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Item Type	Article
Authors	Baruch, John E.F.
Citation	Baruch JEF (2016) The Robots are coming – the 4th Industrial Revolution: Part 2. China Science & Technology Education. 246(9).
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Download date	2025-04-23 07:47:00
Link to Item	http://hdl.handle.net/10454/9501



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The Robots are Coming – The 4th Industrial Revolution

New Education is needed to reap the benefits of the 4th Industrial Revolution

From the time of the first farmers over 10,000 years ago, discovery in science and technology has led to innovation and new ways of living. Farming enabled us to live in villages rather than hunt and gather our food, as we farmed more crops and animals we built cities. The industrial revolution was spurred by developments in astronomy that showed that the world did change, new things happened in the sky and explorers showed there were new things on Earth that we hadn't dreamed of. The innovators devoured the new science and built a world of industry and commerce that China was not ready for.

Today the 4th Industrial revolution threatens to impoverish all who are not ready, generating mass unemployment as cars, trucks, trains and planes are driven by robots; robots consult on a global basis to give the very best health care and robots run the banking systems and nearly all manufacturing and service industries.

The problem of unemployment has been there for a long time, but it has been obscured by economic growth and the development of new industries and services, particularly in health and education. Take a walk around these new robotised industries with the manager explaining how the new robots work 24 hours a day. They don't take rests or have holidays and they even work in the dark, producing millions of smart phones or the self-driving motor cars. You may be prompted to ask the manager "but do they also buy the smart phones and the cars?" There it is! From the very first days of automation, in the 4th Industrial Revolution unemployment will become *the* major issue that needs to be addressed ... or it will destroy society as we know it. In Europe we already are seeing the resultant divisions in society, including the development of an underclass of the unemployed, the poor and old age pensioners; and young people with little hope of finding a job, rather like what African countries have had to put up with for many years.

Already there is a human reaction against these mass-produced standard items by people who are not unemployed and can afford to live differently. Many countries and large cities are striving to express themselves with more exciting products that incorporate new designs and innovation, and which reflect the history and culture of that country or city. In architecture and housing, furnishings and interior design, food, fashion, and all the consumer goods, people who *can*, will pay more for items that are 'special' and allow them to express themselves. Such a society is built on innovation and creative design. On a larger scale it is possible that millions of new products, exploiting technological innovation, will change people's lives, enriching them and building a world of great diversity and interest. This creative society will be driven by the needs of informed people who wish to express themselves, rather than blindly adopting a consumer society driven by the needs of manufacturers who make whatever consumer goods they can persuade us to buy. It will be a world where developing the skills of engineers like the UK's James Dyson and the US Steve Jobs will need to be included in the education of all.

Currently, the Creative Society exists mainly for the rich and educated and it is only a small part of the world economy. If the 4th Industrial revolution destroys jobs and livelihoods on a large scale it will also destroy economies since it will reduce millions of people to poverty. If, on the other hand, working people are able to *maintain* their incomes and remain a part of the active economy then economies will thrive. This will, however, need to be done without significantly raising the cost of goods.

For every nation, unemployment is a very serious issue. It impoverishes working people and it drags down the economy since, in the modern world, payment is made to the unemployed to pay the essential living costs; and then there is a fall in taxes received so the government has less money to spend. For working people it puts much more uncertainty into their lives, and along with unemployment there is a growth in homelessness, in illness both physical and mental, in antisocial activities, and a failure of education with young people becoming alienated as they see no reason for education and little of value in participating in society.

The stalling of the economy with its impact on taxes and the costs of unemployment and poverty puts a serious drag on economic growth and imposes enormous costs on government.

The clever solution is to pre-empt these costs with creative initiatives which ensure that industry changes to suit changing conditions and that jobs are not lost in the first place.

The British solution, is based on the ability to control the thinking of the people, predominantly via the media, and of letting the market decide. But this is not the only or indeed the best way of dealing with the 4th Industrial Revolution. Because it leads to the impoverishment of most of the British people and increases the dangers of the people rising up against their ill-treatment; and because it puts a millstone around the economy, with the need to provide some support for those who are unable to work, it produces a decline of government income since those who don't work pay no taxes. In the view of many in the UK this is not a moral or justifiable policy.

One alternative is to give everyone a living wage or a 'universal citizens' wage', paid for out of taxation. This is a suggestion that has been widely discussed in Scandinavia. It is a basic wage, or benefit, paid to everyone whether they work or not. It would be paid for children as a sort of child benefit, be limited for the top earners and would not include housing benefit, that is help in paying the rent or mortgage for where one lives. That would be separate. It would be a very different world; enabling people to work fewer hours and employers to pay lower wages. There are lots of unknowns around this policy, so it would need to be tried out on a small scale. However, this is not the only possible solution.

The most creative solution is to change the education system so that our young people learn how to be creative and innovative either in technology and engineering (like Steve Jobs of Apple or the British James Dyson who developed the engineering of using air for bag-less vacuum cleaners or fan-less hand dryers) or in the Arts, for example in film, TV, computer games, and other leisure experiences. In this way we can start to increase the numbers of people able to engage with a creative society and greatly broaden and enrich the areas covered by that society, taking it across more and more areas of human interest.

In the UK many academics are deeply committed to building a society in which young people are inspired by the subjects of Science Technology Engineering Maths and Medicine (STEM), where their practical experience of STEM subjects develops their skills of innovation and creativity. The case for financing a UK astronaut to spend six months in space at the international Space Station was mainly based on the effects it would have on the take up of STEM subjects in school. The UK government is sometimes in favour and sometimes regards STEM as irrelevant, saying that the market will sort it all out!

Members of the UK parliament, from both the elected house of Commons and the appointed House of Lords, have shown considerable concern about the falling number of young people opting for STEM careers. They have reviewed the problems and have highlighted the key issues that bring people into STEM careers and reduce the development of the skills, knowledge and understanding which underpin innovation and creativity.

Developing innovative and creative capability requires more than a 'hands-on' approach to, for example, building model cars, bridges, aeroplanes and ships; and it requires more than the ability to follow plans and a set of instructions. It requires students to *think* about the reasons for different approaches and possible solutions and the opportunity to test these out. *This* is the essence of practical science: thinking about *why*, *testing* out ideas and *evaluating* whether it was a good test. When introduced at Primary school, practical science also provides excitement and understanding for students, and a strong basis for understanding difficult concepts in secondary school.

In the UK, few primary school teachers have any science education or training in science beyond a course which includes biology and chemistry up to the age of 16. They find practical science difficult and frequently avoid it. They are often unable to answer the basic science questions asked by the primary pupils; for example, when students look at plants and farming and ask 'why do we have seasons?' or when they look at a globe of the Earth and ask 'why don't the Australians fall off?' or when they see the crescent moon shining after sunset and ask 'what has happened to the Moon?' The inadequate answers of many teachers leave young people thinking that whatever they do when they grow up it will not be science; and although 95% start primary school with passionate interests in, for example, space and dinosaurs, when they start secondary school this has dropped to 30%. This collapse in students' interest and enthusiasm for science is regarded as mainly due to the inadequate knowledge of primary school teachers.

The other issue that reduces the take-up of STEM careers is an attitude, prevalent in the UK, that science, technology, engineering and maths are 'not for girls'. This is more difficult to deal with since it rests mainly on the attitude of parents as well as teachers.

The understanding of the methods and philosophy of practical science are the keys to innovation, creativity and entrepreneurship. They are the same whichever practical science is explored to develop these essential skills.

Europe is keen to increase the numbers of school children opting for STEM. One method has been to robotise practical science by providing remote access to robotic experiments delivered on the web. This has been outstandingly successful in astronomy but has met significant difficulties in Chemistry and physics where reflecting the enormous range of scientific

experiments in a robotic laboratory has proved impossible. In astronomy the whole laboratory goes over our heads every night and all that is needed is a robot telescope as the instrument with which to explore nearly all the major aspects of astronomy. In this way robotic astronomy can deliver the necessary skills of practical science, opening the door to innovation, creativity and entrepreneurship.

A Robot Telescope with a set of projects in astronomy can challenge the students and help them acquire the skills, knowledge and understanding which underpin innovative and creative capability. Experience shows that students are excited by the opportunity to use a robot that will work for them from many thousands of kilometres away, and they are inspired by the science they can explore in this way. Following an introduction to the Robotic Telescope programme in class many students carry on their exploration of the universe from home and return to school with questions which challenge their teachers and prompt their teachers to learn the science themselves. The project has worked with thousands of schools in many countries, all with the same dramatic results of doubling the numbers who wish to take up STEM careers. Just as importantly it provides an impetus for primary teachers to develop their own subject knowledge of science, and especially the science which will enable them to answer their pupils' questions.

Experience has shown that the Robot Telescope, and its projects, is able to handle a million school students as well as servicing many amateur and professional astronomers.

When our young people are educated to be innovative and creative they will enrich the quality of small and large companies and many will opt to set up their own businesses. With an innovative and creative population, society will then be able to reap the benefits of the 4th Industrial revolution and the curse of unemployment need not be the inevitable result..

<http://www.telescope.org>

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JEFB

22nd July 2016