways to empower them to take action and influence society. It has been said, "Don't ask what children can do for society. Ask what society can do for schools. What can society do to enable schools to be schools?" And I think that is the important thing. How are we facilitating schools in empowering people to make change happen without needing to resort to violent protest?

Audience Member: From your presentation, I see the emphasis on science education and place-based or field-based studies. I absolutely agree with the context of climate change and its increasing impact. I was wondering, when you talk about climate change as a global issue, it often has a deeper impact on the Global South. In relation to science education, how much value and what kind of approach should we give to collaborative science education? I am talking about collaborative innovations between the Global South and Global North, rather than just circulation of knowledge from the North to the South. How can we ensure resources are equitably distributed? Often, climate change-related resources are much more accessible to students in the Global North. What about the Global South? Could you shed some light on this?

Professor Justin Dillon: Yeah, that is a vastly

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challenging topic. This morning, I was involved in a webinar based on a special issue of the East China Normal University Review, which focused on cross-cultural dimensions of climate change. There were contributors from many countries whose voices would not normally be heard because they lack the resources to conduct social research. So, while there are people working on these issues, there are nowhere near enough good examples of collaborative learning between the Global North and South. Unfortunately, some efforts suffer from the misconception that the Global South is "just poor", which hinders mutual respect and value. This lack of an effective approach is partly our fault for not finding solutions.

There is an enormous potential for collaborative projects that go beyond describing contexts to actually finding ways for people to work together. Achieving this across vastly different contexts with diverse challenges is enormously difficult. This is an area ripe for funding. UNESCO has spent decades trying to develop materials for different regions, but their projects have not fully addressed these challenges.

Dr Tricia Seow: I do not have a clear answer, but I see the issue. Rather than focusing solely on North-South collaborations, which can be overwhelming, we might foster empathy by exploring diverse lives, values, and perspectives within our classrooms. Singapore, positioned between North and South, offers a unique platform for this approach.

I have written about cognitive empathy which is the ability to understand others' experiences without necessarily feeling what they feel. For instance, teaching geography with GIS to map typhoons might provide spatial context but fails to connect students emotionally. Students may view such disasters as remote and unrelated to their lives.

To bridge this gap, we could link global issues to local contexts. For example, connecting typhoons in the Philippines with flooding in Singapore could highlight shared challenges stemming from climate change. Similarly, when discussing disaster preparedness, we might shift from focusing on deficits like poverty or "poor decisions" to amplifying voices of those affected. Understanding their reasons, such as spiritual or communal ties to their homes, fosters deeper respect and collaboration. Incorporating these approaches into classroom pedagogy could nurture cognitive empathy, leading to greater compassion and action aligned with the values and needs of others.

Professor Justin Dillon: Young people should recognise the environmental and social impact of the devices they use daily such as the use of mobile phones. These devices often rely on materials sourced through exploitation and poverty, linking their convenience to the struggles of millions globally. Realising this connection can inspire a sense of shared responsibility and a willingness to act, especially in the global North, to support the global South.

This awareness does not require direct interaction, like Zoom calls, but can be cultivated by examining everyday items in terms of what we consume and use, and their global consequences. However, this must be balanced with hope to avoid a narrative of doom. By understanding that our lives are intricately connected to challenges elsewhere, we can foster a deeper sense of empathy and collective responsibility.

CJ KOH NIE SEMINAR: PANEL DISCUSSION

Audience Member: You started off talking about this idea of scientific literacy in an almost deficit model. That these are the things people ought to know. I am sympathetic with that position. I think people need to know, however this is the part where I am a little bit pessimistic. I think that even when people know, it is yet another thing whether or not people can act upon what they do. For science education, the worry is, with reference from Collins and Evans in a Nature article several years back, the founding myth of the individual scientists using evidence to stand against the power of the church or state has been replaced with a model in which Machiavellian scientists engaged in artful collaboration with the powerful. It seems like scientists everywhere have been contaminated with this idea of this notion that we are all in artful collaboration with the powerful and even here all of us in this university, we are all in neoliberal universities and there does not seem to be a very good way forward. And hence I am not sure exactly, what steps we can take forward because as you say, it is a wicked problem. Anything that we do right now is likely to cause further problems downstream. So how can we cure my pessimism?

Professor Justin Dillon: There is a fine line between pessimism and realism, and realism without hope is different from realism with hope. I could retire tomorrow if I wanted, but I do not. I do not want it because I think I can still make a difference. And I think we are all in this together. Being aware of the issues is a critical step forward. I mean, it is not, it is not black and white. You know, there are enormous shades of grey. I think things are getting better and some things are more transparent. For example, some museums have stopped taking funding from energy companies. There is a commitment to open sites as a commitment to all sorts of things. There is a danger in just seeing today is the same as yesterday rather than seeing, today is quite different than it was 20 years ago. Hence I think if we have to look back sometimes and convince ourselves that some things have got better, to convince ourselves it is worth investing time in making the future better.

Associate Professor Tan Aik Ling: It is not all doom. Our study revealed that while many teenagers experience climate anxiety due to constant exposure to doomsday narratives, hands-on experiences can shift their perspective. For instance, students who worked with scientists on coral restoration at Saint John's Island after learning about techniques to revive bleached corals caused by land reclamation and climate change have expressed newfound hope.

They saw that people are actively working to repair environmental damage, which inspired them to believe they, too, could contribute meaningfully. This highlights the importance of engaging students with real-world environmental efforts. By taking them out of classrooms and into active collaboration with scientists, we can counter fear with hope, showing them that change is possible and empowering them to take action.

Audience Member: Today, I would like to share some thoughts on climate and science education. While we often discuss what we should be doing, I have noticed a lack of conversation about defining success in environmental education. How do we evaluate or assess whether our efforts are genuinely effective in addressing climate change? My first question, then, is: "How do you envision a utopia for environmental education?"

My second question stems from my experience working

in an environmental charity before joining NTU. I have often felt a disconnection between environmentalists and educators. As a third-party service provider, how can NGOs collaborate effectively with the education system to drive systemic change? After all, sustainability hinges on collaboration, so I would love to hear your thoughts on the role NGOs can play in fostering meaningful partnerships within this system.

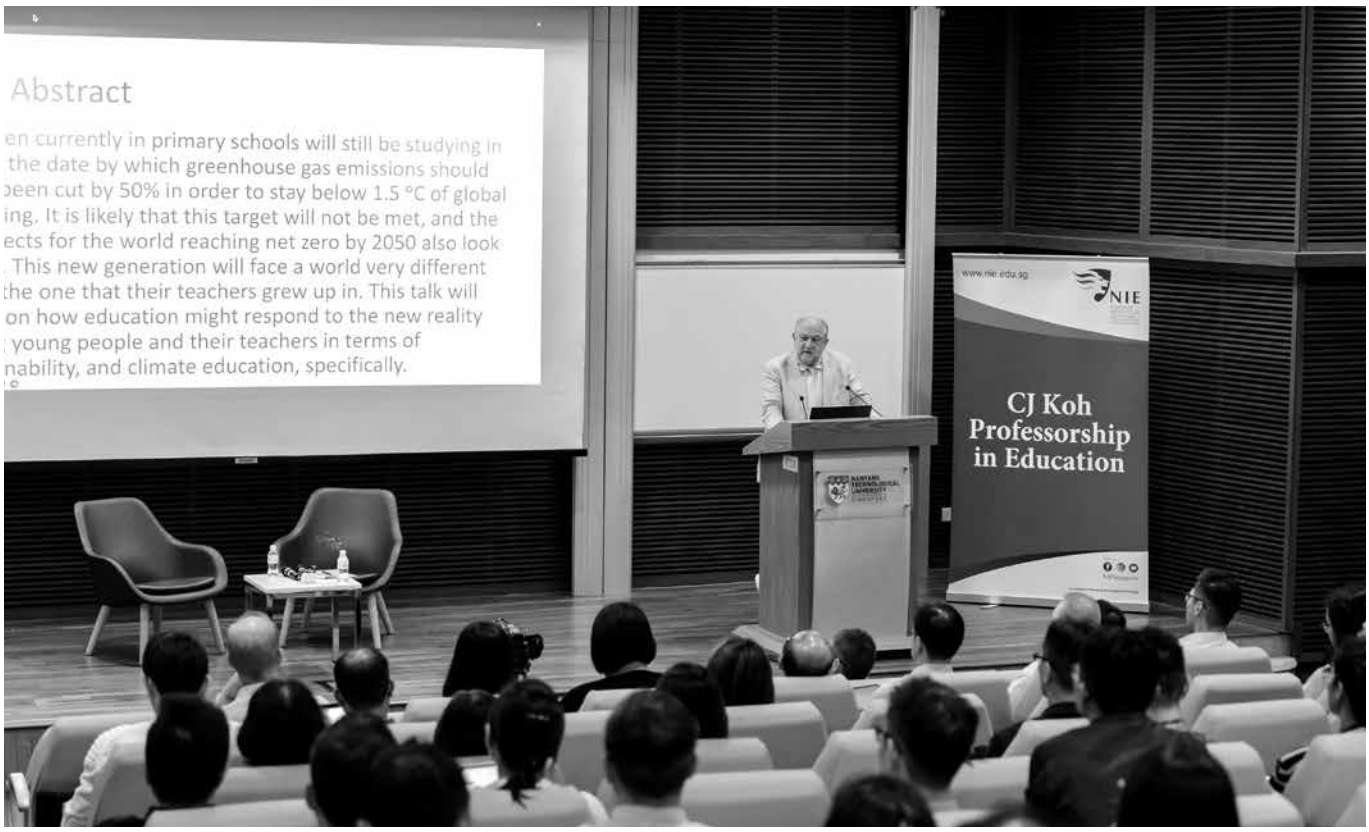
Professor Justin Dillon: There are two ways to assess the effectiveness of sustainability education. The long-term measure is whether, in 100 years, the world is a better place. However, this timeline is impractical, so we must act with the assumption that what we are doing now is effective.

A parallel can be drawn with health education. For years, campaigns warned against smoking, yet people continued. It was not until governments enacted laws, like banning smoking in public places, that behaviour changed. The success of health education lies in preparing the public to accept these measures as fair. Similarly, if environmental education enables society to support actions like plastic bag charges or mandatory recycling without resistance, it is likely we have laid the groundwork for meaningful change.

SUSTAINABILITY AND THE FUTURE OF EDUCATION

PROFESSOR JUSTIN DILLON

1 OCTOBER 2024, PUBLIC LECTURE, NTU@ONE-NORTH, SINGAPORE



Synopsis

IN THIS TALK, Professor Justin Dillon explains that children currently in primary schools will still be studying in 2030, the date by which greenhouse gas emissions should have been cut by 50% in order to stay below 1.5 °C of global warming. It is likely that this target will not be met, and the prospects for the world reaching net zero by 2050 also look bleak. This new generation will face a world very different from the one that their teachers grew up in. This talk focused on how education might respond to the new reality facing young people and their teachers in terms of sustainability, and specifically on climate education.

Introduction

I would like to begin by thanking NIE for inviting me to be the 16th CJ Koh Professor of Education and for hosting me for these two weeks. It is both an honour and a pleasure. My talk is framed by a realisation that children currently in primary schools in Singapore and elsewhere will still be studying in 2030, the date by which greenhouse gas emissions should have been cut by 50% in order to stay below 1.5 °C of global warming. Looking at how little progress has been made towards reaching that target, it is unlikely to be met. Similarly, the prospects for the world reaching net zero by 2050 also look bleak. This new generation of young people will face a world very different from the one that I and

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their teachers grew up in. In this talk, I will focus on how education might respond to the new reality facing young people and their teachers in terms of sustainability, and specifically on climate education.

A brief history of sustainability and sustainable development

The term sustainability is far better understood now than it was when I visited NIE in 1996 and, more recently in 2014. Wherever I look, I see hotels covered in green walls, I see hybrid cars and I see lots of information about saving water and reducing, recycling and reusing. Society has begun to get the message that we are living on a finite planet and we cannot continue to exploit it at the rate that we are doing.

The term 'sustainable development' appears to have been first coined at the 1972 UN Conference on the Human Environment. In a book published in 1980, called 'How to save the world', Robert Allen defined sustainable development as "development that is likely to achieve lasting satisfaction of human needs and improvement of the quality of human life". In 1987, the Brundtland Report 'Our common future', was published and its definition is still used today: "Humanity has the ability to make development sustainable to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs".

Over the years, the United Nations has formulated a number of targets for its member states beginning with Millennium Development Goals, which were never met and, more recently 17 Sustainable Development Goals (SDGs) which are equally aspirational. Agreed by the UN General Assembly on 25 September 2015, the SDGs are meant to be met by 2030. The aim of the goals is "to secure a sustainable, peaceful, prosperous and equitable life for everyone on earth now and in the future". The underlying principles are of universality and indivisibility, with all countries aiming to align their own efforts with the aim of promoting prosperity whilst simultaneously protecting the planet. They recognise that there is an ever-present tension between anthropocentrism and ecocentrism. The fact remains, though, that we need to take a long hard look at our own lifestyle choices.

Education for sustainable development

SDG 4 "Quality Education" aims to "ensure that all learners acquire knowledge and skills needed to promote sustainable development, including, among others, through education for sustainable development and sustainable lifestyles, human rights, gender equality, promotion of a culture of peace and nonviolence, global citizenship and appreciation of cultural diversity and of culture's contribution to sustainable development". As well as being the focus of one goal, education is clearly critical in achieving the other 16.

The idea of education for sustainable development (ESD), was developed in response to the idea of sustainable development. Delegates at the 1997 Thessaloniki Conference discussed 'education for sustainability' but the official name became 'Education for Sustainable Development'. UNESCO has produced a set of learning objectives for the SDGs which include eight competencies: systems thinking; anticipatory; normative; strategic; collaboration; critical thinking; self-awareness; and, integrated problem-solving competency. All these seem rather vague and it would be hard to see them in the curriculum of many schools. My friend and colleague, Arjen Wals, from the Netherlands, has identified what he calls 'sustain'abilities' which include sustainability literacy,

questioning hegemony and routines, empowerment and collective change, and passion, values and meaning making. These competences could be a blueprint for a transformative education.

The need for a change

I have written a number of times about how a very different form of education is needed to prepare young people to engage with the wicked problems facing society: poverty; climate change; inequality; food insecurity; water insecurity; biodiversity loss; homelessness; unsustainability, etc. The latest Intergovernmental Panel on Climate Change report 'Climate Change 2023' spells out the challenges facing us: "Human activities, principally through emissions of greenhouse gases, have unequivocally caused global warming, with global surface temperature reaching 1.1°C above 1850-1900 in 2011-2020". The report continues "Continued greenhouse gas emissions will lead to increasing global warming […] Every increment of global warming will intensify multiple and concurrent hazards". The report graphically illustrates the likely impacts on a number of sectors including agriculture and fisheries.

ESD and sustainability education in England

When the National Curriculum was introduced in England and Wales in 1989, environmental topics could be found in Science and Geography. A number of cross-curricular themes were also introduced including 'Environmental Education'. For many in the sector, this was a key moment that represented a shift in government thinking. However, a number of tensions existed in the environmental education field including the challenge of presenting complex global issues to young people in ways that do not make them feel helpless.

As is the case in many countries, high stakes testing in England led to the marginalisation of all but the 'core subjects' of English and Mathematics. Indeed in 1985, the Conservative government, following the USA's lead, had withdrawn from the organisation. In 2000, the English and Welsh National Curriculum was revised and the Government took the opportunity to focus schools' attention on issues of sustainability and the environment and, following a change in government, the UK re-joined UNESCO and in 2005, signed up to UNESCO's Decade of Education for Sustainable Development (DSED: 2005 – 2014). The Decade had four key objectives:

- Facilitating networking and collaboration among stakeholders in ESD;
- Fostering greater quality of teaching and learning of environmental topics;
- Supporting countries in achieving their Millennium Development Goals through ESD efforts; and
- Providing countries with new opportunities and tools to reform education.

The UK Government's response to the Decade included setting up the Sustainable Development Education Panel (SDEP) – a group of advisers who were briefed to ensure that pupils were fully-equipped to be active citizens for the new millennium. The Labour Government claimed to have put sustainable development at the heart of their agenda.

After signing up for the Decade, England introduced the Sustainable Schools framework (DCSF, 2008) which had three key components: a commitment to care; an integrated approach (developing education for sustainability through the curriculum, campus and community); and eight doorways or entry points that

develop sustainability practices. The doorways were: food and drink; energy and water; travel and traffic; purchasing and waste; buildings and grounds; inclusion and participation; local well-being; the global dimension. There is some evidence that, done well, the framework resulted in educational benefits to both schools and children. However, schools' commitment to the Decade and to education for sustainable development was mixed. Evidence from research suggested that teachers were inhibited by their lack of knowledge of the complexities of sustainability.

While progress seemed to have been made in England as well as Scotland and Wales, with a change in government in the mid-2010s, the framework was abandoned, much to the frustration of many in the environmental education sector. In 2013, UNESCO published a review – 'Education for Sustainable Development (ESD) in the UK – Current status, best practice and opportunities for the future'. Compared with Scotland and Wales, England lagged behind. Whereas Scotland had developed an extensive eco-school network, England had not. The briefing did find evidence of good practice in ESD, however, even though provision was very uneven. Currently, In England references to environment can be found in Science and Geography. So, for example, primary-aged pupils are taught how environments can change, including positive and negative impacts of human action, weather and climate zones.

In recent years, young, people, teachers and parents became increasingly frustrated at the lack of commitment to climate change and sustainability education. In response, the government announced a Sustainability and Climate Change Strategy in 2022. The strategy, which is quite broad, contains sections on climate education, green skills and careers, the education estate and infrastructure, operations and supply chains, and international collaborative working and trade opportunities. Schools that sign up can receive limited funding to improve their school grounds and then share their progress online (a National Education Nature Park). However, taking part is not mandatory and schools can decide how they respond to the Strategy. Perhaps, not surprisingly, it has disappointed many in the sector particularly as it does not take a serious interdisciplinary approach.

A number of environmental and educational charities have produced high quality resources to help schools introduce sustainability into the curriculum. My own Centre is developing high quality online training resources for teachers in both primary and secondary schools.

Is there hope

Despite the growing evidence of human impact on the climate and the relatively slow progress towards implementing high quality climate change and sustainability education, there is some reason to be hopeful about the future. During my travels, I have visited a number of schools in the UK and elsewhere that exemplify good practice.

The Odyssey School in Denver, Colorado organises its teaching around 'Learning Expeditions' whereby the length of an activity varies with the age of the students. The quality of the work that I saw and the engagement of the students with climate change and sustainability was inspirational. The same can be said of the XP Academy in Doncaster, England which I visited in 2023. Here students work in crew of 12/13 students on interdisciplinary topics. They, too, use the learning expeditions approach. Each

module takes around 12 weeks and involves input from a range of teachers from different disciplines. I have also seen evidence in China that schools are taking a very serious approach to sustainability.

I can see in Singapore that there is a substantial network of eco-schools and the textbooks clearly include reference to climate change and sustainability. My vision for the future involves whole-school approaches where different forms of learning (e.g. inquiry-based, disciplinary, and social learning) blend with the use of ICT, citizen science, and community engagement. School grounds need to have a more central place in teaching about health, food, and ecology and schools need to strengthen their community involvement and develop a deep sense of place in their students.

One approach is to take a Science|Environment|Health approach, integrating these areas of knowledge whenever possible. The health impacts of climate change are often poorly understood and the latest IPCC report notes that "Vulnerable communities who have historically contributed the least to current climate change are disproportionately affected". The impact of global warming is often felt more dramatically on indigenous groups who fish and farm in areas that are already suffering from the impacts of climate change.

Museums and science centres

I have spent many years working with colleagues in museums, science centres, botanical gardens and aquariums. Such institutions can complement the work of schools in educating about climate change and sustainability. While students spend years in schools, visitors to out-of-school organisations might visit once in a decade for three hours. Nevertheless, what they see and experience might live with them for a very long time. Our school educators have to grab visitor's attention using specimens of phenomena and explain ideas simply and clearly – museum pedagogy has not been researched as much as it should.

During my visit, I was privileged to be shown around the Singapore Science Centre. Sustainability and climate change were featured heavily in the many halls in this huge centre. I was particularly taken by the Guilt Trip space in which visitors take a plastic card which can be used to record their progress through a number of stations which focus on aspects of everyday behaviours such as travel, eating and water use. The exhibition provides an opportunity for the visitor to reflect on how sustainable their lifestyle is and, more importantly, what they might do to become more sustainable.

The Guilt Trip exhibit reminded me of a project that I had been involved with in Denmark, some years ago. The Experimentarium, a very well-known science centre, involved children and adults from richer and poorer parts of the city in co-designing an exhibition focusing on health promotion. The families were encouraged to think of ways in which they were active or not while engaging in everyday tasks. The exhibition designers then created an interactive exhibition in which families could compete against other groups. The exhibition was very popular and its effectiveness was evaluated by a doctoral student.

The Natural History Museum in London, one of the most popular visitor attractions in the UK, has taken a more active approach to promoting sustainability in recent years. The museum now works with a number of activists and supports initiatives in different parts of the world

much more actively than was the case a decade ago. The museum's award-winning exhibition, "Our broken planet", was a mixture of specimens and activities encouraging people to adopt more sustainable lifestyles. I have also seen other natural history museums, such as the one in Oxford, addressing sustainability issues in very engaging ways.

A few years ago, I worked on a European Union project that linked primary and secondary schools with university departments and aquariums in three countries, Denmark, England and Spain. The Ocean Connections project aimed to design a set of educative principles to guide teaching for ocean literacy using creative, digital pedagogies. The project, which was hugely impacted by COVID (there were no student mobilities) drew on virtual reality technologies to allow students to see what lies in the ocean. The project was an excellent example of co-design of educational experiences between universities, schools and out-of-school institutions.

Conclusion

In this talk I have tried to show how education might respond to the new reality facing young people and their teachers in terms of sustainability, and climate education, specifically. I believe that we need a much more transformative education system. I also believe that schools and out-of-school institutions such as museums and science centres might work together to produce education to address wicked problems.

C J KOH PUBLIC LECTURE: Q & A SESSION

Audience member: My question is, how do you see Singapore's efforts in our 2030 goals? And if you did visit some of our schools or are going to, especially at the secondary and primary school level, how would you think our efforts are bearing fruit, or are there some opportunities that we ought to leverage?

Professor Justin Dillon: I think as I understand it, Singapore is probably one of the leaders, in sustainability. And that is partly because of your size. I think that you can do a lot because you are a small country and initiatives can take on and be supported quite quickly. It is partly because you have a stable government, whereas we are jumping from one government to another, and that gets in the way. It is partly because the impact of climate change and problems with sustainability are immediately obvious to people who live here and have been for a long time.

I would be very positive in a way. The question is how much more can you do and how much more do you want to do? And it seems there is an enormous potential for doing even more. There is enormous potential and enormous resources. There is demand, I guess, from young people. So, if every country in the world had made the progress you had, we would be in a better place. But I think, like all countries, there is so much more that can be done, so much more opportunity and a willingness to do that, I think, really.

C J KOH PUBLIC LECTURE: Q & A SESSION

But you know, I know I am going to visit a school tomorrow which is doing wonderful work, but it is one of four, I think, pilot schools, and there are 300 schools, I guess, who could be doing the same sort of thing. The question is how can we scale things up so that every school is doing wonderful work? And that is the challenge in most countries — scaling things up.

Dr Trivina Kang: What then would you see as some of the barriers to taking things to scale, at least from the systems that you have had the opportunity to work within?

Professor Justin Dillon: Many education systems rely on high-stakes testing, where teachers are judged by their students' exam performance, often with financial incentives tied to results. However, these assessments typically focus on memorization, not sustainability, creating a barrier to teaching sustainability effectively.

When I visited Singapore in 2014, I suggested the country should exit PISA, as it seems to offer little benefit to any country, focusing only on the lowest common denominator. Instead, countries should set their own standards based on local contexts.

Teacher education is another challenge. To drive effective change, we need committed, highly qualified teachers. However, teacher training programs often lack the time to cover everything needed, and many pre-service teachers burn out quickly. A more sustainable teacher education model with a focus on sustainability and backed by research could help address this. We need bold ideas for training the next generation of educators.
Finally, parents and communities must be more involved in supporting sustainability education. Building stronger partnerships with schools is essential to fostering mutual benefits. Overcoming barriers like the exam system, parental attitudes, and policy drivers will require concerted effort from all involved.

Dr Trivina Kang: Many things for us to think about, but I would like to assure you that teachers in Singapore are not paid by how their well their students perform in high stakes exams. I am also happy to tell you that, I think we recently had an exchange with UK senior leaders, heads of schools, and they were sharing with us how the day after the Pisa results were released in the UK, it was a big splash in the papers and everybody had something to say. Whereas in Singapore it is quite the opposite. When the results are released, they are released very factually. And yes, it is good to know how we stand and very much, I think the interest is really about the students who are on the tail and as opposed to how we rank, although I am sure if we ranked somewhere below 10, perhaps it might be quite a different reaction.

Professor Justin Dillon: Can you point to one thing n the Singapore education system that Pisa has influenced positively?

Dr Trivina Kang: Andre Snyker, whom most of us know is involved in PISA from OECD was actually one of our very early CJ KOH professors and at that time PISA was in a very different place. And as I understand it, a lot of his conversations with NIE colleagues at MOE helped him think about how the matrix that we use or the different things and competencies, so collaborative problem solving and some of the new things that have been included came up from conversations. While I do not think the test itself tells us very much more than we probably would know anyone as teachers in schools, I

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think that conversation has allowed us to contribute to the larger conversation and to things that are important in education.

Professor Justin Dillon: I think Singapore has outgrown PISA. I think you have consistently shown you can do well on it and it offers you nothing back really. I would like to see Singapore and some other countries devising its own assessments of critical thinking of collegian, all the sort of things that we think we laughably call 21st century skills. All those things to devise, attest and attainment in a Singapore context for those so that we can sample schools every, say five years, not every school, but just sample schools every five years to see how much progress we are making on the Singapore attainment and Singapore values. I am not interested in comparing us with Singapore or Finland or wherever. We are not Singapore or Finland. We are England and we have our own problems and our own education system. It is time to sort of move on beyond that thing to a bolder, brighter, more inclusive, challenging way of assessing attainment and assessing the outcomes of education.

Dr Trivina Kang: I would like to also just jump in to say that indeed, this is really what is happening, so while we participate in a lot of international benchmark tests, I think at the NIE and in a lot of the research projects, we actually delve deep down. I am sure many of you have participated in projects that are along the lines of the E21CC skills and many of the things which we feel as a system are important to us. And just like you know, students are, it is not about comparing themselves with other students. It is, about where they are going in their own learning journey, their own growth and I think we are working on that.

Audience Member: I am from the National Institute of Education, specialising in reading research. Before my question, I would like to share how Pisa has been helpful to me as a researcher. In Singapore, Pisa has highlighted the persistent "long tail" in student performance. While it is improving, it points to equity challenges, particularly for students struggling with reading. For me, Pisa is less about global rankings and more about identifying areas for improvement within our system, guiding efforts to support those who are not excelling.

This brings me to my question. I appreciated your emphasis on whole-school efforts, but schools often face competing priorities ranging from reading, sustainability to other initiatives which require a "whole-school approach". From your experience working with schools globally, how have successful institutions balanced or integrated sustainability goals with other priorities, particularly in contexts where foundational skills like reading also demand attention?

Professor Justin Dillon: Thank you for your example of Pisa's positive impact. I may make reference to it in the future. The schools I mentioned, like the Odyssey School in Denver, highlight how sustainability and literacy can be mutually reinforcing. For instance, sustainability topics provide real-world contexts that inspire meaningful, creative writing, storytelling, and reading. The rise of books focused on sustainability and hope has even created a genre, motivating engagement and deeper thinking about critical issues.

Literature-rich environments with strong focus on oracy and core competencies foster this synergy. Sustainability-based learning, for example, can motivate students who struggle with reading, much like my mother's

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work in remedial reading aimed to close learning gaps. Contextual, place-based learning materials can help these students catch up in meaningful ways.

Interestingly, the portrayal of the outdoors in literature shifts with age which is exciting and positive in primary school but often threatening in secondary school, a trend worth exploring further.

Dr Trivina Kang: Have there been any strategies or frameworks or concepts that you found in your experience to be impactful in helping environmental education concepts land better with teachers?

Professor Justin Dillon: Our diploma course is nine months, compared to your 16 months, but both face the challenge of fitting so much into limited time. In England, our course is 36 weeks, with 24 weeks spent in schools, leaving only 12 weeks for us to teach key skills like classroom management and lesson planning. This leaves very little time, just a few hours for topics like interdisciplinarity and sustainability.

One approach we have tried is taking science students to Kew Gardens, where they learn how to use the space and then teach children the next day. It is a good model but highlights how much more could be done with more time.

Another challenge is the narrow focus of our biology pre-service teachers. None of our 30 recent biology trainees had backgrounds in ecology or plant biology, reflecting a shift in the UK toward genetics and human biology over broader ecological knowledge. This gap is concerning, as it limits the breadth of what future biology teachers can offer.

Finally, the quality of practice varies widely depending on school placements. Some students gain valuable experience through residential trips and fieldwork, while others miss out entirely. This inconsistency makes it difficult to ensure uniform, high-quality training.

Dr Trivina Kang: I am just reflecting on how, while there is obviously irreparable damage that has happened and we may have issues reaching our sustainability goals. I think the message that actually comes out a lot is how we work together, how we collaborate, how we bring communities into schools, how we bring schools out into the communities and leverage on museum science centres and other exciting institutions that lie within the system, but out of our schools. And I think the message about how there are many programs that are happening and I think this is the case in Singapore schools. How then do we work together to use some of the resources to connect and to help us develop, you know, better programs for the students so that they will have a better future tomorrow?

About the CJ Koh Professorial Lecture Series

Each year, outstanding professors in the field of education are hosted by the National Institute of Education under the CJ Koh Professorship in Education programme. The CJ Koh Professorship has been made possible through a generous donation by the late Mr Ong Tiong Tat, executor of the late lawyer Mr Koh Choon Joo's (CJ Koh) estate, to the Nanyang Technological University Endowment Fund.

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