The 'creativity gap' and developing countries

Only when developing countries such as Singapore recognize that the key element in technological advance is creativity, which must be fostered at the earliest stages of education, will they be able to catch up with the advanced industrial nations

Dr Bernard T. G. Tan
is a lecturer in the department of physics, University of Singapore

Much has been written and said about cultural gaps that are believed to exist in British society—for example, Lord Snow's "two cultures" and lately the contention by Michael Fores (*New Scientist*, vol.45, p.58) that the vital gap is really between "pure" and "applied". The underlying objective in these debates is, presumably, to revitalize or rejuvenate the quality of British industrial technology, and in a broader sense to re-examine the rationale behind long-term educational, scientific, and cultural policies in Britain and the western world.

Recognition of these gaps or dichotomies is also vitally important to developing countries, which are trying to catch up with western industrial countries. Several different panaceas have been suggested for developing countries seeking to industrialize, including better scientific and technical education, more funds for research and development, and direct importation of scientific and technological skills and know-how from more developed countries. In most developing countries one or more of these courses of action are being taken in a "blunderbuss" approach to activate and develop industrial technology.

Inheritance from Britain

In a semi-developed country such as Singapore, where tremendous efforts in industrialization are being made on all fronts (*New Scientist*, vol.44, p.514), it is beginning to appear that an overall approach using every "likely" technique may turn out to be too wasteful. Singapore is especially interesting in relation to the British educational and cultural system because it has inherited an educational and cultural infrastructure almost wholly British. Thus any discussion of these gaps in British society will have an important bearing on the direction of scientific and educational policy necessary for industrial progress in Singapore.

It is interesting that the two gaps postulated by Lord Snow and Michael Fores have been reflected in two significant trends in educational policy designed to advance technological progress in developing countries. Paralleling Lord Snow, the basic educational policy in most developing countries since the war has been to emphasize science at the expense of the arts. This trend still continues. Any school child in a typical developing country who has aspirations to be a better material life for himself or his country invariably chooses a science rather than an arts-oriented education. (The majority of students with political rather than materialistic ambitions still choose law or political science.) Likewise, the educational budgets of most developing countries allocate the major amount to science education; school curriculums in these countries also reflect this bias. Subjects such as history, geography, literature and art have been relegated to the background, being considered too irrelevant to technological development for the students of these countries to spend their time or in favour of physics, mathematics, chemistry or biology.

In Singapore, this development is emphasized by the acknowledged fact that the best students opt for the science stream, leaving the second raters in the arts classes in the pre-university ("A"-level) classes. The long-term effects of this on the country's cultural development has not been quantitatively measured, but in the long term it may manifest itself in the mass production of culturally deficient scientists.

"Pure" and "applied"

The second gap—that between pure and applied—is now beginning to make its influence felt in scientific and educational policies in the developing countries. In Singapore, this is evidenced by a marked emphasis in the last few years on the development of applied technical education as opposed to traditional pure science subjects. These science subjects are now being downgraded and de-emphasized as being too theoretical and non-productive in comparison with the engineering-type subjects such as applied electricity, metal and woodworking skills, and technical drawing. This move is undoubtedly the right one at present in that it fills the pressing need for technicians in the fast growing industrial sector of Singapore's economy.

On the other hand, in emphasizing technical and applied education, there is a latent danger that polarization of the curriculum into pure and applied sciences may lead to an artificial and harmful dichotomy in the scientific outlook of the country. A solid base of competence in the basic field of science may become weakened, to the ultimate detriment of technological growth. It is, unfortunately, all too easy to point to any apparently obscure topic in physics and brand it as being devoid of useful application. One must be very careful not to make arbitrary boundaries between pure and applied science where none have existed before and which may introduce an unhealthy preoccupation with "nuts and bolts", in the belief that technological progress rests solely on techniques and not principles. Even in the United States, there is a danger that the prevailing mood of R & D funding policy, demanding that only projects of immediate applicability be carried out, may lead to a dangerous recession in basic research.

In the search for guidelines for their educational policies which would contribute most to industrial and technological development, developing countries such as Singapore have thus been heavily influenced by the two cultures and

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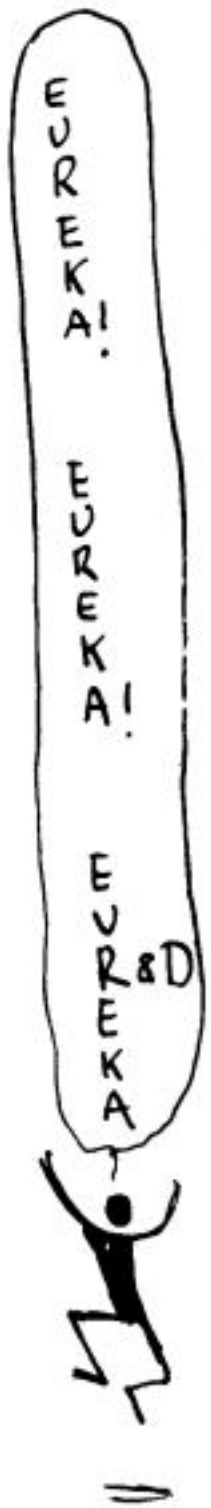

"pure versus applied" debates. However, if taken to extremes, unthinking adoption of these guidelines could lead to both cultural and technological disaster, or at best to stagnancy. Are these "science versus arts" and "pure versus applied" guidelines the only viable or discernible ones which developing countries may use?

I believe that the real and vital cultural gap in British society, which is reflected to some extent in Singapore, is between "creative" and "non-creative". I use the word "creative" here in its widest sense, more to define a frame of mind or philosophy than in a narrow material sense (e.g. of producing works of art or research papers). Let me illustrate by a few examples. By postulating the existence of a creativity gap, one implies that this gap cuts across the former boundaries of the other two postulated gaps. In both pure and applied science, for example, there are many forms of activity that may be labelled as creative or non-creative. It is common knowledge that the majority of published work in pure research does not add significantly to the sum total of human knowledge. In particular, much of the mundane research work churned out by PhD students falls into the non-creative category. It may involve, for example, repeating some well tried experiment with a new or little known material, or duplicating some well-known result using an esoteric method concocted for the purpose of getting results for the degree. The day is long past when PhD research results in significant and really new results; the Josephson junction is a notable exception.

Nation of copiers?

In the applied sciences and technology, productive work may be essentially non-creative when, for example, some product is designed with no new or original improvements other than cosmetic or superficial ones. Japanese industry in the days before its present heyday has often been cited as the prime example of an industry that lived only by copying other peoples' designs. (How different the story is now, but we will return to that later.) There is, I realize, nothing new in my suggestion that creativity, ingenuity, innovation, inventiveness, or originality, call it what we like, is the vital spark in any aspect of a country's cultural or scientific or technological life. What I emphasize is that in the effort by developing countries to modify scientific and educational policies to accelerate technological growth, there is a danger that rigid guidelines which give first priority to applied science will smother the deeper need for educational and cultural systems to foster and nurture the truly creative mind.

In Britain and the United States, of course, many imaginative educational programmes are being carried out already that recognize the need for a thorough rethinking of the rationale behind science education—the Nuffield Project and Project Technology, for example. Unfortunately, in most of the Commonwealth countries such as Singapore which have been left with the traditional British system of education by examination completely intact, it appears that no great changes in the educational philosophy can be made unless we revise the entire system of educational testing and assessment. A system of assessment that requires students to cram several years of secondary school work into a few hours of an examination, to be spewed out and be eternally forgotten, is hardly likely to encourage creative thinking. Again, this is a problem that will not be easily solved without further research into the techniques of educational testing; it also implies that the teacher at the front line will need to take on greater responsibilities as educator, stimulator and assessor.

Creativity not a luxury

Apart from a basic overhaul of the examinations system, what other ways can be used to foster the element of creativity in science education? Conventional methods, such as science fairs, are no doubt effective within their limited aims, though in a piecemeal way. What is really needed is official recognition in educational planning that creativity in children is not just an educational extra—a luxury that we might indulge in once we have got the bread and butter of cold facts and figures down the students' throats—but that it has to be an integral part of the curriculum from the earliest stages of a child's development. The heaviest burden for this will obviously fall on teachers, which implies that we should attack the problem at its roots, and re-examine the training of science teachers. Much has also been written about the vicious circles that probably exist and short circuit the educational process with jaded graduates returning to school to influence their pupils in the same way that they themselves were (see, for example, *New Scientist*, vol.42, p.470).

Why is the recognition of a creativity gap so important to developing countries? In the long run, it is probably not so much the acquiring of scientific and technical expertise that alone determines the long-range direction and quality of a country's industrial and technological progress, but the quality of its creative and innovative impulses. For most developing countries like Singapore, the problem of nurturing the creative spirit must be attacked at the earliest stages of the children's education in the schools. With the conservative and antiquated educational systems these countries have inherited, this will require something approaching a revolution in educational policies—certainly much more than the piecemeal efforts being made now. Most of the developing countries have almost no tradition of home-workshop and laboratory inventiveness and innovation, having climbed aboard the technological bus long after the initial stages of the industrial revolution when the hardy individual inventor could and did make significant contributions to technical advances working on his own. The developing countries are obliged to promote a technological revolution in their countries without the benefit of this experience, which makes it all the more urgent that the creative and inventive impulse be vigorously encouraged in their young.

The key to the Japanese success is due not merely to their growing expenditures in R & D, and it would be a grave mistake for developing countries

to assume so. Japan has always been cited as a country that started out by copying other people's designs but has now gone on to become perhaps the world's most inventive, ingenious, and innovating industrial nation. I suspect that the old stereotype of the Japanese as being copiers was never completely true; one could always see a touch of the original even in their prewar cheap children's toys. It is instructive to examine the mechanics of the Japanese creative impulse. The assumption of too many economic planners has been that an increase in technical sophistication will lead automatically to industrial progress. This is also supported by the science versus arts and applied versus pure arguments, when applied to national science policies. Thus too many developing countries either establish expensive and sophisticated research establishments or import foreign technical expertise (often in the form of UN advisers) and sit back to wait for the technological revolution they hope will come. One of the most successful Japanese consumer innovations is also one of their least sophisticated—the electric rice cooker. Only the highly inventive Japanese mind would have thought of devising such a product to ease the drudgery for millions of rice-eating Asians of cooking rice. Yet its invention did not require any more sophistication than could have been found in any school laboratory. Other similar examples of Japanese ingenuity can be found, particularly among their consumer electrical and electronic goods.

What can we learn from the Japanese example? The Japanese may indeed plough back an increasing percentage of their profits into R & D, but without the Japanese zeal for innovation, this expenditure could never have put them where they are today. I have used Singapore as my main illustration for developing countries because it has often been compared in its present industrial efforts to Japan; at the present stage it seems set for a full scale industrial take off. However, unless developing countries like Singapore also recognize that the key element in technological advance is creativity which can and must be fostered only at the earliest stages of education—probably only with a thorough overhaul of their present education systems—can they have any chance of catching up with the advanced industrial nations. With the present conservative system of educational testing by examinations inherited from their former administrators, a creativity gap does exist which may never be narrowed. No amount of emphasis on science as opposed to the arts, or on applied sciences as opposed to pure sciences, can in the long run remedy basic defects in the educational system which stifle any spark of inquiry or creativity that a child may have.