International Journal of Information Science and Management
Vol. 15, No. 1, 2017, 149-158

A Conceptual Framework for Popularizing Science in Muslim Societies

Mahmoud Mehrmohammadi
Tarbiat Modares University
Corresponding Author
Email: mehrm_ma@modares.ac.ir

Abbas Sadri
ISESCO Regional Office in Tehran
Email: ab_sadri@yahoo.com

Abstract

Science popularization is an exigency in the era of knowledge explosion which has made the dissemination of scientific knowledge and attitudes of public aligned with such understanding of a prerequisite for further development of all societies. The concept of SKAQ has been introduced with an accompanying argument that can play a constructive part in making an objective determination of nation's attainment level. The author, then, explicates a variety of rationales behind such proposition and maintains that in light of such rationales the Islamic nations can be regarded as prime candidates for urgent policy and action in this respect. A conceptual framework has been developed envisions of science popularization at two critical layers referred to as the institutional and cultural one. At both layers, though, the formal schooling is argued to have a pronounced role to play. Finally, certain recommendations as action principles have been suggested to consolidate future efforts in this respect.

Keywords: Science popularization, scientific knowledge, Islamic nations

Background and Rationale for Science Popularization

Now more than ever, scientific knowledge is being recognized as the major source of power in human societies throughout the world. It explains a substantial portion of the difference in the level of development, in its most general and comprehensive sense of stressing the psycho-socio-economical welfare that manifests in nations today. Science, although by no means, represent all possible knowledge and its ways available to human beings and may not be viewed as a "meta- narrative" anymore, is, nevertheless, considered as one of the most reliable and trustworthy types of knowledge and modes of problem posing / problem setting and problem solving in modern times. This is partly due to the "net" positive experience of humanity with scientific discoveries and technological innovations embedded in such discoveries. The word "net" should be underscored to eschew allegations of offering a parochial, unethical and biased account which does not qualify as a descriptive and non-ideological one.

Science in general, then, is revered by people in all walks of life alike, although with different degrees of scientific consciousness and understanding which is in part due to successful popularization efforts. In light of the role science can play in raising the quality of life both individually and collectively and through optimum resolution of life problems,

governments are expected to discharge their indisputable responsibility in the equitable distribution of scientific knowledge and in shaping the scientific attitude of their respective public, if not globally. This is indeed a critical responsibility that if neglected or marginalized, will prove to be costly for individuals, groups and society as a whole.

Fortunately, along with the explosion in scientific information, technological inventions and its incredible rate of change, it turns to the revolution in communication technology; i.e.: mobile, satellite, internet, etc. Such technological advancements can be resorted to, especially by governments, in order to facilitate the dissemination of scientific information and the formation of scientific attitude among the public and to guard themselves against the charges of irresponsibility and unethical conduct. New technologies, in other words, can come to assist encountering some of the challenges associated with this mission of equitable distribution; specially for reaching out to the populations who are passed "schooling" age and are at the mercy of non formal channels of communication and education. In case governments fail to fulfill their role in this respect, chances are that a new breed of class-based society, on the bases of a poly dimensional concept I refer to as "Scientific Knowledge and Attitude Quotient (SKAQ)" will take shape with the severe social consequences which accompany gaps and divisions and the concomitant result radical degrees of dissimilarity in terms of life quality, fueling all sorts of tensions and dissatisfactions threatening the coherence of the society.

Scientific knowledge and attitude quotient (SKAQ) is defined as the multilevel-multidimensional ability to acquire relevant scientific knowledge and the tendency to utilize such knowledge to guide one's decisions and actions. This concept is coined as a substitute for terms such as "science literacy" preferred both because it explicitly addresses the knowledge and the attitude aspects of the goal in mind as well as containing the word "quotient" which suggests the possibility of quantification and measurability. The argument is that every member of every human society must be considered as being entitled to quantity and quality of education so that he/she can be said to have embraced SKAQ at its defined baseline. What is meant by multilevel and multidimensional is inclusivity of the term. It is a reference to the level that the action pertains to (personal, family, local…) and the domain of action or decision it represents (environmental, political and economical). The aspects associated with this concept, i.e. SKAQ, however, needs to be further explored and its assessment instruments developed, so that policy making could take place in an enlightened fashion and priority target groups and their target domains of knowledge (selected few areas) could be more accurately and objectively identified.

Before proceeding further, a critical observation introduced to the very idea of science utilization. Utilization of scientific knowledge can take place at the simplest level manifesting a direct application which belongs to the so called "technical rationality" paradigm (Schon, 1983). Utilization can take place at a more sophisticated level encountering scientific knowledge as a guide for more intelligent choice, but not as a prescription embodying a fix and definite course of action to be followed (Dewey, 1929 ; Schwab,1971). While the first view does not attribute meaningful agency to the human subject in the process of knowledge utilization and reduces the decision space to a technical application, the second view on knowledge utilization entertains the heuristic function of knowledge that aims at the

enrichment of the so called deliberation process. What should be concluded from the differentiation thus explained? It is suggested that both views with respect to the issue, simple and complex or direct and indirect application of scientific findings, could be regarded as defensible or indefensible, depending on the nature of the problem at hand and the qualifications of the target person or group.

What could be offered as other expressions of the rationale behind raising SKAQ?

- SKAQ rising or in more general term science popularization is supported through other formulations of rationales, some of which are reviewed here. The first and the most widely known is the UNESCO expression offered in the organization's official documents pertinent to its Science Popularization Program (See for example: *http://www.unesco.org/new/en/natural-sciences/science-technology/sti-policy/global-focus/science-popularization/*). To summarize the UNESCO rationale it could be maintained that science popularization is an important pillar in sustainable development with direct bearing on the welfare and the quality of social justice a society enjoys. This phenomenon, in turn, contributes to the establishment of peace or acts as a powerful deterrent of violence in societies.

Another expression of rationale suggests that science popularization plays a meaningful role in the conservation of natural resources at the macro level which has a direct impact on the preservation of environment as the shared public asset. The more such assets are handled with care and caution by each generation, the more the prosperity the future generations' experience. In other words science popularization is a reliable link in the chain of events that has the vital interest of future generations in mind and consciously refrains from acting selfishly or in a narcissist fashion. Policy makers are well advised to take such futuristic orientation into account when formulating policies.

Still another expression of rationale for science popularization could be found when the issue is evaluated from a personal perspective or the micro level. It follows a line of reasoning that links science popularization to a better management of personal resources and from there to the betterment of life quality experienced by a micro social unit, i.e.: individual or family.

Last but not least, an argument could be built around the fact that science popularization is the concept which assumes a human centered type development. It, therefore, requires a minimum level of social capital in aspects such as mutual trust, respect and willingness to cooperate and contributes to its further expansion. The more widespread the social capital in any society the argument goes, the more chance for the community to experience a life quality considered ideal, that is experiencing a collective life in which nearly every member would characterize his or her life condition as satisfactory.

The foregoing rationales are unquestionably resonates with immediate as well as long term requirements of Islamic states, categorized as developing states.

Concepts and Conceptual Framework

This section will begin with a review of definitions followed by specification of Science popularization domain. The writer then attends to the discussion of the preferred conceptual framework which reveals a concentration on the school age population in drawing the conceptual map for science popularization. The logic behind such concentration is disclosed

and elaborated upon in the final part.

Definitions

Most European nations use the term *"scientific culture"* (culture scientifique) to describe a field known in the UK as *"public understanding of science"* and in the USA as *"scientific literacy"* (Solomon, 1997).

The House of Lords' "Science and Society" report (2000) defined the public understanding of science in general terms as the:

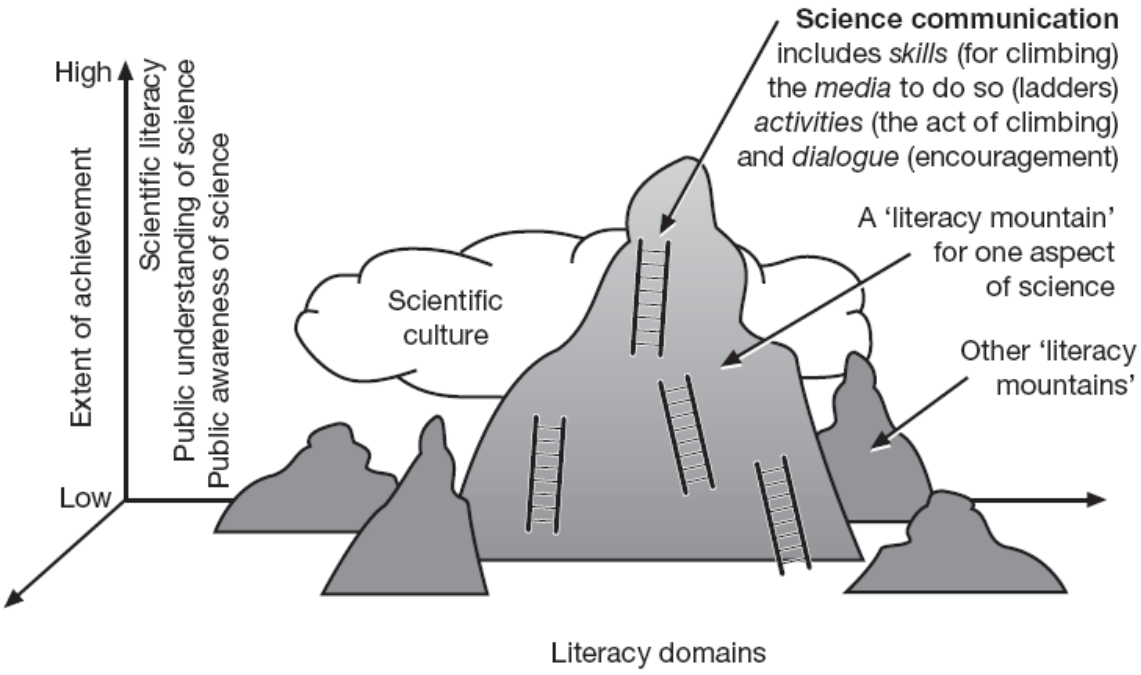
"*Understanding of scientific matters by non-experts. This cannot of course mean a comprehensive knowledge of all branches of science. It may however include understanding of the nature of scientific methods . . . awareness of current scientific advances and their implications. Public understanding of science has become a shorthand term for all forms of outreach (in the UK) by the scientific community, or by others on their behalf (e.g., science writers, museums, event organizers), to the public at large, aimed at improving that understanding."*

Along the line of European concept, I very much like to refer to the mission of science popularization project as having a dual purpose or de-culturing and re-culturing the public, which embraces both the knowledge and the attitude component of the competency domain under investigation. This is so because culture refers to a mode of conduct presupposing knowledge and attitude.

Burns, O'Conner & Stocklmayer (2003) coined the term science communication to address a similar concept. This is what they had to offer to reveal the relationship between the concept of communication and science popularization:

"What is clear is that any communication that involves the general public is complex and highly contextual. Simple linear models (transfer of information from sender to receiver via a medium) and diffusion models (disperse the information widely and let it soak in) do not adequately represent the science communication process. More recent models recognize the importance of context and social negotiation of meaning, and have been more successful in explaining the complexities of communication". (P.186)

They then take up the question of "Science and society: where does science communication fit in?" and offer a mountain climbing analogy which is an insightful and illuminating representation of the concept.



Specification of Domain

Burns, O'Conner & Stocklmayer (2003) offer some explanations to further clarify the concept and preemptively exclude misconceptions that might surround the concept relying on the analogy. They include:

1. Not leading to immediate and linear increase in scientific literacy
2. Not being solely for the benefit of lay public
3. Not involving a single peak, but having multiple horizontal plane of domains
4. Person's profiles are not fixed but changes over time, though it is unique
5. Scientists are not at the top of the mountain and the lay public at the bottom(*ibid*. p.192-194)

As the third point within the above list of misconceptions also indicates, there are several domains that need to be dealt with as one attempts to identify the contours of scientific knowledge in the popularization project. The writer's treatment of the issue of domain starts with a presupposition which reflects a temporary stand to be reckoned with in the conceptual framework. The presupposition states that *public* is understood in the more conventional sense, not embracing the school age children. The main proposition, then, related to the issue of domain is as follows:

Science popularization is concerned with *profession independent knowledge*. *Profession specific knowledge*, in other words does not enter this field of action. Science popularization, therefore, is a field concerned with numerous knowledge domains which is deemed necessary regardless of one's profession or which is equally important for everyone due to *general roles* they assume, to enable them to make more intelligent choices and decisions or to guide and inform their do's and do not's, so to speak. The general or non- professional roles played may include, but are not limited to, roles as parents, as community members, as an active member of the economy earning a living, as a national citizen, as an environmental agent and as a

global citizen each calling for a specific knowledge domain.

Suggested Conceptual Framework

I would like to begin with an introductory note revealing the conception of scientific knowledge the author subscribes to. Science, I consider to be after Popper (1972), any evidence based knowledge provided by a disciplined mind through a disciplined process which, nonetheless, awaits refutation and elimination due to further evidence. Therefore, science popularization is not restricted to its conventional understanding limited to physical sciences and embraces social and human sciences as well.

The conceptual framework is consisted of two layers. First layer is identified by its direct or explicit character in teaching scientific knowledge and nurturing scientific attitude. The second layer is characterized by its indirect, tacit or implicit approach in teaching scientific knowledge and nurturing scientific attitude. While the first layer requires discussion of institutional set up, the second layer requirement is a discussion of the necessary cultural set up which represent a very critical distinction between the two layers. A popular misconception worth noting at this point is that second layer does not lend itself to prior planning or programming due to its very nature. Nothing could be further from the truth.

To round up the discussion on each of the two layers comprising the proposed framework, the major players are identified. Within the first layer, the players could be listed as follows:

- Schools, as part of the public education system by transmitting scientific content or product to students acting within their replicative and applicative functions as proposed by Broudy (1988)[1]
- Higher education institutions, as the complementary part of the formal education system and active as an agent in the non- formal education system
- Discipline based NGO's, which pursue specific disciplinary goals consistent with their label in the science and technology or professional fields, they can assume popularization goals in their specific knowledge field as well
- Interdisciplinary NGO's with popularization mandates only, these represent multidisciplinary organizations who have joined hands for purposes of advancing popularization goals only
- Governmental institutions, which should perform knowledge advocacy or popularization functions in line with their organizational missions
- Industrial or private enterprise sector, that should play an active role with respect to raising public's awareness as part of their social or public dues, making a clear distinction between this line of activity and profit earning advertisements
- Public communication media, which like schools and higher education institutes should have a focus or allocate part of their programs to delivery of scientific knowledge in a direct transmission or instructional mode

The player within the second layer or the layer responsible for the tacit approach in pursuing the popularization cause in each society could be listed as follows:

- Schools, only this time stressing the school culture as the contributing factor or the extent to which such institutions effectively immerse students in the scientific atmosphere leaving a long lasting imprint on their character (enculturation). This reflects schools' activities that could be categorized as relevant to their more complicated functions named by

Broudy as associative and interpretive (1988).

- Culture at large, reflected in macro- economic behavior such as employment policies or in the general reward system operating in the society. The extent to which a social system manifests commitment to standards of justice or provides opportunities and recognition justified based on individuals' tangible merits and competencies is of concern here. Employment opportunities, for example, demonstrating distinct sensitivity towards the scientific knowledge and attitude component of candidates based on reliable measures.
- Public communication media, only this time stressing the cultural values tacitly conveyed to their audience rather than the content directly transmitted to them. For example, the implicit messages that are communicated to the audiences of a popular family TV series with respect to the basis for proper decisions and actions.

A careful attention to the make-up of players in the first and second layer reveals the conceptual framework's pronounced emphasis on capitalizing on the potentials of the schooling system and school age portion of the population in pursuing the cause of popularization which may be regarded as unconventional in this field. This emphasis, however, is argued to be reasonable when evaluated in terms of propositions provided below. In other words, the question casted in the form of "why the concern with school function when dealing with the general public?" could be addressed by reference to the following points:

1. School age children contain a substantial portion of the target group, that is, the public stemming from a so called *snap shot* view of the public.

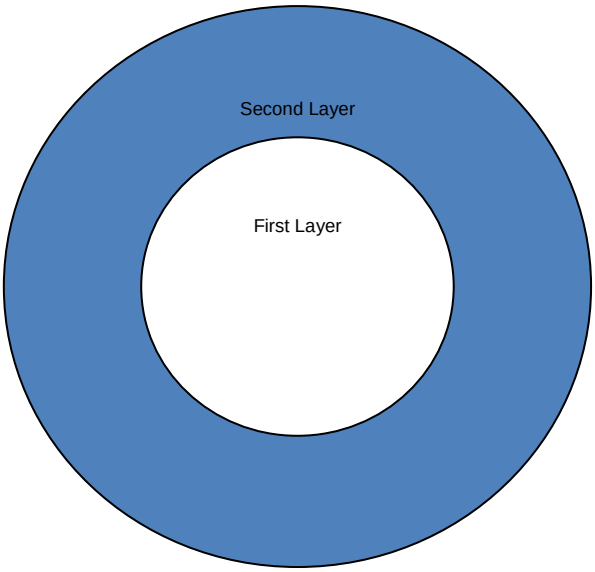
2. More significantly, the pivotal role of schooling in shaping the qualities of the *future public* could entangle the presumed difficulty in comprehending this popularization strategy. The transfer of learning as an outcome of schooling is in mind which makes the school effort much more feasible and economical compared to investments at later stages of life. To start instilling the desirable qualities vis-a-vis scientific knowledge and attitude, in other words, has a fantastic spill- over effect. A *motion picture* view of the public is another proper expression of this argument. To be even more clear attention is focused on the fact that students will enter all walks of life as they grow up and, thus, ensure the preservation of SKAQ at an optimal level

3. If the previous line of reasoning conveyed a sense of spill- over effect, one could speak of yet another sense of this very effect. This alternative sense of spill-over effect of concentration on the school age population is derived from the newer approaches to teaching science and technology such as STS (Science, Technology and Society) and STEAM (Science, Technology, Engineering, Arts and Mathematics)(Mehrmohammadi,2008). These approaches represent a basic connection with social and out of school activities, thus requiring the participation and consequent exposure of people engaged in various social institutions to the science and technology content. The educational planning usually takes place by networks of local councils comprised typically of a diverse set of players such as educators, government and business leaders, and representatives of nonprofits and other community groups Activities such as setting up science caravans, exhibitions and science camps are already considered among viable modes of learning science planned and carried out by school children in countries such as Pakistan (Ibupoto, 2012). Principles number 7 and 8 among the ten

principles put forward by France's famous organization in the field of science and technology education is another case in point (La main a la pate,1996)

4. School age children are the most manageable portion of the population and the most easily reached. School is a modern social institution which has a unique character in enjoying a statutory status rooted in compulsory education acts which no one can easily resist attending.

5. The fact that schools and schooling system is so potent that can function effectively at both layers of science popularization scheme is offered as the final justification in this respect.



Suggested action principles

The concluding section of this article addresses some action principles derived mostly from the experiences of different countries in the field of science popularization which is also consistent with the conceptual framework proposed above:

1. Make sure that pseudo-science is not made public, to represent a malfunction contaminating under the guise of popularization. The process of translating technical information into lay language has historically been subject to various forces that can distort or misrepresent the information(Sapp, 2008) Disciplinary NGO's, if present and active, are the most trusted bodies to perform this sensitive filtering function.

2. Make sure plans for training knowledgeable and skilled manpower is in place. Groups such as science journalists are of prime importance[2].

3. Make sure you don't overdose the public (find the optimum level of information need for each target group in each knowledge domain)

4. Make sure the information is correct (up to date), no need to apologize for misinformation later which destroys the public trust

5. Make sure the information is of life (existential) relevant (such as poverty, water purity, local/epidemic diseases, natural disasters), all must be regarded as a SP opportunities for the agents and institutions involved.

6. Make sure the proper medium is used relative to the goal being pursued and also the characteristics of the target group; the interaction between the media and content (idea) which

is the point behind creation of different art forms require conscious resort to different communication media informed by their special features.

7. Make sure proper feedback and reinforcing mechanisms are in place, like awarding certificates

8. Make sure the information is comprehensible/ lay language is critical

9. Make sure personal benefits (in terms that are tangible for people) are emphasized, making the rate of return on personal and collective investment visible.

10. Make sure the SP events are framed with reference to deeply rooted cultural beliefs and preferences to raise the chance of meaningful involvement, even religious beliefs specially Islam which can provide a persuasive front for SP events

11. SP initiative publicity scheme; public awareness of the scheme itself, is a necessity… Taking advantage *dignitaries, public figures and "significant others" in all sectors.*

12. Make sure the national occasions and holidays are integrated with the SP events

13. Make sure the SP events are linked to national development priorities and can benefit from funds made available to them(like eradication of illiteracy, poverty alleviation)

14. Make sure that government allocates sufficient fund since relying on the private sector is a myth. Science popularization is among the basic rights of citizenship. Thus governmental institutions should be prompted to carry out specialized plans and held accountable for achievements in this area.

15. Make sure "surfing on the web" is regarded as a fundamental ability to raise individuals and community's SKAQ. This principle might be side stepped in light of the reservations and worries that characterize Muslims and their respective governments with respect to internet use (Mehrmohammdi, 2009).

16. Make sure a master plan is in place, a road map which drives consistent and sustained action; preferably translated into an act (law), like *"Promotion of Science and Technology Act"*, to enjoy the system wide support that implementation of the plan requires.

Endnotes

1. In The Uses of Schooling (1988), Broudy delineated four uses of knowledge: replicative, associative, interpretive, and practical (applicative). Because the ability to replicate information diminishes significantly after formal instruction ends and because practical education only is useful in vocational training, Broudy believed that schools should focus their attention on the associative and interpretive uses of knowledge. Broudy pointed out that aesthetic studies provide students with associative and interpretive experiences and develop the capacities for interpretation and informed criticism, as well as a richer vocabulary for self-expression.

2. Journalists' role is recognized as very critical as means to dissemination of scientific knowledge and strengthening the proper attitude in the public. However, caution must be exercised when they perform the role of producing scientific interpretations to be popularized. This has in times led to the popularization of pseudo scicence (For a popular example see Cornelis, in Is Popularization of Science Possible?)

References

Broudy, H.S. (1988). *The Uses of Schooling*. Routledge Kegan & Paul

Burns, T. W., O'Connor, D. J. & Stocklmayer, S. M. (2003). *Science communication: a contemporary definition*. Public Understanding of Science 12; 183-202.

Cornelis, G.F. *Is Popularization of Science possible?* Retrieved at: *http://www.bu.edu/wcp/Papers/Scie/ScieCorn.htm*

Dewey, J. (1929). *The Sources of the Science of Education*. The Kappa Delta Pi Lecture Series

Ibupoto, K.A. (2012). *Best Practices of Science Popularization in Pakistan.* Presented in the Regional Workshop on the Popularization of Science in Asia- Pacific. Baku. Azerbaijan.1-3,

Joan Solomon, "School science and the future of scientific culture," in *Science Today. Problem or crisis? Eds.* Ralph Levinson and Jeff Thomas (London: Routledge, 1997), 151–162.

La main a la pate.1996 (http://www.lamap.fr/)

Mehrmohammadi, M. (2002). *Internet and the Muslim Youth: Challenges, Paradigms and Strategies*. Presented to the Regional Seminar to Consider Ways to Immunize the Youth and Children against Harmful Internet Content and help them Benefit from Blogs..

Mehrmohammadi, M. (2008). *Recognition of "technology education" as a null aspect of school curriculum.* Presented in the: International Conference On Science and Technology Education. Kish Island, Iran.

Popper, C. (1972). *Conjectures and Refutations:The Growth of Scientific Knowledge(Fourth edition).* Routledge and Kegan Paul

Sapp, G. (1992). *Science Literacy through Popularization: Problems and Potential.* Science and Technology Libraries. Volume 12, Issue 2. Pp 43-57.

Schon, D.A. (1983). The Reflective Practitioner. Basic Books.

Schwab, J. (1971). *The Practical: Arts of Eclectic*. The School Review, Vol. 79, No. 4. pp. 493-542.