

SCIENCE EDUCATION: TRUSTING THE FRONTLINE

Association of Science Education Annual Conference

Sir David Bell - keynote speech

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"Thank you for those warm words. And let me first thank ASE for its outstanding, constructive and intelligent contribution to promoting excellence in science education. And second, thank you for all your work in classrooms, labs and lecture halls across the country.

"It is such a pleasure to welcome you back to Reading. I want the link between us to be much more than symbolic. We must never break the umbilical cord between science education in schools and science research in universities. Because I regard you all as scientists, first and foremost.

"Teaching science, indeed teaching any subject, is a moral mission above all. One of the great divides of the next century will be people with scientific literacy and those without. So whether you are teaching early years or are an eminent Professor, you all share a vocation to inspire, mentor and nurture. To pass on the love of your discipline. To open up knowledge and insight to all.

"It is fashionable now to say that we have the best generation of teachers ever - an observation I first made as Chief Inspector of Schools. A decade later, it still stands. So I am honoured to be your President this year. Although in the spirit of the honesty, I have a confession to make. A daunting admission to hundreds of scientists. For I am but a mere history and philosophy graduate. I am afraid the siren call of the laboratory never attracted me. But in preparing for today I mused on those age-old academic divides. And I reflected on the words of Mae Jemison, who in 1992 became the first female, African-American astronaut in space - an incredible achievement given that millions of blacks faced racial segregation, enshrined in law, less than three decades earlier."

The Sciences Need The Arts & The Arts Need The Sciences

"She says:

"The difference between science and the arts is not that they are different sides of the same coin... or even different parts of the same continuum. Rather, they are manifestations of the same thing... They spring from the same source. The arts and sciences are avatars of human creativity."

"We should listen to her.

"Because just as Jemison's generation was inspired by the space race of the 1960s, space and cosmology still captures the imagination like few other scientific endeavours. The astonishing landing of the Philae space probe on a comet travelling at 84,000 mph, less than three miles wide and long, after a 10 year journey over more than hundreds of million kilometres. Or the first steps NASA has taken in the last six months toward the first manned mission to Mars within 20 years. Or the first official British astronaut Major Timothy Peake who lifts off on a European mission in November. Or even the ground-breaking satellite and earth observation research here by Reading and our partners to understand how space and solar weather drives our own climate. It is easy to forget space scientists are still right at the start of their journey. They are the early pioneers and explorers of the universe, much like in centuries past, Columbus, Magellan and De Gama were pioneers and explorers of the seas and Galileo of the solar system.

"Jemison's point is human advancement cannot be divided into strict academic disciplines, departments, schools and faculties. It is true that without a firm grounding in science, in a scientific age, we are no better off than our forebears - who used blind superstition to make sense of the world. Great science is always driven by a deep curiosity of what is around us. But for Jemison, science must fully embrace and learn from the arts and humanities - the soul and inspiration of literature; the spirit and creativity of the visual arts; the thought systems and morality of philosophy; the insight and context of history.

"The voyagers of the past had only basic science to navigate. But they were driven by deeper feelings - courage, ambition, stubbornness, even foolhardiness. And those same attributes are needed by humanity to tackle the enormous challenges and exploit the opportunities of the twenty-first century. All these must be grappled from every angle possible, with all research disciplines at our disposal working in sync.

"That ethos underpins the University of Reading's academic mission - that ideas are limitless that human potential is limitless. We ally our fundamental pursuit of knowledge with a deep responsibility to build a thriving, sustainable and secure society. And our scientists now pool their thinking and collaborate in a manner which they never conceived of in the past.

"We have four centres of research excellence in place and dozens of other leading research groups.

- An extensive clinical cardiovascular, pharmacological and psychological research programme with the NHS and industry.
- An established knowledge transfer network for industry.
- A home to 150 businesses, with a £50 million science park on the way.
- A new £13 million big data centre to come, the Institute for Environmental Analytics.
- A big outreach programme bringing science alive for thousands of young people in the region.
- And, as of last month, a £1 million Leverhulme Trust programme to educate a new generation of PhD students, able to apply climate science in the legal system and in ethical policymaking.

"Interdisciplinary work in action.

“That is the approach the Frontier Science lecture series is showcasing this week to stimulate debate and discussion among you on the frontline - from how cosmic rays affect lightning strikes to the neuroscience behind bilingualism.

“So, I will not apologise for studying history and philosophy. Rather, I see them as applying fresh and different knowledge to science, in ways that we still yet do not fully comprehend. One downside perhaps of not having an eminent scientist as your President is I cannot stand here today and reveal new frontiers of discovery. But our academics here can. And one of my primary jobs as Vice-Chancellor is to break down any barrier they face in pursuing research and finding answers. To give them the support structure they need to get on with what they do best. To enable not direct.”

TRUSTING THE FRONTLINE – TO ENABLE NOT DIRECT

“There is a simple lesson underpinning that - trusting the frontline.

“I consider myself fortunate to have spent almost a decade at the heart of national decision-making on education in England. But it has given me cause to reflect on how we ‘do’ policy in this country - particularly that relating to schools. For we are in a time of huge change. A new industrial revolution - the digital revolution - with all the social and economic upheaval it brings. And we are in the uncomfortable position of being unable to tell our students frankly what sort of world they will emerge into when they finish school or university.

“One of the most refreshing surprises of moving into higher education three years ago was the lack of day-to-day contact with Whitehall. Our leading universities are still our great national ‘jewels in the crown’ and internationally respected. Politicians and policymakers attribute that to institutional autonomy and academic freedom. And they are right to do so. But despite three decades of promises from central and local government to free schools from state management, the teaching profession still feels pulled from pillar to post - a fact which remains constant across the UK, despite the devolution of education policy.”

LESS MONEY EQUALS LESS GOVERNMENT

“Because trusting the frontline has to mean far less government direction from Whitehall. And less government, paradoxically, could help rebuild the frontline's trust in policymakers. It goes hand-in-hand with the very tough choices on public finances for whoever is in power after the May election and in each part of the country. For the scale of the cuts we face mean nothing less than a fundamental reshaping of the state's purpose - in part to get back in the black, in part to cushion us against future economic shocks. Even in the boom years, we bemoaned the gross underinvestment in science and engineering in this country for decades. And the financial crash saw the chickens coming home to roost. For the economy is still dependent on financial services not real engineering and scientific innovation. We import not export manufactured goods. Our research base is too narrow and supply chains are too long. There are still too few women and ethnic minorities among those who reach top-flight positions in science.

“The main parties have indicated the schools budget will be protected in the medium-term over the next five years - for STEM the devil will be in the detail. But the general consensus is that the Business department will face a 30 to 40 per cent cut over the next five years, on top of a 30 per cent cut in this Parliament. All this coupled with the prospect of imminent radical devolution across the United Kingdom; a possible exit from the EU; and an uncertain global economic outlook. And with so little wriggle-room for public investment, it leaves us with big questions.

- How do we get industry expanding and innovating when the fiscal and monetary levers are so limited?
- How do we best attract new private and philanthropic investment into R&D budgets - to keep pace with our competitors?
- How do we best increase the supply of highly educated and skilled people?
- And how do we structure tuition loans to still encourage and enable bright students, from all backgrounds, to access the sort of world-class science teaching and research that higher education offers?

"Whichever government is in power cannot protect the frontline and reduce the size of the state, without rethinking, even renegotiating its entire relationship with the education sector - particularly if we have a minority administration or coalition after May. Indeed, real savings may come from Whitehall stepping back and not needing to fund, often with hundreds of millions of pounds at a time, frequent changes of policy or direction. Such an approach could have real, tangible benefits for the frontline, not least when school budgets are likely to come under even greater pressure in the next spending review."

ENDING SHORT-TERMISM OF EDUCATION POLICY

"Because education policy is still driven by short-term firefighting, ministerial personalities and electoral politics. Too often it lacks the rigour and proven evidence-base that you scientists use day-in, day-out.

"We can see that in the Home Secretary's bizarre suggestion, now ruled out, to remove bright foreign students the moment they graduate - exactly the sort of hardworking talent that growth and innovation depends on. When public finances are so tight, we cannot afford that sort of waste.

"Monolithic, remote government departments revert to tactical fixes because they are not agile enough to lead this industrial revolution we are living through. There have been dozens and dozens of pieces of legislation and statutory orders affecting schools in England over the years. And while there have been big improvements in standards, it is unclear of the long-term value of the vast majority of centrally-run programmes we have seen. At best, they are blunt instruments in guiding a complex system of 23,000 state schools. At worst, they undermine standards.

"We can see that in computer science. The UK has an outstanding heritage in computing - from Turing to Berners-Lee. We led the first generation of home coders and programmers in the 1980s. The Thames Valley here is still our Silicon Valley - home to global computing giants like Microsoft and Cisco. And Tech City in East London - home to hundreds of great start-ups. But we are at risk of squandering that legacy.

"We all take for granted that our hermetically-sealed smartphones, have more processing power than any of the Apollo space vehicles which put man on the moon. But in a society built on digital technology, the vast majority of citizens still have little or no understanding of the science behind it.

"We have a lost generation of programmers thanks to the clunky, short-sighted focus on ICT and buying-in hardware, which quickly went obsolete. Industry had too little input into the curriculum and skills development, when it needed it most throughout the 1990s and early part of this century. Too many people over the last 20 years learnt how to use hardware and software not simply how to build them. Too many now put their faith in switching computers on and off at the plug to solve every problem. And this yawning skills gap means that increasingly our first year programming courses spend too much time getting young people up to speed on the basics.

"The Coalition has taken steps to address this but it will take years to repair the damage, leaving the UK economically vulnerable - both in not having the full capability to create competitive new digital technology but also building defences against cyber-warfare and -crime."

TAKING THE POLITICS OUT OF POLICY

"Trusting the frontline should have been a priority in the enormous reform programme in English schools since 2010 - by ministers and the agencies accountable to them. Thousands of new academies, many now in multi-million pound chains. Hundreds of free schools. UTCs. Teaching schools. Hard and soft federations. Local authorities as commissioners, not providers, of education. New floor targets and league tables. An expanded intervention programme. Performance-related pay. Pensions' reform. A brand-new inspection regime. A complete overhaul of qualifications. A rewritten National Curriculum. This can only work by building alliances across the teaching profession, industry and higher education to achieve it.

"I provoked some controversy last year by suggesting that it was a mistake for ministers to dismiss those giving legitimate advice about ongoing reform as being the voice of 'The Blob'. If you know your pop cultural references, you will recognise that 'The Blob' isn't science - it is of course science fiction. The idea that academic excellence was only valued by a small coterie holed up in Westminster was as insulting as it was wrong. And allowing public debate to be couched in such language meant that goodwill and trust was undermined when, in a period of reform, it was desperately needed. Whether intended or not, the unfortunate impression was allowed to develop that teachers didn't care about standards and were complicit in the 'dumbing down' of the education system.

"My sense, from outside the schools sector now, is that the new Education Secretary is less tone deaf to people who can offer intelligent, constructive proposals and critique which, in turn, make a positive contribution to improvement. That feels more like trusting the frontline. The proof of the pudding is in the eating, however.

"Failing to build consensus results in the sort of highly dangerous experiment by Ofqual and ministers to separate the grade for assessed practical work from the main grades at A-level and GCSE science. I know many of you have been discussing it this week. It sends out a message that hard-nosed practical skills are not valued equally to theory. It risks diverting cash from science department budgets for equipment, technicians and training. And I fear universities will be forced to spend more time in the first year getting students up to speed with basic lab experience, with a knock-on effect on the flow of postgraduates, PhD students and senior academics in future. On top of perennial concerns from admissions tutors about science undergraduates lacking pure and applied mathematical knowledge and good basic writing skills, the proposals must be revisited. We should also learn the lessons from the recent past.

"It was on my watch as Permanent Secretary that the last Labour government removed science from the Key Stage 2 tests - a reaction in part to political pressures created by the implosion of the SATs marking system in 2008, in part to appeasing teachers' unions. The tests as they stood were weak - giving a perverse incentive to drill pupils to regurgitate basic facts, failing to stretch the brightest and having too little incentives for practical work. But in retrospect it was perhaps a decision ministers took at pace, too close to an election and without piloting or sufficient preparation time in the system to absorb the changes. And we have seen a chilling effect in far too many schools since - with too few high quality science specialists and poor investment in equipment in the primary sector.

“So, to address these challenges and failings, I would advocate three measures to depoliticise education policy in England - although the lessons are clear for Scotland, Wales and Northern Ireland. Because only radical change will help the ASE and the science community deliver your wider agenda - on everything from transforming primary science to getting more girls specialising in A-level science.”

PERMANENT, INDEPENDENT STRATEGIC ADVISORY BODY ON CURRICULUM AND ASSESSMENT

“First, a strong, permanent, independent strategic advisory body for curriculum and assessment. Backed by all the main parties. Underpinned by proven pedagogical practice and current research. Based on hard, detailed analysis of performance data. Driven by the long-term needs of the economy; industry; and higher education.

“I confess that I have changed my mind on this matter over the years. My instinct in government was such advice should not be separated from ministers and officials. But now I worry, as many others do, about education policy being constantly at the behest of five-year electoral cycles and ministerial whims.

“We are moving towards long-term independent commissions to oversee transport, energy and urban regeneration projects - harnessing the best private, public and voluntary sector thinking. The same surely must apply to education. Because just as we revisit the debate for whether a new runway should be built at Gatwick or Heathrow in every Parliament, we cannot go back to square one in schools policy after every single election.

“Teachers need to be accountable but also have stability and consistency. You need to be insulated from the day-to-day vagaries of the political system. Because teaching practice, knowledge and skills evolve faster and more organically than Whitehall can possibly direct. That means we can end the ridiculous situation where some ministers feel compelled to sit in their offices drafting maths and science curricula. Particularly ridiculous if they have never taught a class of children or young people in their life. And while I am a big supporter of a professional civil service, the concept of an education system managed by career generalists in Whitehall is antiquated.

“So I would advise refocusing the Department for Education on giving stable overall strategic direction - starting with a moratorium on yet more new legislation and structural changes to the curriculum and testing systems for the next Parliament at least. That means its role should be limited to financing the system efficiently and devolving budgets as far as possible. Through ministers providing democratic accountability and challenge where needed. Building a system which constantly self-improves without the temptation for constant top-down tinkering and intervention. So with no Sir Humphrey-like irony intended, it is time to be brave.”

EXPAND A-LEVELS INTO BROADER, DEEPER BACCALAUREATE

“Second, let us finally build cross party consensus on expanding A-levels into a broader, richer baccalaureate-style system – with core specialist subjects supplemented with extended project work and top-level literacy, numeracy, computer science and softer, non-cognitive skills.

“I have talked about the need for collaboration between academic disciplines. The sciences needs the arts. And the arts needs the sciences. Yet five years of permanent revolution has seen us come full circle to a decades old system which culminates in sixth formers still specialising in three or four ‘gold-standard’ A-levels, with two years of study ending in a pass-and-fail exam. The economy and society is changing out of all recognition - and yet we still have an out-of-date system, when the UK can least afford it.

"A broader and deeper curriculum and exam system must be our ambition. It will not happen overnight and will have to be carefully phased in. It would require tough decisions over the real long-term value of qualifications at 16. It will require better specialist teaching and facilities. It will not be appropriate for all students. And top-class science, technology, engineering and maths degrees will still require early specialisation. But given the demands of employers and society, it is a no-brainer. Future generations will need retraining and education throughout their lives. A Bacc-system sends out a clear message from pre-school onwards that students must have a rounded education to equip them for this, with a wide range of skills on top of specialisms. This does not undermine rigour. It enhances it.

"A decade ago ministers bottled creating such a system following the independent Tomlinson Review because they were scared of being seen to be weak on standards. We cannot make the same mistake again."

REFORMING SCHOOL DIRECT - PUTTING RESEARCH AT HEART OF TRAINING

"Third, trusting the frontline must apply to universities and the central part they play in initial teacher training and continuous professional development.

"Credit where credit is due. The Coalition has put in place big golden handshakes for the brightest science and maths graduates to enter the profession - a huge incentive given low or no wage growth in the wider economy since 2008. But the challenge is still huge.

"We still face acute shortages in specialist maths and science teachers across the board. Too many primaries lack science specialists. The most disadvantaged pupils have the least exposure to top-class science teaching. Too few teachers have access to high quality ongoing training to keep their skills sharp. And there is real competition from big employers moving into the market for the brightest sixth form scientists and mathematicians. So I am hugely frustrated by the implementation of the School Direct system so far. And I urge the next government to fully review the system after May and change tack. It is right to create a range of training routes. And I back the argument that trainees need practical experience early - that's why I am closely involved with Teach First. But not if it means squeezing good, proven providers out of the sector.

"School Direct as currently configured is starting to choke off the best university postgraduate courses because of a false ideological fixation that university education departments are Marxist hotbeds. Here at Reading, I'm still searching to find my first Marxist in the Institute of Education! We have been stepping in at the last minute to take on unfilled places from schools. That safety net will not be there if higher education institutions start pulling out of teacher training completely.

"Individual schools do not need to take a broader strategic, national or even regional view of supply - but universities must. And the best initial teacher training and professional development is research-orientated. Ministers need to take a more grown-up view of policy - not cut their noses off to spite their own faces.

"So I want to see the next government working harder with us and industry - to create an effective market for teacher training; the right pay and reward incentives to attract the best into shortage subjects; better targeting at schools that need great teachers most; and make continuous specialist professional development a core contractual entitlement - with exposure for all to the best in science research and innovation."

RISING TO THE CHALLENGE

"ASE has a privileged, vital role to play as the voice of science teachers.

"We will be shaping education policy and political discourse over the next 12 months and beyond. We should all be excited and energised by that challenge - setting why and how the frontline can shape and drive forward the changes we need.

"Trusting the frontline does not mean letting teachers and schools do exactly what they want. Governments, acting with a democratic mandate, have the right to propose reforms and make what might seem to be unpopular decisions.

"But think of what I have said, even in that context.

- An expert advisory body turning round the best researched advice.
- Allowing more teachers to design reform locally based on national ambitions.
- Ensuring that teachers are spoken of as the solution not the problem.

"These alone would change the dynamic and allow the people in this room and beyond to drive forward the improvements we all seek. There are never easy answers - just like the hardest problems in science.

"I will give you all the support I can. Because the decisions taken now will shape our society for generations to come.

"Let me close with the words of my distinguished predecessor and the first Voice-Chancellor of the University of Reading, W.M. Childs. Written almost 90 years ago, his words could not be more relevant today:

"It would be absurd to say that in education there is no room for organising genius. Nor is anyone so foolish as to suggest that education is best served when it is unbusinesslike, slipshod, piecemeal and starved. But the first thing that ought to be pondered and understood by anyone who approaches education as organiser or critic is that it has to do not with dead material but living personalities. Once that fundamental truth is grasped, a whole batch of irrelevant heresies slough away."

"So, ladies and gentlemen, let us hope that 2015 will be the year when irrelevant heresies are no more and living personalities are at the heart of our education system once again.

"I wish you very good luck.

"Thank you very much."