

Context-sensitive science

Mode 2 society and the emergence of context-sensitive science

Michael Gibbons

The notion of context-sensitive science is put forward as a way to approach what might be meant by interactive social science. Universities are now operating in a social environment which values research but which also has the ability and in some cases the resources to play a greater role in influencing what research is carried out and how. The environment is 'speaking back' to science and society is looking for leadership in the production of context-sensitive science.

IN THIS PAPER, the notion of context-sensitive science is put forward as a way to approach what might be meant by interactive social science. In what follows, the term science will be used to designate knowledge production whether in the sciences, social sciences or the humanities. The argument describes a general shift in the way that science is being pursued which can be applied across the research spectrum.

Mode 2 knowledge production

In some previous research we put forward the proposition that a new set of research practices have emerged which were sufficiently coherent, yet different from the current ones, to be called a new form of knowledge production (Gibbons *et al.*, 1994). We called it Mode 2 to distinguish it from the form of the discipline-based knowledge production, currently dominant in the universities — Mode 1. The differences between Mode 1 and Mode 2 can be described in terms of the context of discovery, the role of the disciplines, the skill mix of researchers and forms of organisation they adopt, social accountability and reflexivity of the researchers and quality control. Briefly:

in Mode 1, problems are set and solved in a context governed by the, largely academic, interests of a specific community. By contrast, in Mode 2, knowledge is produced in a context of application involving a much broader range of perspectives;

Mode 2 is transdisciplinary, not only drawing on disciplinary contributions but can set up new

Michael Gibbons is Secretary General, Association of Commonwealth Universities, 36 Gordon Square, London WC1H 0PF, UK; Tel: +44 20 7380 6731; Fax: +44 20 7387 2655.

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Michael Gibbons was appointed Secretary General of the Association of Commonwealth Universities (ACU) in 1996. From 1992 to 1996 he was Dean of the Graduate School and Director of the Science Policy Research Unit at the University of Sussex; prior to this he was Professor of Science and Technology Policy and Director of Research Exploitation and Development at the University of Manchester. His university education was at Corcordia University, McGill University, Queens University at Kingston and the University of Manchester. He is a member of the UK Economic and Social Research Council and Chair of its Research Priorities Board and of the Canada Foundation for Innovations Multi-disciplinary Assessment Committee. He has authored and co-authored several books including *The New Production of Knowledge*, as well as many articles on science and technology and science policy.

frameworks beyond them; it is characterised by heterogeneity of skills, by a preference for flatter hierarchies and organisational structures which are transient. It is more socially accountable and reflexive than Mode 1.

Mode 1 and Mode 2 each employ a different type of quality control. Peer review still exists in Mode 2 but it includes a wider, more temporary and heterogeneous set of practitioners, collaborating on a problem defined in a specific and localised context. Thus, in comparison with Mode 1, Mode 2 involves a much expanded system of quality control.

Distributed knowledge production system

The reasons why this new mode of production has emerged at the present time are not hard to find. In the first place, Mode 1 has been eminently successful. About that there can be no argument. However, over the years the numbers of graduates grounded in the ethos of research, together with some specialist skill, have been too large for them all to be absorbed within the disciplinary structure of academic life.

Some have gone into government laboratories, others into industry, while others have established their own laboratories, think tanks and consultancies. As a consequence, the number of sites where competent research can be carried out has increased. These individuals and the organisations they work in constitute the intellectual resources for, and social underpinnings of, Mode 2.

Further, the development of rapid transportation, as well as information and communication technologies have created a capability which allows these sites to interact. The interactions amongst these sites of knowledge have set the stage for an explosion in the numbers of interconnections and possible configurations of knowledge and skill. The result can be described as a socially distributed knowledge production system, in which communication increasingly takes place across existing institutional boundaries. The outcome is a web whose nodes are now strung out across the globe and whose connectivity grows daily.

Not surprisingly, when traditional scientists begin to participate in this, they are perceived to weaken disciplinary loyalty and institutional control. Yet contexts of application are often the sites of challenging intellectual problems: involvement in Mode 2 allows access to these and promises close collaboration with experts from a wide range of backgrounds. For many, this can be a very stimulating work environment.

The scientific establishment can be expected to be concerned about this and about how quality control will be assured in a socially distributed knowledge production system, but it is now a fact of life. The challenge for all knowledge-producing institutions is to learn how to interact with it.

Mode 2 society

In Mode 2, there is greater interaction than in Mode 1 both with other knowledge producers and with society more generally; the system of knowledge production is more open. What we failed to draw attention to in our previous writing, however, was that this more open system of knowledge production is not an autonomous development affecting science only; rather it reflects, and is reflected in, the emergence of a more open type of society.

In our most recent work we have attempted to correct that oversight, by drawing attention to the nature of contemporary society and to certain parallels between Mode 2 science and what we label Mode 2 society (Nowotny *et al*, forthcoming). In specifying Mode 2 society, we note that it is characterised by an overall increase in complexity which embraces a pervasive uncertainty in social relations, greater institutional permeability, the emergence of new forms of economic rationality, the emergence of a greater degree of self-organisation amongst social actors, and a profound shift in our perceptions of time and space.

This is not the place to work through the whole argument in detail but it is contended that complexity brings with it a more open society. In particular we note that the boundaries of the major institutions of our society whether the state, the market, culture or science are being transgressed. In other words, it has become more and more difficult to be clear where one institution's boundaries end and another's begin. As a consequence of the uncertainty created by greater institutional permeability, there are more diverse kinds of behaviour by individuals and groups, generally.

Mode 2 science and Mode 2 society

In *The New Production of Knowledge* (Gibbons *et al*, 1994), despite the importance of the 'social' in its account of Mode 2, wider social transformations went largely unexplored. In retrospect this avoidance of any substantial discussion of the 'social' was a weakness in three senses.

First, it allowed the argument to be assessed purely in narrowly empirical terms, as a more-or-less accurate account of recent trends in scientific production. For example, Diana Hicks and Sylvan Katz used bibliometric data to test claims about the growth of networking and collaboration made in the book. It was revealing that their tentative explanation was that this trend was probably an 'internal' phenomenon, the consequence of the end of institution building and budget growth during the 1970s, rather than an 'external' phenomenon, the result of the changing dynamics of research itself (in scientific as well as professional and organisational terms), still less of the emergence of a new relationship between science and society (Hicks and Katz, 1996).

Second, it made the argument unclear at crucial points. As a result, the book was read by some critics as an endorsement of applied science and an apologia for relativism. For example, Paul David characterised our argument as "a post-modern vision" in which "mission-oriented R&D is well on its way to displacing disciplined-based scientific practice, and becoming an ubiquitous and institutionally de-contextualized activity" (David, 1995, page 14). John Ziman (1996) has offered similar criticisms.

Third, this avoidance of the wider social picture made it difficult to differentiate our argument from those of others such as Latour who readily acknowledge the changed relationship between science and society. That difference may lie not simply, or perhaps especially, in more radical notions of the new articulations between them but in a more radical vision of society. This is important because whether the idea of Mode 2 (or contextualised) science is perceived as substantially different from earlier ideas of science and, consequently, more threatening to the rigour of scientific method and robustness of scientific practice depends on how this 'context', that is, society, is defined.

If the evolution of society is defined in terms of benign continuity, the difference, and therefore the threat, are less. If it is defined in disruptive and disjunctive terms, they are greatly increased. At its simplest, the argument in our most recent work can be reduced to the assertion that (to borrow the terminology used in *The New Production of Knowledge*) Mode 2 science has developed in the context of a Mode 2 society. That Mode 2 society has moved beyond the categorisations of modernity into discrete domains such as politics, culture, the market, and, of course, science and society. Consequently, under Mode-2 conditions, science and society have become transgressive arenas, co-mingling and subject to the same co-evolutionary trends.

As a consequence of these trends, transgressiveness has increased institutional permeability to such an extent that, as with the state, the market and culture, it is increasingly difficult to separate science from society. It is in this sense that it is possible to argue that both science and society have become more open, interactive systems.

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Context-sensitive science

The point of this excursion into the changing nature of society is to argue that this process of co-evolution grounds a process of contextualisation which establishes conditions that make it more likely that society can (and will with increasing frequency) 'speak back' to science. The idea of science communicating with society is familiar enough. Science has, since its inception, always intended to communicate its discoveries to society and has done so extremely effectively. The evidence, if any were needed, can be seen in the steady stream of discoveries and inventions that have flowed into society over the past 200 years.

Now, though, in part because of the changes outlined above, society is speaking back to science, not generally and hopefully, but specifically and imperiously. This reverse communication affects scientific activities both in its forms of organisation, division of labour and day-to-day practices, and deep down in its epistemological core. In the case of the former, for example, industrial R&D, governmental research and the strategic policies pursued by research councils have successively opened up to a wide variety of socio-economic demands, have admitted more and more cross-institutional links and have altered the balance of funding of academic research by industry, government agencies, foundations and other sources. In these developments, society is speaking back, demanding innovation in a variety of ways — through national objectives, the emergence of new regulatory regimes and in the multiplication of user-producer interfaces. In the case of the latter, the reverse communication is altering what problems researchers work on, how they do so and with whom.

Reverse communication is generating a new kind of science, let us call it context-sensitive. In epistemological terms, context-sensitive science is new in the sense that it produces socially robust knowledge, that is, knowledge likely to be reliable not only inside but also outside the laboratory. It is, therefore, less likely to be contested than context-free science which produces only reliable knowledge. The production of socially robust knowledge is new in the sense that it can exhibit novel theories, methodologies and research practices; Mode 2, in fact. Context-sensitive science, then, is a more general category under which interactive social science can be subsumed.

According to the argument being developed here, context-sensitive science (Mode 2) is produced in a more open system of knowledge production. Thus it is a form of science more appropriate to a Mode 2 society. Openness is related to the density of communication amongst those involved in the research process, but, in context-sensitive science, more is involved than enhanced communication between a wider range of actors. There are not only different degrees but also different kinds of openness. Mode 2 is open in at least five senses.

First, as we have just described, in each context of application there are multiple interactions between the a larger number of experts and sites of expertise. Second, in each context of application, more than scientific and technical expertise is involved; other, social and personal, perspectives also enter and it is these non-technical communications that are contributing to the production of context-sensitive knowledge. In fact, each context of application can be thought of as a transaction space at which society can speak back to science.

Third, the sites of problem formulation have gradually moved out from their traditional institutional domains in government, industry and universities into the market-place. The contemporary market-place is a new phenomenon. It emerges in a Mode 2 society as a new kind of public space in which 'science meets the public', and in which the public 'speaks back' to science. It is the domain (in fact, many domains) in which context-sensitivity enters the research process. Neither government, nor market, neither exclusively private nor exclusively public, the market-place is the space in which societal and scientific problems are framed and defined, where 'solutions' are negotiated.

This view of the market-place is very different from that of classical times. Plato, it will be remembered, felt that, from within the jumble of ideas, passions and interest that pervade the marketplace, Truth would not reveal itself and the Academy was necessary to provide a place for calm reflection at one remove from the market-place. Now, in Mode 2 society, the market-place becomes an essential component in establishing context-sensitive science.

Fourth, people feature in more and different ways in the research process. In Mode 1, social concerns were held at one remove from problem formulation and solution. Even in the social sciences, knowledge production was intended to be context-free, in the sense that, in areas of social interest, 'people' were often treated rather abstractly, whether, for example, as the poor or the rich, as élite or marginal, as sick or healthy. In Mode 2, people and their interests, concerns and perspectives enter concretely in, and in some cases provide essential data for, every aspect of the research process. People enter the research process through the market-place, and they remain there.

As a consequence, whereas in Mode 1 research the locus of policy was concentrated in the major social

institutions — government, the market and universities — today 'policy' is also formulated in the open public spaces of the market-place. It is 'public' policy, whose objectives are not mediated indirectly through government but directly through a society which comprises individuals and groups who have perceptions about what research might do for them and in some cases have the ability to mobilise resources to see that it is carried out. As has been indicated, in Mode 2 society behaviour is more complex and, in the sphere of policy making, it becomes evident.

Fifth, participation in the market-place is reflexive; that is, the interaction of scientific and social perspectives not only affects research priorities but also modifies scientific beliefs about what research to do, how to do it, and with whom. It is in this sense that the reverse communication between society and science is transforming science in fundamental ways. In the market-place, conditions are created for the reflexivity that we have identified as one of the key attributes of Mode 2 knowledge production; this is enabled by the parallel emergence of Mode 2 society.

Context-sensitive science, then, is a new kind of science. Institutional permeability and the associated willingness of individuals to indulge in a variety of behaviour allows for a multiplication of the routes along which interaction can take place; that is why it is not out of order to denote context-sensitive science (or social science) as interactive science. Contextualisation generates not only alternate agendas but also modifies research practices and social perceptions of the potential of research. It moves beyond improving the diffusion of the results of research or even modifying research to accommodate 'user' needs (still the language of Mode 1) to a form of joint production by science and society in which the line between science and society has been so transgressed that it appears to have disappeared altogether.

Who will champion the cause?

Universities are now operating in a social environment which values research but which also has the ability, and in some cases the resources, to play a greater role in what research is carried out and how. Contemporary society has attributes similar to those that we have identified in Mode 2 knowledge production. As with Mode 2, social life, too, is more volatile and uncertain. Most negotiations and agreements now comprise many more actors, decision making is less reliant on the leadership of government and institutions generally. Individuals are more prepared to take risks, to pursue parallel careers, to adopt different identities, to collaborate with many different individuals and organisations.

Just as Mode 1 was the form of knowledge production appropriate to a world in which boundaries of the state, the market and science were more clearly delineated, so Mode 2, because of its more open and reflexive attributes, is a form better adapted to our

current more open institutional environment. That environment is 'speaking back' to science, demanding innovation in a variety of ways. Typically, the way forward is uncertain, and society is looking for leadership in production of context-sensitive science.

Universities need to adapt themselves to this new environment. As we have seen, moving into the market-place and participating in the production of context-sensitive knowledge implies a more-or-less continual expansion of research practices which will have the effect of altering what it means to do good science.

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