PART IV

19. A Synthesis

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Introduction

Science and technology are recognised as key drivers for soci-economic development and Commonwealth countries have recognised the need for their popularisation. This chapter critically re-examines why this need exists; the current state of popularising science and technology in different Commonwealth countries; and the arguments for Commonwealth governments to co-operate and initiate a systemic and effective approach to popularising science and technology in their respective countries.

The Growing Need – Why Popularise Science and Technology?

It is widely acknowledged that science and technology play an important role in the development of a country's economy, environment and social relations. An understanding of S&T is essential for coping with facts, principles, material technologies and practices, and social forces that shape our world. These factors help to define the circumstances of individuals and communities, and eventually determine their possibilities for further development. Development theorists often cite orientation towards a scientific and technological way of life as one of the main indicators of sustainable modernisation and development. Moreover, advances in science and technology have dictated the pace of development, degree of inequality, and change within and across countries, and continue to do so.

In the coming years, the pace of change will quicken. Change will impinge on all citizens, young and old and rich and poor, and much of the change will involve new technologies that will influence living conditions and the environment. To adjust to such change, a new flexible science education will be required to enable coming generations to deal with social decisions that relate to issues concerned with technology and science. Citizens are faced, more than ever before, with decisions about issues of public policy – food and health security, nuclear energy and the disposal of waste, invasive medical technologies, gender identification of embryos, care for the environment, AIDS, organ donation, the list is endless. Without some familiarity with the scientific concepts that underlie such issues and how science views evidence, it is impossible for citizens of a democratic regime to take part in its decisions.

Denying them this right to participate in government, and to determine the future developments of their country and that of the Commonwealth, negates the current plan of action on the Jomtien Declaration of Education for All. Hence there is a need for all citizens to be scientifically and technologically literate through all stages of their lives. Following the Jomtien Declaration in 1995, UNESCO has endorsed the call for *science and technology literacy for all.* However, few citizens within the Commonwealth are scientifically and technologically literate. Thus, popularising science and technology will help the realisation of this central need and aspiration. Here popularisation carries several meanings. It means the spread of scientific and technological knowledge to the masses, the acquisition of new science and technology for improving one's social and economic life, and the sceptical, questioning, problem solving frame of mind characteristic of science and technology.

The Growing Gap – The Current State of Popularising S&T

The Commonwealth is made up of both industrialised and developing countries. It includes 13 of the world's fastest growing economies and 14 of the world's poorest, with a high degree of correlation between the state of the of these countries economies and the level of science and technology development. In the past all Commonwealth countries used formal education structures to popularise science and technology.

Great progress has been made in these formal education systems through curriculum reform and with innovative ways of presenting S&T. However, formal scientific and technological knowledge in most developing countries remains beyond the public domain, particularly for girls and women, and it is largely the preserve of elites. Indeed the expansion of S&T has been such that even amongst the educated elites of industrialised countries, specialisation means they can only lay claim to certain facets of S&T knowledge. Consequently, the majority of human beings in the world continue to live in relative ignorance about the forces, principles, phenomena and technologies that shape their lives. As important, few have received an education that familiarises them with the rules of evidence so central to the practice and understanding of science and technology that are essential to making appropriate decisions and judgments.

The issue then is how far formal education in S&T can influence the everyday thinking and actions of the general population. Can we cultivate a genuine popular scientific and technological culture by changing the school curriculum and the way in which we present S&T to learners? Do we need to combine this approach with other strategies for success or are we simply barking up the wrong tree?

In the last two decades science and technology have become increasingly popularised through non-formal and informal structures. In the last decade this has accelerated in industrialised countries, with scattered efforts in developing countries including. Commonwealth countries. However, the capacity to popularise science and technology, that ironically is key to narrowing the wealth gap with industrialised countries, is more limited in developing countries.

Developing countries recognise the role of informal structures and many have committed considerable resources to the development of their science and technology, and their educational systems. In the early 1960s, immediately after independence, most African Commonwealth countries promoted capacity building in science and technology by sending scholars for training in universities in industrialised countries, while offering science and technology as subjects in their primary and secondary schools. Some invested heavily in development of infrastructure such as national laboratories, and university and school science departments. Similar patterns were followed in many other developing countries in the Commonwealth.

Despite such investment, these countries continue to rely on agrarian and extractive sectors and, in some cases, tourism. The agrarian sector largely consists of subsistence farmers and pastoralists who often cannot produce sufficient excess to meet national needs and exports of cash crops such as coffee, tea and horticultural products. Tourism is dependent on adequate infrastructures and stability, itself dependent on good governance.

Numerous theories are used to explain the underdevelopment of these countries, including a lack of science and technology infrastructures. I argue that much science and technology, and science and technology education, is irrelevant or dysfunctional to the developmental needs of these countries, and that their failing can be ascribed to a lack of understanding of what and whose science and technology system was introduced and promoted. The first assumption made when science and technology was 'introduced' was that no science and technology was practised in developing countries and that the knowledge base and tools for science and technology had to be imported and transplanted. Most scientists were trained in industrialised countries with rich resource infrastructures for research that focused largely on fundamental problems within the scientific disciplines. As a result, scientists and technologists trained in the metropolitan centres could not continue their research when they returned home, and many could not contextualise their research within their country's development needs. Within the industrial sector, little scientific research is conducted because most industries are

multinationals that conduct research in the parent companies located in the mother country. Thus development and practice of science and technology is the state's responsibility, and is largely confined to education and training. Over the past decades, economic decline has contributed to a deterioration of government infrastructures for science and technology, promoting a flight of many of the best scientists to developed countries. Furthermore, training of scientists at school and university levels is based on irrelevant curricula that are decontextualised from societal problems and indigenous, informal, and formal sector science and technology practices. Such science is alien to indigenous society; an alienation that is further promoted by rote learning that does not embed science and technology in everyday practice and culture. Thus science and technology are seen as alien, Western bodies of facts that must be memorised and that have no bearing on the improvement of the everyday existence of indigenous people.

For such reasons, I argue that science and technology have not realised their full potential for improving the quality of life for most people in developing countries, though they have contributed, for example, to reducing the incidence of infectious disease, improving agricultural production and better communication and transportation. However, these and other benefits have been better capitalised on in developed countries and will continue to contribute to an accelerated pace of improvement, hence further widening the gap between rich and poor countries. Indeed, developed countries have launched major programmes on 'Science for All' to popularise science in their countries. They have recognised that scientific and technological literacy is a major precondition for continued modernisation, wealth generation and development of a democratic society. They argue that a science and technology culture addresses the need for innovation and problem solving, acquisition of transferable skills, a capacity to think and act rationally in response to new experiences, appreciation of new technological developments and the ethical issues involved in active participation in modern democracies. This renewed interest in science and technology in industrialised countries recognises the role of the local community, state and private sectors in promoting, developing and sustaining a science and technology culture, as well as the comparative edge it gives in the global economy.

Although, to date, science and technology, and science and technology education, have failed developing countries, I emphasise that this has been a science and technology that stresses memorising facts rather than problem solving. To narrow the gap, developing countries also must recognise the need to promote, develop and sustain a culturally sympathetic, problem-solving science and technology culture. Formal education on its own has so far

demonstrated its inadequacy (some would even say inappropriateness) to enable S&T to take root in the local cultures of non-Western societies and become an integral part of everyday thinking and action. This has given rise to experimentation with alternative ways of presenting S&T, which resonate with local cultures. A major challenge for non-industrialised Commonwealth countries, therefore, is to develop strategies for promoting an S&T acculturation that enables individuals to realise their own potential, while playing diverse roles in the development of society. This challenge becomes increasingly urgent in the quest to close the development gap.

A recent study by Sjoberg and others (2000) has revealed some interesting trends. A survey undertaken in 22 countries showed that children in developing countries see scientists as caring people who try to solve society's problems, while in developed countries children see scientists as cruel, uncaring people. The study also showed that there is a greater interest among children (both boys and girls) in developing than developed countries in the study of science or in following science careers. The inferences one can draw from this are that:

- Popularising S&T among children in developing countries will be easier;
- Developed countries have a huge challenge in attracting the next generation to S&T and will need to develop special programmes to target children – otherwise they will lose the gains they have made through the development of S&T.

Increasing strategies to popularise S&T.

Recently, there has been a dramatic increase in the number of strategies to promote S&T, particularly outside formal education and government. I have identified five important sectors that use a variety of strategies to promote S&T, namely government, academy and professional associations, business and labour, civil society and NGOS. I will delineate some of the more significant strategies these sectors use.

Government policy

Almost all Commonwealth countries have developed policies for science and technology, within which the popularising of science and technology is seen as a priority.

Formal education

All governments use formal education, particularly at primary school levels, to popularise S&T and some have initiated programmes at pre-school levels. The formative years of children's development are important in shaping views,

attitudes and aptitudes towards science and technology. Some governments are making it compulsory to study some S&T at secondary school level, while some universities have compulsory courses on public understanding of science for all graduates.

Science councils

In Britain, Canada, Australia, New Zealand, India, Malaysia and South Africa, government-sponsored councils that fund and engage in S&T research are obliged to promote popularisation. Some have made it compulsory for researchers to participate in programmes that promote the public understanding of S&T. In South Africa, for example, researchers funded by the National Research Foundation are expected to develop a plan that promotes a public understanding of the science that is integrated with their research project. Some councils have actively participated in science fairs and promoted science competitions and campaigns.

Museums

Most countries use museums as vehicles to popularise S&T. The common strategies they use include permanent, temporary and travelling exhibits; special events; school programmes; workshops and demonstrations; publications and loans; conferences and lectures; expert advice; and joint action with other museums and organisations with similar goals. In some countries, such as Canada, a special Science and Technology Museum has been established. The mission of this museum is to help the public to understand the ongoing relationships between science, technology and Canadian society.

Science centres

Some countries have established science centres that provide opportunities for the public and schools to gain hands-on experience of science. Such centres design exhibits that encourage participants to explore and solve problems. Models show the operation of technology and live demonstrations show natural phenomena. These centres have proved to be popular among adults and children alike.

Events, programmes, competitions and campaigns

The South African government declared 1999 a year of science and technology and planned an extensive campaign to popularise S&T. Together with other stakeholders, the government developed and operationalised an extensive programme that covered both rural and urban areas. The campaign certainly heightened awareness of S&T within the country. For the last ten years, Ghana has run a week-long science camp for girls to popularise S&T

among girls and encourage them to pursue S&T-related careers. Singapore runs a competition for youth to encourage new technological inventions. The Indian government runs a National Children's Science Congress during which children write research papers that are presented to their peers and evaluated by eminent scientists. Many countries sponsor radio and television programmes to popularise S&T. Most government departments run extensive related campaigns, such as the Ugandan health department's campaign on AIDS. In Kenya, the government family planning department has used strategies such as song, dance, poetry, drama and story telling to popularise family planning which has proved effective, since they appeal to the rich oral tradition of most African societies.

Other initiatives

In India, the National Council for Science and Technology Communication (NCSTC) is a national apex body for communication and popularisation. The government Department of Science and Technology set up NCSTC with two broad objectives – to orchestrate and co-ordinate popularisation, and to promote the development of science communicators in the various Indian languages.

Academy and professional associations

In the 1980s, the Royal Society of Scientists in Britain realised they had to become more involved in popularising S&T. Under the leadership of John Ziman, the society embarked on an extensive research and development programme on public understanding of S&T. The British Association for the Advancement of Science organises the successful National Week of Science or the Science Festival. An average of 3000 events are held during this week that draw audiences of up to 2 million and approximately 60 million through a BBC TV special.

Today, in most Commonwealth countries, academy and professional associations such as the Trinidad and Tobago Scientific Association are actively involved in popularising S&T. Generally, the academy and professional associations use similar strategies to those outlined above, including writing for the media and giving public lectures. In some countries, such as Australia, Britain and Canada, scientists are actively encouraged to demystify their research and make it accessible to the general public and to attend special courses that help them develop such skills. Science journalism has become a degree course and career option in some countries. However, the academy should also play another role to evaluate current strategies and develop more effective strategies to popularise S&T. This area has been grossly neglected in most Commonwealth countries and needs urgent attention.

Business and labour

Many industries in the developed countries of the Commonwealth play an active role in popularising S&T. In the main they provide financial resources to sponsor popularisation programmes. More recently, some have developed programmes about the science and technology that is involved in their industries. In Ghana, for example, industrialists work with science educators to produce multimedia curriculum materials that bridge school science and industrial science and technology. Some industries are open for school tours that demystify the science and technology.

In South Africa, the biggest trade union has recognised the role of science and technology within the workplace and has developed education programmes to help workers understand the science and technology behind industrial processes. Similar efforts are planned in Zimbabwe, particularly around AIDS awareness. The potential for labour unions to promote popularisation among workers is an underutilised strategy.

Mass media

Most countries use the mass media to popularise S&T. In developing countries radio is the most accessible media and is being used extensively. Developed countries use TV and the Internet. Dave Chalk's TV Computer Show, for example, is beamed weekly across several countries, including Canada, the USA, Philippines, India, Singapore and Australia, to 70 million viewers. In an entertaining and informative manner, viewers are introduced to the latest hardware and software.

Civil society

Self-initiated interest groups are societies or clubs of individuals that have a mutual interest in a particular area such as bird clubs. These clubs can be made up of individuals from a wide range of occupations and can develop a sophisticated understanding of birds and their environment.

Self-initiated need groups are informal groups of individuals who have the need to understand and cope with a particular issue that affects their friends or family, for example parents of children with Downs Syndrome. These individuals develop a good scientific understanding of Downs Syndrome and in addition develop a good practical understanding of how to care for Downs Syndrome children. They integrate their everyday practices and scientific knowledge so that they optimise their care for their children. In addition, they share experiences with each other and provide mutual emotional support.

Social movements for action and change involve a group of interested or

affected persons who try to initiate action for change. Examples of such movements include Greenpeace in Canada and Kerala Sastra Sahitya Parihat (KSSP) in India. Greenpeace is an activist group that uses scientific understanding to prevent the further destruction of the environment. On the other hand, KSSP, with the slogan, 'Science for Social Revolution', is an organisation with diverse activities that cover social services, environmental protection, woman's development, educational reform and scientific methods in agriculture. This group uses scientific knowledge to promote people's empowerment and development. These movements go against the grain of traditional thinking within the scientific community that science is information taught to a group of scientific illiterates. It is interesting to note that more such groups are emerging. The scientific community, governments and business need to take note of this development.

NGOs and other organisations

International NGOs operate in many countries including the Commonwealth. An example of such an NGO is the Wildlife Society that effectively popularises environmental and conservation using a variety of strategies.

Continental organisations operate on a continent and within Commonwealth countries on that continent. An example of such an organisation is the African Forum for Children's Literacy in Science and Technology. AFCLIST's mission is to popularise S&T among children and young people in sub-Saharan Africa. Approximately 70 projects have been initiated in 15 African countries. Projects range from using traditional toys to science camps for girls.

Country organisations operate within a particular country. An example is the NGO Eklavya in India, which has activity centres where children can conduct science experiments, origami, clay modelling, painting and other activities. These clubs spread across a network set up for children. They organise children's fairs, exhibitions, quiz competitions and street theatre.

Towards a Coherent Strategy to Popularise S&T

Commonwealth co-operation

The gap between developing and developed countries within the Commonwealth is widening. S&T is key to decreasing this gap. The development of S&T capability is dependent on popularisation of S&T. Countries within the Commonwealth have evolved a host of effective strategies to popularise S&T and it is important that they learn from each other. It is therefore recommended that the Commonwealth Secretariat should launch a co-operative plan to help all countries popularise S&T.

The corporate plan should include a cataloguing of all effective popularising strategies; publishing and disseminating good practices; providing professional and technical assistance to assist countries develop their plans; training programmes for professionals involved in popularising S&T; and organising workshops and conferences to share experiences on popularising S&T.

National plans

Formal education is no longer the only vehicle to popularise S&T. Increasingly many countries use a variety of strategies and agencies. Although this new development increases the ability to popularise S&T it does not always increase effectiveness. Effectiveness will only increase if all popularising strategies and agencies work within a coherent and co-ordinated framework. Hence there is a need to develop a national plan. Governments must take the initiative and develop plans with the participation of major agencies and stakeholders. These plans must be flexible so that they allow for regional needs and cultural diversity. They should be implemented in a reflexive manner with continuous evaluation and allowance for appropriate implementation adjustments.

Conclusion

The popularisation of S&T in the Commonwealth is key for the development of Commonwealth nations. A variety of strategies and agencies can be used. Their effectiveness is dependent on their fitness and purpose. When one develops strategies for popularising S&T, one has to consider why, how and for which target audience. I have not explored these ideas, but they will need careful consideration. Because there is a need to popularise S&T in all Commonwealth countries, the Commonwealth Secretariat should develop a plan to assist them. However, individual countries need to develop and implement their own national plans in order to optimise the effectiveness of popularising S&T.