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Science and Society: Public Understanding of Science (PUS) in South Africa and other collaborations.

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Abstract

The role of research in the field of Public Understanding of Science (PUS) is globally recognised as playing an important part of the development of government policy of Research and Development (R&D) and Science and Technology (S&T). The analysis of PUS surveys provides governments with insight into society's attitudes, understanding, aspirations and opinions regarding science. In the current 'science and society' paradigm in PUS, the call toward the ambitious development of a global Science Culture Index (SCI) is providing a complex challenge to a group of international PUS researchers from India, China, Japan, South Korea, Canada, Italy, UK and South Africa. In the African context, this challenge serves as a wake-up call towards the importance of PUS and provides scope for debate around both the theoretical and the technical aspects of PUS survey content and aim. This presentation will probe some of the more crucial requirements for a shift towards the establishment of PUS as an organised discipline capable of global research participation within both African and South African context.

Introduction to Science Communication and its protégé Public Understanding of Science (PUS).

The communication of science has been practised for centuries. As Massimiano Bucchi (2008:1) aptly informs us: "… communicating ideas or insights drawn from scientific research to a wider public was part of the enlightenment enterprise of the 18th century". According to Bucchi (2008:57), modern European science communication developed mainly in relation to two broad processes: "…the institutionalisation of research as a profession with higher social status and increasing specialisation; and the growth and spread of the mass media". Recognising the obvious intersection between

mainstream science and peoples' cultural complexity of thought, new fields of research such as *Science communication* and *Public understanding of Science* (PUS) were introduced in academia during the late 1960's.

It is important to note the difference between the two disciplines.
Science communicators use the impact of the media and other channels of communication to disseminate science findings. The focus is on a multi-media *communication process* through journalistic reporting, displays in science museums and science reporting in the media, TV and radio. There are two types of science communication that scientists are involved with which Hans Peters (2008:131) describes: *"the first is popularisation of research as the public reconstruction of scientific projects, discoveries, achievements and theories from a science-focused point of view: the second is meta-discourses about S&T and the science-society relationship, such as disputes about risky technologies and conflicts between science and social values (animal experimentation, etc.)"*. Scientists in society occupy dual roles: scientists as (policy) advisors and scientists as public communicators (with political impact). Popular topics that construct a 'social reality' or 'public reality' include: climate change, depletion of the ozone layer, biotechnology, stem cell research, nuclear safety and health issues such as HIV/AIDS and other epidemics (mad cow disease, bird flu). A 'pluralistic knowledge society' receives science communication with existing knowledge that developed in competition with other research communities and from extra-scientific domains. The practice of everyday knowledge, especially knowledge based on practical experience (traditional indigenous knowledge) that stems from religion, belief systems, folk wisdom and indigenous culture adds complexity to science communication.
Main areas for science communication are:

- Science museums and science centres that reflect the encyclopaedic spirit of the scientific community and fulfil a crucial role in communicating science to the publics in support of science research.
- The media, TV and public communication forums, conferences and public lectures.
- Publications on science communication that can be found in the *Journal for Science Communication*.

The **public's attitude towards and understanding of science** developed as a discipline in relation to the growing complexity of the relation between science and society. The term *'public understanding of science'* has a dual meaning. According to Martin Bauer (2008:111) it covers, in the first place, "… a wide field of activities that aim at bringing science closer to the people and promoting PUS in the tradition of a public rhetoric of science. Second it refers to social research that investigates, using empirical methods, what the public's understanding of science might be and how this might vary

across time and context. This includes the conceptual analysis of the term 'understanding'". As a specialised discipline PUS developed, during the early 1960's, a special focus on conducting surveys to establish what people know about science (eg. their levels of science literacy). PUS surveys became well established in Europe and the methods developed there initially dominated the way in which PUS research was applied and used by policy makers in governments. However, the discussions of PUS have been limited to national or regional data within developed and industrialised countries.

Since the 1960's the field of PUS has grown into a globally recognised research based discipline. In its historical development Martin Bauer (2008) recognised three distinct paradigmatic changes that are described as:

- The *Scientific literacy* paradigm (1960s to mid-1980s) that built on two ideas: science education is essentially part of the secular drive for basic literacy in reading, writing and numeracy; and that science literacy is a necessary part of civic competence (Bauer, 2008: 115). Bauer (2008: 115) further stated that the perception was created that scientists, in support of politicians, are informed and educated and "… the public, *de facto*, ignorant and disqualified in participating in policy decisions". To interpret survey data the *deficit model* was applied since communication was considered as a linear process whereby the scientists informed the public.
- The *Public understanding of science* paradigm (1985 to mid-1990s): in this paradigm the concern emerged amongst scientists that a better understanding is required regarding the attitudinal deficit about science amongst the public. A process to better appreciate science was put forward since science was "… important for making informed consumer choices; it enhances the competitiveness of industry and commerce; and it is part of national tradition and culture" (Bauer, 2008:119). A number of models were considered during this period, based on science *communication* needs, which brought into consideration the aspect of a two-way communication process.
- The *'science-in-and-of-society'* paradigm (mid-1990s to present) is currently giving recognition to the fact that "… science and technology operate in society and therefore stand relative to other sectors of society" (Bauer, 2008:122). Most significantly, in the current 'science and society' paradigm, the field of PUS is now recognised as a fully established and multi-disciplinary (social sciences, sociology, philosophy, anthropology and others) based area of research. However, there is a deficit of trust in science mirrored by a deficit on the part of S&T and this is resulting in a shift in the focus: attention to the deficit of the science experts and their prejudices about the public (Bauer, 2008:122).

Main areas for PUS activities are:

- Agency (government) commissioned surveys over the past 40 years. This includes surveys such as the Eurobarometer survey series (since 1978) covering initially 8 and recently 32 European countries and the UK Wellcome Trust series.
- Publication in the *Journal for Public Understanding of Science.*

The time is now ripe for a renewed ambition in PUS research by what Bauer (2008:125) calls research opportunities for secondary analysis, dynamic modelling and global comparisons:

- Integrate the different national and international surveys as far as possible into a global database, maybe under the EU, World Bank, UNESCO or UN flag, and in collaboration with existing social science data archives.
- Encourage sophisticated secondary analysis and the continued documentation of this growing database.
- Construct dynamic models of PUS over time, including cohort analytical and quasi-panel models, and to test these in different contexts.
- Work towards global indicators of a 'culture of science' based on these surveys.
- Seriously commit to and develop alternative data streams, such as mass media monitoring and longitudinal qualitative research efforts.

Similarly, the time is ripe for an intensified debate about the contextual and theoretical disciplinary content of both science communication and PUS. A critique about the literacy paradigm as a continuum or threshold measure is required. Questions regarding 'textbook knowledge' in relation to 'indigenous knowledge' pose a challenge now that the developing world is participating in PUS surveys. (Should we now refer to the 'old world' of Europe versus the new worlds of India and China?). The coexistence of superstition and scientific literacy is being debated. Knowledge items are becoming increasingly controversial (evolution versus fundamentalist religious culture) and require intense debates. The need to evaluate the complex original source of science knowledge by the public(s) instead of evaluating the actions of mediators (journalists, TV commentators) could lead to new insights in the theoretical development of science communication and PUS.

1. Short historical indication of the development of global Science Culture Indicators (SCI):

i. 2007. During November 2007 the first call towards the development of a global Science Culture Index (SCI) was made during an international workshop by the British Royal Society on *International Indicators of Science and the Public.* The workshop was convened by Dr Martin Bauer, Dr. Rajesh Shukla and Dr. Nick Allum. The aim was to bring together specialists in the field of PUS to review the process that was globally followed in a wide range of research in PUS. Discussions were focussed on, what Bauer (2007) aptly referred to as 'great societal conversation about science' which included existing surveys based on science indicators of the public's knowledge, interests, attitudes and engagement with S&T. The explicit aim of the London workshop was to:

- Take stock of survey research on PUS.
- To initiate step-changes in future research in this area of enquiry.

In this meeting it was mentioned that, within the challenging area of international indicators of science and the public, cross-cultural comparisons are, at best, tricky [1]. It was recognised in the report of 2007 is that "nationally representative surveys, a highly development technique of observation, are not sufficient to map the societal conversations". What are required are complementary data streams to "understand the symbolic environment of a typical survey respondent and of the scientific culture at large" (Bauer, Shukla &Allum, 2007). The problem lies with questionnaires returning standard answers which do not tell us how to interpret these in different contexts, nor of the different questions that have arisen in the interviews.

It was indicated during the workshop that it is this area where possibilities open up for a more conceptually driven approach for the analysis of data. The workshop organisers therefore called for conceptual issues relating to science and science communication, to be one of the main foci of PUS researchers. Step-changes in this regard pointed to:

- How to improve survey research of subjective indicators of science?
- Why and how to mobilise complementary data streams?

[1] There is the perception that cross-cultural studies facilitate possible development of new theoretical approaches. In regard to the conceptual focus the following: though statistical data informs most of PUS research and is central to the debate around PUS, other factors extern to data collection plays an important role in PUS research. One such is the complexity that enters this discipline when conceptual issues indicates a shift in attitude through the establishment of a notion of 'different ways of knowing'. This shift, in some cases, is captured by the Item Response Theory (IRT) which allows scientists the possibility to rephrase questions and concepts to be more appropriate to the community under survey. Though a vocabulary of terms is consistently developing in the field of PUS, these terms might differ in interpretation by different cultures (and different disciplines).

Dual frameworks exist in the dual agenda that refers to different genres of representing science: informal-every day and formal-professional. As the London conveners (2007) report: “presently these two modes are relatively autonomous, co-evolving processes of spoken and written language embodies in text and visual images. This duality of frameworks is fundamental and remains an open question”. Three major issues were identified: data integration, complementary data streams and conceptual developments.

As a first step it was recommended that a minimal set of key concepts for international indicators might be developed. (As a key driver areas in different disciplines such as the ‘theory about knowledge’ (epistemology) in philosophy, could become a conceptual focus for PUS researchers). As knowledge provides the base (and driver) for the gathering of information, evaluating concepts such as ‘public attitude’ and ‘scientific perception’ should be conceptually analysed. Besides looking at the format of performance indicators of scientific activities aimed at increasing the PUS and developing barometers for the better understanding of the proper ‘climate’ for science development, the development of international indicators of science will be best achieved through the acknowledgement of the different knowledge interests potentially served by these indicators through debates regarding the various considerations and underpinnings of such research.

In the second place key issues are often discussed on the way scientific knowledge is statistically measured and how different societies are to be ‘scientifically’ understood. There is often a lack of understanding regarding so-called ‘developing’ societies (or communities) and their varied applications and understanding of science. Even in the use of Item Response Theory (IRT) where a deliberate effort is made to capture appropriate angles when asking questions, these questions are most often drafted by specialists with inadequate knowledge about the specific ‘ways of knowing’ embedded in less developed societies. When such questions are internationally applied there is a danger of these questions being manipulated to suit a (often political) ‘bigger agenda’.

ii. 2008. This first London workshop was followed by an international meet with the theme: *Mapping the scientific consciousness: National and Global efforts.* The event was organised by the National Institute of Science, Technology and Development Studies (NISTADS) and took place in New Delhi during March 2008. This event took the discussion regarding global indicators one step further by introducing the needs and perspectives of a number of developing countries such as India, China and South Africa. A number of salient points were listed in a resolution adopted at the end of the *Mapping the Scientific Consciousness: National and Global Efforts* meet in New Delhi in March 2008:

- During the past few decades a number of scholars directed efforts to build and enrich the area in theoretical and methodological rigour.

- The number of scholars working in this area has increased exponentially, cross-fertilizing from different disciplinary perspectives.
- The number of institutions dedicated to PUS has not matched the growth in the number of scholars.
- The meet noted that the indicators developed in various parts of the world are culture-specific and cannot be applied to measure the public understanding of science universally.
- The public understanding of science has matured in developing countries. However, it is a serious matter of concern that, barring a few, in most culturally rich countries (generally known as developing countries) the research efforts have not even started.
- The meet noted that the role of statistical tools is a crucial component in carrying out large scale empirical studies. There is a need to integrate the quantitative and qualitative methods developed in other disciplines [2] .

iii. 2009. During 2009 the First Global Environmental Leaders International Symposium: *Public Understanding of Science and Technology and Environmental Sustainability* took place at the International Conference Centre in Hiroshima, Japan. This conference provided the PUS researchers, to look in depth at a dedicated theme around PUS and a large number of presentations indicated the efforts currently going into issues related to climate change. The reality of the urgency to develop a global SCI became pronounced during visits to the Hiroshima Museum where science communication highlighted the effects of science in its most destructive and ugly form. It was during this conference where, during the more informal talks, the PUS researchers discussed in depth terms such as 'scientific literacy' with the creator of this term, Prof Jon Miller from the Michigan State University, USA. The term 'scientific literacy' stands central to surveys conducted in Europe and was firmly entrenched in the *Scientific literacy* paradigm (1960s to mid-1980s).

iv. 2010. The next meeting took place during the China Research Institute for Science Popularisation (CRISP) – The 17th Annual Conference of the China Research Institute for Science popularisation (CRISP). The retrospect and prospect of PCST Studies. China Hall of Science and Technology, Beijing, China. (16–19 May). The conference focussed on the development of a theory of PUS and this provided an opportunity for the PUS group to structure contributing chapters towards the book: *Development of the Public Communication of S&T studies: a comparative approach*, edited by Bernard Schiele, Michel Claessens and Ren Shunke (to be published by Springer). This book will address key questions:

[2] It is in this regard that this author is exploring *transdisciplinarity* as an appropriate methodology to be applied in PUS research. This is currently done as a team member on the project of Transdisciplinarity at the Mapungubwe Institute of Strategic Reflection (MISTRA) during 2011)

- What are the disciplines that have an impact on the field? (and associated university structures?)
- What were the questions or problems dealt with and what disciplines were brought in?
- What kinds of tools were used? Survey, observations, etc.
- What types of situations were studies applied to? Media, museums, informal communication, etc.

v. 2010. 11th International Conference on Public Communication of Science and Technology (PCST–2010): Science communication without frontiers. New Delhi, India (6–10 December). Shukla and Bauer (2009) developed a working paper (No 100) *'Construction and validation of 'science culture index'. Results from comparative analysis and engagement, knowledge and attitude to science: India and Europe'.* This paper was shared at the workshop *International workshop on Global Indicators of Public Understanding of Science (PUS)* hosted by the National Council of Applied Economic Research (NCAER), New Delhi, India during December 2010. Shukla and Bauer (2009) reported on the attempt they made to construct an index of science culture with the ambition of global validity. As one example the controversial relation between 'knowledge and attitude' was explored through the two culture dynamic model which suggests that 'knowledge and attitudes are in a non-linear, inverted U-shaped relation'. (The more we know the more sceptical we tend to become).

vi. 2011 onwards…Besides the technicalities of survey data collection and interpretation two more aspects remain: the conceptual (theoretical) development of PUS as a discipline and the development and application of an appropriate model for interpretation of data under the 'science and society' paradigm. The 'cultural distance model' developed by the NISCAIR group was presented at the NCAER *International workshop on Global Indicators of Public Understanding of Science (PUS)* and received with great interest. The model was tested against data from India and China and proved to be successful – even though the datasets differed, they could be manipulated through this model to provide comparative results. (reported as an unpublished paper by Gauhar Raza, Lian Qi, Surjit Singh and Ren Fujun. 2010. *Cultural distance: a comparative study of India and China*). General opinion is that the 'cultural distance model' [3] introduced by the NISCAIR researchers [4] as the best adaptable and adoptable model to facilitate the analysis of global comparative data [5].

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3 The cultural model developed by the NISCAIR PUS research team can be explained as follows: The Indian research team introduced in its first report a conceptual framework for analysing the data that was collected in 1989. As opposed to the notion of 'scientific literacy', or what now has come to be known as the deficit model of public understanding of science, the report introduced an analytical framework of 'cultural distance' between the structures of thinking prevalent among the public and the thought complex which configures the scientific knowledge system. In the report the authors discussed four factors, intrinsic to the nature of scientific knowledge, that influence this cultural distance. These were:

1. complexity in explaining the phenomena,
2. duration of its life cycle,
3. the likely impact it can have on human survival
4. the control that an individual or a collective can exercise in altering the process of the above mentioned life cycle (Raza, et al, 1989).

The authors illustrated that a comparative distance across these areas of scientific knowledge could be observed. As per the earlier data analysis, the authors concluded that astronomy and cosmology occupied the furthest end of the cultural distance and health and hygiene could be placed closest to the cultural life of the common citizens. At that stage, however, the authors had not developed a schema for measuring this comparative distance.

By analysing the data collected during subsequent surveys it was found that education plays a crucial role in the population's understanding and appreciation of science. Long duration schooling leads to better understanding. A simple method was previously proposed[3] by which one can determine the cultural distance of a given scientific explanation from the quotidian life of a common person in terms of the years of socialisation in modern education[3]. In order to explain the new insights gained we are reiterating the salient features of the method.

Let us consider a dichotomous response variable[3] where the first category is constituted by valid scientific answers and all scientifically invalid responses are clubbed together to form the second category (see Fig 1). The percentage response variable is plotted on a scale constituted by the years of formal schooling that a respondent has received. For convenience sake, we call it the *education variable* and plot it on the x-axis. The Y-axis characterises the dichotomous percentage response variable and is represented by two curves i.e. the scientifically valid and scientifically invalid responses offered by the populace that was interviewed. Since the response variable is dichotomous the two curves would always intersect each other at a point where fifty percent of those who were interviewed offered valid scientific explanations or vice versa[3]. The perpendicular drawn from this point on the x-axis would indicate the education level required for the concept, idea or information to become part of the cognitive structure of fifty percent of population under discussion. We call this point the *Index of democratisation* ***(id)*** of a concept. An incremental increase in the level of education would mean that more than fifty percent of the population subscribe to a valid scientific explanation[3] .

Conversely, it can be alleged that a piece of scientific information or concept has to travel on the education scale for x number of years in order to achieve the threshold level ***id*** at a given point of economic and socio-cultural development [3] (Miller et all, 1997).

The idea here is not to establish that the socialisation in modern education is the only determinant that influences the worldview of a common citizen and that a change in educational level will bring about an identical change in the world-view irrespective of other factors. It has been established repeatedly that a whole host of factors, external to the nature of scientific information such as gender, occupation, access to informal channels of information, economic status, predisposition to cultural and religious activities and age have a bearing on the world-view of indigenous cultural formations and subgroups. The authors here propose the development of a scale on which the comparative cultural distance of various scientific concepts and information from the quotidian life (that is the IKS of the community) could be mapped.

Having clarified the purpose, at this stage the authors return to the stratagem proposed above. This graph helps us measure distance of the index of democratisation ***(id)*** on the x-axis from the origin. In most survey studies, besides other variables, the years of schooling which the respondents have undergone is recorded as one of the control variables followed by questions related to indicators of public attitude towards and understanding of science[3]. Through curve fitting techniques any empirical data collected from the field can be used to determine $\boldsymbol{id_i}$ and the distance $\boldsymbol{x_i}$ for each of the question $\boldsymbol{c_i}$ posed to the populace. The curve plotted on the two-dimensional graph i.e. response variable versus education can now be reduced to a one-dimensional plot without loss of information.

We could, on the education scale, plot ***id*** for each concept at a corresponding cultural distance $\boldsymbol{x}$ and also measure their comparative distance from the quotidian life of the populace that has been interviewed. The larger the distance $\boldsymbol{x_i}$ for a given natural phenomenon or episode in the first quadrant, the farther would the phenomenon be from the daily life experience (imbedded in their IKS) of the population segment under scrutiny. Once the actual distances for a set of questions posed to the populace are determined, they could be plotted as bars arranged in ascending or descending order representing the absolute and comparative cultural distance of each concept from the thought complex of the sampled population.

[4] Gauhar Raza, Head,and Dr Surjit Singh and Dr PVS Kumar from the Science Communication through Multi-media. National Institute of Science Communication and Information Resources, CSIR, New Delhi, India.

[5] In a recent *International workshop on Global Indicators of Public Understanding of Science (PUS).* National Council of Applied Economic Research (NCAER), New Delhi, India the PUS group committed PUS research to an international collaboration of the development of global science indicators towards generation of comparative data between Europe and the developing countries; India, China, South Korea, South Africa and Brazil. 6 December 2010. A presentation: *Cultural distance: a comparative study of India and China* provided evidence about the adaptability and successful application of this model towards different countries and different data sets. The 'cultural distance model' was generally accepted as appropriate by the group.

A commitment was made by the group attending this workshop to embark on a collaborative effort towards the development of a global SCI. This is only the beginning of the process for most countries and South Africa should participate in this effort.

South African development of PUS as discipline in relation to global needs – the Science Cultural Index (SCI).

From inception science indicators, as methodological study, was focussed on (economic) institutional interest by measuring and standardising input, process and output. (with a marked absence of information from Africa and the Arab countries in the past). While being focussed on the concept of 'science activity' (STA) and 'related science activity' (RSA), Bauer's concept paper (2007) aptly comments that the objective and subjective world of science remained neatly separated. The ambitious project of developing global Science Culture Indicators (SCI) is challenging this separation. It considers subjective indicators as possible measures of intangibles assets. SCI proposes that objective and subjective indicators should be integrated into a single model referred to as 'science culture'. Bauer (2007) considers this 'culture of science' as an independent driver of scientific society and as important as science findings and research.

What are these cultural indicators? Bauer (2007) lists them as:

- The performance of the cultural industry – the so-called creative industry of the arts.
- UNESCO's term to indicate cultural diversity – languages, religions, festivals museums, etc.
- Significance of traditional knowledge systems (IKS) - for sustainable agricultural development .
- Mass media's midrange power to cultivate ideological beliefs (belief in a mean world).
- Print media analysis – indicators for action.
- Co-variance analysis of literacy data –'national cultures of mathematics'.
- Class of questionnaire items that tap into cultural dispositions with a long cycle of change, namely values.

Bauer (2007) retains particular concern for:

- The global quest for routine science culture index with a global validity
- Culture as a context for action rather than a target of management
- Datasets based on representative surveys of the population.

As previously discussed the 2007 British Royal Society workshop on *International Indicators of Science and the Public*, (convened by Dr Martin Bauer, Dr. Rajesh Shukla and Dr. Nick Allum) introduced the first discussion regarding the possibility for global data integration. Some 18 countries are considered to be in a position to conduct systematic longitudinal analysis (time series data) of

trends over two decades and it is possible to systematically analyse the public's relationship to science for most parts of the 20th century in many different contexts [6].

Where does South Africa feature in this scenario? According to the Bauer report (2007) Damose, from South Africa, commented: "there is some PUS survey activity, its status is unclear and in development'. What we do know is that, within the 'science and society paradigm' the door was opened for new research opportunities in the further development of PUS. On a local level the South African National Research Foundation (NRF), in recognition to this change in paradigm, aptly organised an International Conference on *Science and Society* during 1998. This was followed by a number of Science Communication conferences such as hosting the 7th PCST International Conference on Science Communication in Cape Town, South Africa (4–6 December 2002) and the African Science Communication Forum and SAASTA Conference. Port Elizabeth, South Africa (4–7 December 2006). The National Advisory Council of Innovation (NACI) was appointed in 1998 with one of its objectives being the promotion of PUS&Technology in its supportive role in innovation for development and progress.

The Human Sciences Research Council (HSRC) report: *Science and the Publics: a review of public understanding of science studies* (2009) [7] presented an overview of the South African PUS research in this time. The report clearly indicates that South Africa does not have a systematic, comprehensive and nuanced assessment of the public's relationship with science. It refers to policies that indicate a transformation process of an economy that is resource based to one that is increasingly knowledge-based – with the expressed aim to harness the growth potential of the knowledge economy for socio-economic development. With South Africa being a highly stratified society it is recommended to consider the society under a topic: *'public(s)' relationship with science'*. There is also (most importantly) recognition that the public's relationship with science is shaped by the culture in which that public is located.

According to the HSRC report a few surveys were conducted in the past by the Foundation for Education, Science and Technology (FEST) which later became the South African Agency for Science and Technology Advancement (SAASTA) and can be summarised as:

[6] During the 2007 London workshop it was recommended to develop a manual of standards for subjective indicators of science in anology to the FRESCATI manual of 1963. It was also indicated that "Micro level data integration is necessary to conduct systematic comparative analysis in the future. Vertical data integration, I e. combining national data across various waves into a single database for the purpose of cohort analysis is now realistic and should be a research priority (EU, USA, India, Japan and China). This type of data integration should be undertaken rather sooner than later, as it represents a clear step-change in PUS analysis and diagnostics" (Bauer et al 2007).

[7] The Human Sciences Research Council (HSRC) report: *Science and the Publics: a review of public understanding of science studies* compiled by Reddy, V & Gastrow, M & Bantwini, B. was commissioned by the South African Agency for Science and Technology Advancement (SAASTA).

- 1991: 1,300 respondents (face to face in white suburbs) *Understanding and appreciation of science amongst the public in SA.* A. Pouros.
- 1993: 400 white and 400 black respondents (face to face amongst teenagers) *Understanding and appreciation of science amongst South African teenagers.* A. Pouros
- 1995: Omnibus survey HSRC.
- 2001:1,000 white households. *Public attitudes and sources of scientific information in SA.* A. Pouros
- 2003: 7,000 respondents (face to face in white suburbs) *Biotechnology.* HSRC
- 2004: 1,000 white households. (face to face in white suburbs) *Assessing Public support for Biotechnology in SA.* A. Pouros.
- 2007: 3,164 respondents. *Climate Change.* HSRC.

The HSRC report concluded:

- Science communication perceptions are still dominated by race perceptions with a near complete absence of a fair demographical representation.
- The public(s) perceptions exist in theory only.
- The public is still perceived in 'deficient' terms with scientists following the by now globally contested 'deficit model' of science communication.
- A fairly recent new focus is developing on a bi-directional relationship between the public and science with related issues such as understanding the communication of messages about S&T, the dynamics of attitude and belief formation regarding S&T and, most importantly, access to information about S&T.

However, PUS as academic discipline remained neglected despite the growing recognition of the important role it could play in education as well as policy development.

Where to next?

By looking at the intensified activities of PUS over the past few years (2007 – 2010) it is clear that there is a need to develop PUS as an academic discipline in Africa in general and in South Africa in specific[8]. This should be done with a dedicated inclusion of a well-defined balance between theory

[8] During a UNESCO meeting in 1999 (*Science and Technology in the SADC Region for the 21st Century*, Pretoria, South Africa, 20–21 April), the directors general and heads of S&T in the Southern African Developmental Community (SADC) reported on the status of academic and modern science and technology development in their countries. The report indicated:

(conceptualising), method (methodology – transdisciplinarity [9]) and practice (surveys and data analysis). In my opinion the endeavours towards developing a global SCI provides a focus while creating opportunity to consider different theoretical issues.

How can Africa in general and South Africa in specific find the theoretical content towards the development PUS? In this current 'science and society' paradigm with the adventurous ambition of the global SCI project new possibilities are presented.

- The foundation for PUS research should be contextualised in an understanding of the specific and unique history of the African continent.
- The theories developed by the social movement 'post-colonialism' are important in this regard.
- As a further I find African philosophy as a rich and stimulating source of intellectual debate and reflection. If we ask some crucial questions related to African philosophy such as: 'what science and whose knowledge?' what have been included in African philosophy as (western) knowledge-through-philosophy?, why does (western) philosophy fail to acknowledge non-western intellectual and practical epistemology within the global epistemological lexicon of philosophical discourse ? Finally, what exactly is meant by (scientific) 'rationality'? [10].

- The absence of a Ministry or Department of S&T and a lack of academic R&D expertise (Botswana);
- Difficulty in monitoring the S&T system due to a lack of S&T indicators (Lesotho);
- A lack of statistics on R&D expenditure (Malawi);
- No S&T coordinating mechanism (Mozambique);
- A low level of human and financial resources for S&T coupled with a lack of S&T coordination, a lack of science and maths teachers and lack of S&T information (Namibia);
- The poor dissemination of information related to the impact of research on development linked to a lack of S&T coordination (Zimbabwe).

This absence of reliable information and statistics on African S&T makes it difficult to estimate the current state of science education on the continent. Reasons for this lack of development are multiple. Governments blame the so-called 'brain drain' of African academics to the west. They relate the low priority ranking of R&D to a lack of funds, technological obsolescence and last but not least, political instability (www.UNESCO.org.: S&T in SADC, 1999). What is generally agreed upon is the absence of PUS surveys and research in most parts of Africa. PUS surveys provide the dissemination of findings on cultural, economic, political and social values and worldviews.

[9] In relation to the application of appropriate methodology: the Mapungubwe Institute for Strategic Reflection (MISTRA) is developing a number of core projects of which on is on the theme of *Transdiciplinarity.* Transdiciplinarity could provide the appropriate methodological framework towards the development of PUS as a complex multi-disciplinary, intra-disciplinary and meta-disciplinary discipline.

[10] Richard Rorty (1980) draws attention to the fact that the relation of the concept of rationality to the so-called 'philosophical dogma of the day' reflects the Kantian endeavour to present a permanent neutral framework for culture whereby the "…framework is built around a distinction between inquiry into the real – the disciplines which are on the 'secure path of a science' – and the rest of culture". Thus the Rortian challenge to philosophy: in its distinction between

Let me mention a few examples:

Isidore Okpewho (1992:3) argues that the traditional African oral literature (literature delivered by word of mouth), contains a number of different forms in which traditional African philosophical thought is expressed ('orature', 'traditional literature', 'folk literature' and 'folklore', proverbs, sage literature, etc) . These terms refer to different forms of communication and indicate the richness of African epistemological options [11].

Thandika Mkandawire (2005) further points out that Africans are intellectually grappling with developmental issues [12]. The academic support through science and technology in Africa is considered as a crucial and complex part of development. So is the need to support the continued practise of traditional science in Africa.

Olugbemiro Jegede (1998:151) argues that the need to develop science and technology must include questioning the link between African art and African technology [13].

Kwame Gyekye (1997) challenges the western inspired understanding of modernity that has led to a problematic distinction between culturally rich traditional societies which have been identified as practising 'irrational and backward thinking', on the one hand, and modernity, which has been identified with 'progressive thinking', on the other hand [14]

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science and non-science, philosophy is endangering all current formulations, endangering philosophy itself and with it, tamper with the concept of rationality.

[11] Isidore Okpewho (1992:17) mentions past studies on literature by the British anthropologist, Captain R.S. Rattray's *'Ashanti Proverbs: the Primitive Ethics of a Savage People'* (1916), as a prime example of the racial arrogance that characterised the attitude of colonial administrators and field researchers in the quest of understanding African cultures.

[12] Organisations like the Council for the Development of Social Science Research in Africa (CODESRIA) in Dakar, Senegal provides support for the publication of books on developmental issues.

[13] Edward Said (1994) in this regard points out that indigenous knowledge, as a field of research, has been linked to aesthetic theory and practises of interpretation, in which the relative autonomy of the aesthetic discourse has been separate from, and dogmatically defended against the economic, social, and political discourse

[14] Ethnographers from the past initiated perceptions about the so-called 'African irrationality': Claude Lévy-Bruhl (1910) argued that the mentality of the so called 'primitive' people is radically different from that of the scientific mind of western rationality, in so far as the former shows little or no evidence of an understanding of the principle of logical consistency or the process of discursive reasoning. From this perspective, the African race was designated as the 'other of reason' and the 'marker' of cultural difference. Claude Levi-Strauss (1966) followed these ideas of Lévy-Bruhl (1910) by attempting to reveal the underlying structure – the deep grammar of mythical thought – that he believed could explain the endless multiplicity of culture-specific meanings and forms. From this perspective so-called 'primitive societies' identify meaning through a method of bricolage and could not apply scientific method.

Michael Cloete (2008) states that, with the denial of other (non-western) forms of knowledge and rationality, "… the possibility of other non-western 'subjects of reason', committed to different forms of inquiry, and equally committed to an explication of the rational grounds of legitimations and validation of the knowledge claims, raised within their own philosophical systems of thought, is therefore ruled out".

Emmanuel Eze (2008) developed a framework for categorical discussion on African rationality that embraces the formal or logical, the hermeneutic or interpretative, some phenomenological models, the empirical-probalistic, the sceptical and the political.

These few selected examples indicate a richness and depth of refection appropriate for the task on hand: the development of PUS as academic discipline in African Universities.

Conclusion

I presented a short historical background to the discipline of PUS, followed by a more detailed description of the recent efforts towards the development of a global SCI. I described the main context in which this global SCI is proposed - for further reflection and discussion. In conclusion I proposed options in the African and South African context towards the development of a theoretical framework, embedded in African philosophy that will enable Africa to take on the challenge of participating in the global SCI project.

It is crucial to develop PUS as an academic discipline in South African universities and research institutions in order to participate with a growing number of international research projects as well as provide government with comparative statistics towards the development of policy.

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