Journal of Curriculum Studies (J.C.S.)
Vol.7 (28); 2013, 117-138

فصلنامه مطالعات برنامه درسی ایران
سال هفتم، شماره ۲۸ ، بهار۱۳۹۲، ۱۳۸-۱۱۷

Recognition of "technology education" as a null aspect of school curriculum and an exigency in the Islamic world

بازشناسی تربیت فناورانه به مثابه بخشی از برنامه درسی مغفول و یک ضرورت در جهان اسلام

Received 16 January 2012; accepted 28 June 2012

Mahmoud Mehrmohammadi[1] (Ph.D)

Science education has a special place in the school curriculum. This is more and less true in education systems throughout the world, including developed or developing countries, with the Islamic countries belonging almost invariably to the second category. All countries behave similarly with respect to technology education as well, only by neglecting this critical subject from their explicit curriculum. Such neglect, however, is more consequential in Islamic countries than developed countries since it will fuel the perpetuation of under developed status. The neglect, though, appears to be more intense in developed countries as well.

The purpose of this article is to de-nullify technology education from the school curriculum, especially in the education system of Islamic countries. This is argued to be the most reassuring way to initiate gradual exit from the existing calamity such counties face. Technology education is recognized as catering to the competency of technological mentality or solving technological problems. To take this directive seriously, however, requires that fundamental differences between science and technology education be understood and that technology education be taken out of the shadow of science education in the school curriculum. The differences thus mentioned have been introduced in this article in eleven aspects, substantiating the claim that technology education deserves a sovereign space in the curriculum. The author, then, takes a step further by discussing some rather significant strategies that would have to be enacted if the end of technology education is to be met with success.

Keywords: null curriculum, technology education, science education

محمود مهرمحمدی

تربیت علمی در برنامه درسی مدارس جایگاه ویژه و والائی دارد. این حکم درباره تمام کشورها، خواه کشورهای پیشرفته و خواه کشورهای کمتر پیشرفته و در حال توسعه که قریب به اتفاق کشورهای مسلمان نشین در دسته اخیر قرار می گیرند، بیش و کم صحیح است. اما از جنبه دیگری کشورهای توسعه یافته و کشورهای متعلق به جهان اسلام نیز با یکدیگر شباهت دارند که به غفلت نسبت به تربیت تکنولوژیک باز می گردد. البته غفلت مورد اشاره در کشورهای جهان اسلام چون با تبعات جدی در زمینه تداوم توسعه نایافتگی همراه است، از اهمیت ویژه ای نیز برخوردار است. شدت غفلت نیز در برنامه درسی مدارس کشورهای توسعه یافته به اندازه کشورهای توسعه نیافته نیست.

هدف این مقاله تاکید بر غفلت زدائی از تربیت تکنولوژیک به ویژه در کشورهای جهان اسلام است تا مگر به دلیل این اهتمام زیربنائی شاهد برون رفت تدریجی آنان از وضعیت نامطلوب فعلی که با تاکیدات دین اسلام نیز به هیچ رو سازگار نیست باشیم. تربیت تکنولوژیک به معنای دست یابی به ظرفیت تفکر تکنولوژیک و قدرت حل مسائل تکنولوژیک نیازمند باز شناسی است. در فرایند بازشناسی نیز مهم ترین اقدام تفکیک میان شایستگی های مترتب بر تربیت علمی و تربیت تکنولوژیک است که متاسفانه تا کنون چندان به آن پرداخته نشده است. در این مقاله این تمایزات در یازده محور شرح داده شده و از آن چنین نتیجه گیری شده است که تربیت تکنولوژیک مقوله ای متمایز از تربیت علمی و نیازمند تدابیر ویژه آموزشی است. برخی تدابیر ویژه ای که می تواند در این جهت مورد توجه قرار گیرد نیز در بخش پایانی و در قالب راهبرد ها مورد واکاوی قرار گرفته اند.

کلیدواژه‌ها: برنامه درسی مغفول، تربیت تکنولوژیک، تربیت علمی

---

1. Professor of Curriculum Studies Tarbiat Modares University / mehrmohammadi_tmu@hotmail.com

What is problematic; in a contextualized sense?

Fundamental inadequacy or dearth of technological achievements in the Islamic world and the parallel unsatisfactory life quality in most of the Islamic countries constitutes the problematic that has become the focus of attention in this article. This condition is shown to be a reality while in most Islamic schools of thought one not only can trace any controversy over the desirability of scientific exploration and technological innovation, but statements to the contrary abound. As far as technology is concerned, which might be considered a bit more controversial compared to scientific exploration (explanation) as a legitimate human conduct, the author maintains that technology should be regarded as the product of efforts on the part of human beings to replicate the Creator’s exclusive power of creativity on the living globe and, thereby, engaging in a never ending endeavor to strive towards the ultimate Good in life. The following interpretations, from prominent Islamic scholars, are sample accounts attesting to the consistency between Islamic thinking, on one hand, and science and technology, on the other. They are presented here as evidence for shedding further light on the problematic situation in the Islamic countries and justifying the theme of science and technology education as an utterly relevant subject for the school curriculum in such countries.

In perhaps the most influential modernist effort vis-à-vis science, the Egyptian Muslim scholar Muhammad Abduh (1849-1905) argued that "religion must be accounted as a friend to science, pushing man to investigate the secrets of existence, summoning him to respect the established truths and to depend on them in his moral life and conduct."(In Hourani,1991)

Moving to the present time, Seyyed Hossein Nasr, an Iranian and professor of Islamic studies at George Washington University, defines contemporary Islamic science in terms of humanist values he finds in the Qur'an and the hadith. “Inspired by mystical ideals, Nasr articulates less a practical program than a vague Islamic science free of nuclear energy and devoted to environmental harmony” (Segal, 1996). Similarly, Ziauddin Sardar, a Pakistani science-policy specialist, envisions an "Islamic science" rooted in humanistic values. He wants no weapons research (though it is hard to find Islamic support for such a ban). He has written detailed proposals for networks of Muslim scientists, joint projects, and regional cooperation, all based on Muslim solidarity. (ibid)

International data or evidence also documents the rather embarrassing state of affairs with respect to science and technology development that surrounds Islamic countries. The following documents are briefly reviewed as samples with clear and unambiguous indications.

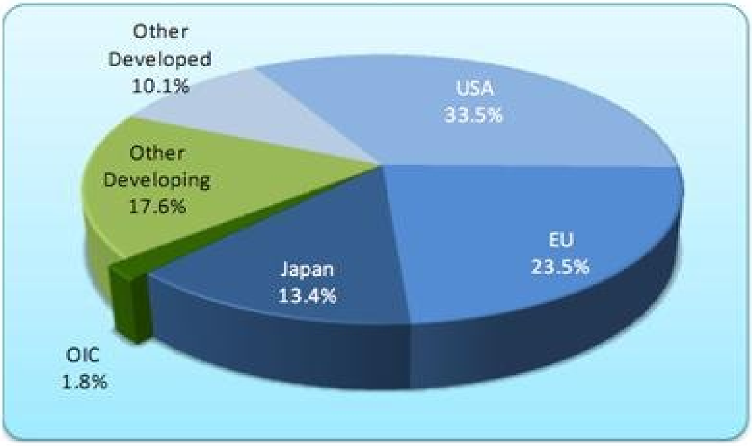
First, the document titled “STRATEGY FOR THE DEVELOPMENT OF SCIENCE AND TECHNOLOGY IN ISLAMIC COUNTRIES” (ISESCO, 2000) developed by ISESCO, the OIC[1] affiliate international body responsible for overseeing science and technology development in the Islamic world. It talks about three assumptions that have provided the basis of for developing the document as follows:

> *“Firstly, the Islamic countries are underprepared for taking up the challenge posed by worldwide advancement of science and technology. The number of S&T manpower is inadequate, the allocation of funds for education, research and development are far below the desired norms, economic development measured on the touchstone of Human Development Index (HDI) is far below the world average, and attitude towards S&T has only begun to be responsive. Secondly, it has yet to be realized that S&T research is a necessary ally of economic development. Thirdly, the "need-achievement" required for growth and survival has yet to be demonstrated. It has been argued that earlier rise of science in the Muslim Ummah during the 7th to 14th century AD, resulted from high collective consciousness and accumulation of vast quantities of intellectual capital. To be able to confront the challenge, these attributes have to be recaptured.”*

1. Organization of Islamic Countries

This strategic document elaborated on this theme by reference to indicators such as R&D expenditure and HTE. It explains that today around 80 % of R&D expenditures is spent by developed countries, of which 33.5% by the USA, 23.5% by the EU. And 13.4% by japan (figure1). The OIC coutries accounted for only 1.8% of the world total Gross Domestic Expenditures on R & D (GERD).or 9.5% of expenditures or, in GDP. Accordingly, R&D intensity (GERD as a Percentage of GDP) is a widely used indicator of S&T activities the innovative capacity in that a higher R&D intensity indicates that relatively more resources are devoted to the development of new products or production processes.

Figure1: GERD, % of world Total (2007)

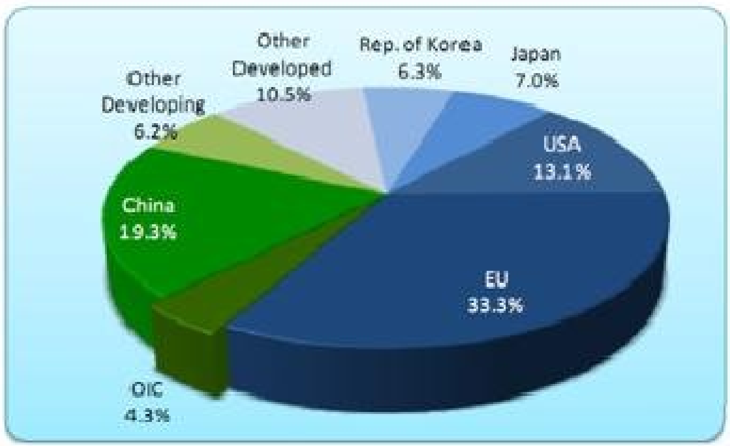


Source: UNESCO

In this connection, the OLC Ten-Year Programme of Action To Meet the Challenges Facing The Muslim Ummah in the 21st Centry, which was adopted at the third Extraordinary session of the Islamic Summit Conference held in Makkah al Mukarrameh, Kingdom of Saudi Arabia, in December 2005, calls upon Islamic countries to encourage research and development programmes, taking into account that the global percentage of this activity is 2% of the Gross Domestic Product(GDP), and request Member States to ensure that their individual contribution is not inferior to half of this percentage (OIC-TYPOA,1995,PART2, Section V,Article 4). Nevertheless, available data show that OIC member countries' is spending on R&D activities was significantly lower than the world average and still far away from the implied target of 1% of GDP by 2015.

Same is true with respect to the indicator of High Technology Export (THE) which is as alarming and implausible as GRED (Gross Domestic Expenditure on R&D) indicator. High Technology Exports are products with high R&D intensity, including aerospace, computers, software and related services, software and related services, consumer electronics, pharmaceuticals, scientific instruments and electrical machinery, which mostly depend on an advanced technological infrastructure and inward FDI in High-tech industries. World high-technology exports were estimated to have reached over $1.7 trillion in 2007. Around 70% of that amount originated from developed countries, of Which 33.3% from the EU members, 13.1% from the United States, 7.0% Frim Japan, and 6.3% from Republic Of Korea.

Figure2: High Technology Exports, % of world Total (2007)



Source: UNESCO

The second document briefly reviewed belongs to RAND. A RAND study lists countries in four categories: scientifically advanced; scientifically proficient; scientifically developing, and scientifically lagging. While most of the Moslem countries are categorized as ‘scientifically lagging,’ only Egypt, Indonesia, Iran, Pakistan, Turkey, and Uzbekistan perceived as scientifically developing countries among the Moslem world.(Quoted in Mansouri, 2007)

What is the problem; in an educational sense?

Upon concluding the discussion on the problematic situation, an explanatory perspective needs to be adopted to identify the stance of the author. The problems, it is argued to reside in a grave confusion over what technology education is and, more specifically, how it could (or should) be differentiated from science education? Put differently, the extant situation is attributed to the fragmented and insufficient presence of technology in the school curriculum. This appears to be a novel educational explanation of why Islamic countries lag behind the western and the developed world when it comes to science and technology[1]. The ISESCO document mentioned above, for example, is void of any reference to the explanatory perspective adopted in this article. The seven recommendations that appear at the end of the document is an unfortunate witness to this claim (P.45). To be sure, there are a range of valid and more widely circulated alternative interpretations than can be traced in the works of many Muslim scholars. The explanation offered here can be regarded as a contribution to this field of investigation from an educational standpoint.

1.Technologically advanced societies like Australia, according to Terry Lyons (2011), do not take technology education seriously either. This paradox can be explained away by refraining from insisting on the unitary and exclusive role of the general education system. That is countries like Australia invest a substantial amount of money on R &D, for example. The author, however, suggests that investment in general education would enhance productivity to a considerable extent.

To elaborate on the explanatory theme adopted here, it is worth mentioning that technology education has not been the focus of attention of many educational systems in an age characterized first and foremost by technological revolution. Even if the title, technology, appears in the school curriculum alongside science, the analysis of the curriculum syllabus does not bear witness to it. All in all, technology education has been subsided if not neglected altogether, thus qualify as a segment of the null curriculum (Eisner, 1994). This is argued to be mainly due to a misconception on the part of educators and curriculum developers. Consequently, technology is not given the space that it deserves in the school curriculum.

The root of this misconception lies in not recognizing the fundamental difference that exists between science and technology and the characteristics that, thus, differentiates between the problems belonging to each sphere. Explication of this conceptual difference and the resulting educational implications are what will be pursued in sections that follow in this paper.

Three rather important disclaimers are necessary to make in the outset before themain argument is put forward. First, what is meant by the revival of technology education in the school curriculum is <u>not</u> teaching *about new technological developments like ICT or biotechnology*. Infusing new technologies into school curriculum as an integrated or independent subject is, indeed, an important event, but it is far from what is called for here. Secondly, the writer’s intent <u>is not</u> to encourage technology education as is suggested by scholars such as Neil Postman (1995). Postman who is a vocal critic of technology specially of its alleged “Omni power” status when it comes to resolving life issues and problems, believes that rather than treating technology as God or savior by educators and policy makers, as if it can magically resolve all the problems afflicting education, technology’s limits, along with its capabilities, should be introduced to students in the context of a course or subject specifically designed for this purpose. As important as this reading of *technology education* is believed to be, the writer is not going to reiterate what Postman argued for eloquently. Finally, technology education emphasized here is by no means related to the sometimes controversial, topic of *technical vocational education, a learning path or curriculum track* usually introduced at the secondary level most frequently addressing the needs of underachievers or expectation from the education system allegedly voiced by the students belonging to the lower social strata. Authors, like Henry (1982) and Levesque (2000), favor this reading when it comes to discussions of the implications of the technological age for the school curriculum.

What differentiates between my contention and all other theses or themes sharing the same or similar title, that is technology education or education for a technological age, is that I encourage educators to concentrate on the development of *technological thinking/mentality in the pupils* .It is therefore distinct from:

– Teaching new technologies as an integral part of the curriculum, alongside science or otherwise
– Teaching about the fact that technology is not a panacea, its drawbacks and dangers of exaggerating technology's power to the extent that will undermine the indispensible human element in determining life quality
– Teaching work related skills to prepare students for specific jobs in the existing technology intensive job market

The core argument, however, is that technological thinking/mentality, is quite distinct from scientific thinking/mentality as a competency and should ,therefore, be given due attention by curricularists to save them from charges of not addressing a distinct potentiality in human beings and missing out on developing a critical aptitude in the education system. The acknowledgement of this distinction, first and foremost, awaits the realization of the differences that exist between science and technology. This is because the popular educational wisdom not only does not testify to this dually, but also presupposes an essential unity or a singular identity for science and technology. Such unwarranted and antirealist understanding has culminated in a chronic insensitivity to the technology component, as reflected in most of the popular science curriculum frameworks and materials. Such frameworks and the relevant learning materials might, and only might, pay a lip service to technology education by gluing the word technology to science, ie: science and technology curriculum by discussing applications of science in life, that is technology, as a marginal topic. For purposes of supporting this claim, consider the definition of “scientific literacy” regarded to be the most important aim of science education courses which seems to be a fairly acceptable definition in the respective scientific community:

> *“School scientific education should aim to produce a populace who are comfortable, competent and confident with scientific and technical matters and artifacts. The science curriculum should provide sufficient scientific knowledge and understanding to enable students to read simple newspaper articles about science and to follow TV programs on new advances in science with interest. Such an education will enable them to express an opinion on important social and ethical issues with which they will increasingly be confronted.” (Millar and Osborne, 1998, P.9)*

Such a definition is testimony to inadequate realization of the importance and the consequent inadequate attention paid to the technological component and its corresponding aims or competencies.

To further delineate the problem or the main contention, the writer will now turn to the differences between the nature of science and the nature of technology. At least eleven differences are detected and described to document the *originality of technology in the curriculum, as much as sciences enjoy originality.* The originality entails that technological competence viewed from this perspective is not an automatic offspring of scientific competence and requires thoughtful educational resolve along with proper programs, measures and actions. Attention to these differences makes is crystal clear that students do not automatically become technologically competent or technological problem solvers by exercising scientific problem solving and becoming highly competent at it.

1. *Goal:* to describe, to unveil, to decode, to discover, to know with no external intentions involved, to model the natural and social phenomenon (S[1]) V. to create, to design, to construct, to enable, to do with reference to a "collective intentionality" or an imagined destination, to change the world(T[2]).
2. *Typical questions* in scientific research and exploration V. technological research and exploration: What happened? Why this happened? How could what happened be explained? What are the causes of this event? (S) V. How could this legitimate end be met? How efficient the design is? How consistent is the design with the espoused value system?
3. *Achievement:* solution, theoretical knowledge(S) V. resolution, practical knowledge(T)
4. *Nature of the process*: structured, more and less algorithmic (scientific process)(S) V. unstructured, fluid, heuristic, dependent on individual or collective ingenuity (T)
5. *Validity and justification measure*: proximity to external reality, corroboration, refutability (S) V. degree of responsiveness to preconceived needs and imagined states of affairs, efficiency (T)
6. *Potential for plurality and multitude*: scarce, limited competition in suggesting alternative explanations of the same phenomenon (S) V. ample, extensive competition in suggesting alternative resolutions or models (T)
7. *Indigenousness or dependability to context, culture and local situations*: non existent to minimal (S) V. minimal to thorough (T)
8. *Ethical concerns*: principles governing the process(S) V. principles mainly governing the product (T)

1. Stand for science
2. Stands for technology

9. *Type of rationality:* logical, analytic, along with degrees of intuitive thought in the context of discovery embraced by “scientific intelligence” (S) V. non-linear, holistic, creative, lateral embraced by “technological intelligence”(T)
10. *Identity or knowledge base*: usually disciplinary (S) V. interdisciplinary (T)
11. *Durability:* high but by no means absolute, representation of Truth although not inalterable (S) V. low, susceptible to changes in the perceived needs and emerging problems, constant alteration is the dominant mode (T)

The roots of this argument could be traced in Aristotle’s view where he discriminates between features of theoretical knowledge (episteme) and practical knowledge (phronosis). From his perspective theoria and praxis differs radically in four ways. In their ends, the outcome of the theoretic mode is knowledge, whereas the outcome of the practical is a decision, a selection and guide to possible action. In subject matter, the theoretic pursues universals, while the practical deals with concrete particulars. The problems of the theoretic stem from identifying areas of ignorance as contrasted with what we already know, whereas practical problems arise from states of affairs that do not satisfy us or hurt us or deprive us of more than they confer. These differences are paralleled by an equally radical difference in method: theoretic methods are controlled by a principle, whereas practical problems only emerge slowly and entail deliberating about the costs and benefits of alternative means of resolving a problematic situation (Schwab, 1970).

Finally, I’d like to draw on the recommendations of a legendary contemporary science educator in the 1940’s as additional support for the position adopted in this paper. Joseph Schwab argues that” science provides the data and the means with no judgment necessarily linked to an end, and hence with no ethical consideration”(Schwab, 1941). Technology, however, deals with an action that is utterly ethical that connects to controversies or involves decisions that are highly controversial to be decided based on ethical principles. Attention to this critical difference too, reminds educators of significant educational implications that radically differentiate between processes involved in science education as distinct from technology education.

A concrete example might help in better communicating the main point emphasized in this article. Nuclear science and nuclear technology is a case in point. The first is a contemporary field of human inquiry and a prime example of human scientific intelligence, that is refutable/ more and less accurate description of what takes place in real world or " out there" and how the phenomenon under investigation in fact behave in nature. The second, specially the military application, is a prime and a highly disputed example of human technological intelligence influenced by, first, whether the need or the so called "intentionality" is considered a legitimate one in a particular culture and , second, by unimaginable variations and designs limited only by human imagination and creativity to make the product more efficient and more responsive to the perceived need. Another example worth mentioning is biology, representing a scientific field, and biotechnology; defined as using living organisms to reach ends enhancing the quality of human life, like selective breeding, if the procedure is regarded as culturally viable and acceptable.

The aforementioned misconception finds its way into important topics such as" responsible science", that is science compatible with sustainable development discussed by Taylor (2011). The author contends that as significant and vital such topics are, they nevertheless have nothing to do with science per se. These topics if considered in light of the fundamental differences that exist between science and technology, relate strictly to the sphere of technology. Responsible technology, therefore, is a meaningful and comprehensible phrase and, of course, a vital concern in every society. Responsible science, however, is argued to be meaningless if the above distinction is kept in mind and regarded as valid. This is because it involves the application of science to meet the perceived needs, which can be classified as legitimate or illegitimate based on accepted norms such as being congruent with sustainable development. Legitimate and illegitimate science are concepts which cannot be substantiated based on conceptual of empirical referents.

Before moving to the next section, the author would like to offer the following preliminary concluding remarks. A "typology of problems" consisting of four types of problems could be envisaged and proposed. The most important discriminating element leading to this classification, of course, is the distinction between scientific problems and technological problems. There is, however, a second dimension to this typology which could be equally important. This dimension enters the scene when social domains are differentiated from physical or natural domains. The resulting classification suggests four types of problems, two scientific and two technological types (see the table below).

	Pure sciences	***Technological sciences***
Social / human phenomenon	*Soft Scientific problem*	*Soft technological problems*
Natural / physical Phenomenon	*Hard Scientific problem*	*Hard technological problems*

On another significant note the proposition that a logical inference from the perspective put forth in this article, arguing in favor of the infusion of technological thinking in curriculum, is to discriminate against social and human sciences and to push represents a misunderstanding which is absolutely unwarranted. This misconception may be the result of a narrow and traditional view on technology that recognizes the material world as its exclusive referent, which can be effectively countered using the above typology.

What is the solution?

The following educational strategies are offered so that the idea of the revival of technology education, with the specific meaning discussed in this paper, can become a reality.

- ***Technology as an independent / separate subject or in combination with other subjects.***

Both schemes should be kept within the purview of possibility. Specific education systems should assess their own situation and make, to echo Schwab (1969), the “best” and not the illusionary “right” decision in a “practical” pursuit. Ideally, though, simultaneously introducing both modes of design and technology into the curriculum is preferred. That is allocating space in the curriculum to an independent subject like design and technology and contemplating the presence of its basic ideas, concepts and skills in all or certain other subject areas. The former mode is exercised in countries such as England (Rethinking the School Curriculum) (White, 2004). The latter, the integrated mode is a powerful mode that leads to more powerful and meaningful learning. The integration can take a variety of forms. Technology attached to science, math and even social science (history). The more frequent integrated form, of course, is the “broad fields” subject that joins science, technology and society known as STS approach (Solomon, 1993) or science, technology, engineering and mathematics known as STEM approach. Recently, though, South Korea is experimenting with a more inclusive approach to integration referred to as STEAM (Hae-Ae Seo, 2011).Letter A in the acronym stands for arts. The advantage of such combinations or integration of various disciplines is that the traditionally dull science courses, too, will be transformed into a more vibrant domain and, thus, a more satisfying subject of study for students. The technological activities and projects, also, could be pursued within the less formally determined portion of the curriculum sometimes referred to as extracurricular or, as I prefer to call them, the “non-prescriptive” portion of the school curriculum

(Mehrmohammadi, 2010).1In general, though, technology education lends itself more to the integrated model of curriculum due to the centrality of project based activities discussed as the next styrategy.

- ***Technology education more clearly relates to the concept of “projects” or project- based education.***

It is closely tied to what Kilpatrick had in mind when he talked about “project method” (1918). In fact I suggest that in the context of science education the term “problem based” be employed and in the context of technology education the term “project based” to mark the difference and assist in preventing the confusion so pervasive in the current educational thought and practice. A reasonable science and technology course, therefore, should bounce back and forth between a “scientific problem” and a “technological project” in an integrated module or unit of study. Understanding scientifically the reason behind global warming, for example, along with variety of learning opportunities to consider technological interferences (projects) to stop or reverse this dangerous trend, is an acceptable unit of study. Although scholars such as Knoll (1997) and Oaks et.al (2000) have constructed their argument in favor of technology education stressing project based learning, but they have not made the aubtle difference that I have highlighted here.

Hard and soft types of technology can also shed light on the idea of a “project” as opposed to “problem”. In the realm of pure (natural /physical) science one deals with both soft and hard technology, with soft technology taking a logical precedence over hard technology. The latter represents the operationalized form of the former by material means be it development of a software or hardware (machines) and instruments. Soft technology, thus conceived, is at the core of suggested project type activities and, in line with my previous emphasis on technological thinking should be given primacy over hard technology when it comes to allocation of resources.

1. I subscribe to a notion of curriculum that is comprised of three pillars or a tripartite curriculum structure; the “prescribed” or the core, the” semi- prescribed” or the elective and the” non-prescribed” or the discretionary.

- ***Integrated thinking and paradox resolution.***

A significant quality needs to be nurtured in the pupils to enable them to solve technological problems. This quality can be characterized as the quality of resolving paradoxical situations and is catered for by a special type of thinking referred to as "integrative thinking" (Martin,2007). This is the type of thinking that begs powers of imagination and creativity. For example coming up with a policy to contain the dual function of containing the upward direction in the inflation index and preventing the rise of unemployment requires an imaginative technological leap(within the soft technology domain) since the two are inversely related based on undisputed claims in the field of economics.

To elaborate on the relevance of integrative thinking to technological thinking one might allude to the necessary entanglement of technological problem solving (or design) with tensions, constraints and conflicting demands. Design activity in whatever field, at the soft or hard stage, takes place within such indeterminate circumstances. Circumstances that might literally call for considering and incorporating mutually exclusive or paradoxical features and demands, at the same time, explaining why technological problem solving is so fertile a ground for breaking new grounds and to exercise creativity and ingenuity. To be sure, TRIZ which is a Russian initiated creative problem solving algorithm with an extensive history of more than 50 years of application in the field of design and technology, rests on the assumption that technological solutions are inherently concerned with conflicting or contradicting demands (Zlotin and Zusman,1991 and Stamey and Peterson, 2006) or that "A fundamental concept of TRIZ is that contradictions should be eliminated"(Barry et al, http://www.realinnovation.com)

To further justify this strategy suffice it to realize that technology is recognized as a social entity by definition. In other word, contrary to science, technology is a social construction. Regarded as such, and within the framework of technological indeterminism, the best resolution (or technological solution), may differ from a social perspective or social group to another. Accordingly, it has been argued that those who seek to understand the reasons for embracing or rejecting a technology should look to the social world. It is not enough to try to explain a technology's success by simply asserting that it is "the best" -- researchers must carefully look at how the criteria of being "the best" is defined and what groups and stakeholders participate in such a definition.

- ***Planning for real problem solving opportunities of the technological type, congruent with the learners’ intellectual powers or potentials.***

Children at the elementary stage are expected to be faced with learning opportunities containing tangible problems and addressing concrete needs (in Meek,1991).Problems that are visible and comprehensible because it can be traced in the “local” environment that they are constantly in touch with, places such as their classroom, school, home or community. Older students can effectively deal with more sophisticated problems of “global” nature and should therefore be provided with opportunities congruent with such qualities. In complying with this apparently self evident strategy one must be cautious not to rely exclusively on Piaget’s original account of intellectual development (Wadsworth, 2003) to determine age appropriateness of educational activities. Alternative conceptions such as the more socio cultural account of Vygotsky (Daniels,2001) and the more artistic and imagination based account of Egan (1997, 2003) are worth looking into by curriculum decision makers and teachers.

- ***Taking advantage of the unprecedented opportunities for group problem solving or working collaboratively on projects through the Internet.***

Internet has removed and abolished the distances and as a result the once “far” places and problems associated with it have become “near” and the “global” has become “local”. This technological advancement is a great asset at the service of expanding genuine opportunities aimed at developing technological thinking. Networks of friendship and collaboration that begin forming in the context of school originated technological projects can continue its life afterwards and expand into quasi professional and professional networks in the future with significant bearing on the growth and development of individuals in the era characterized as the net society inhabited by net generation(Tapscott,2008).

- ***Art education as an imperative part of technology education***.

Art products are the products of artistic thinking that share a great deal in terms of intrinsic characteristics with technological thinking (more than what is the case with regard to science). The holistic mode of thinking, that is taking into account all relevant points and parameters at the same time, represents one such similarity between arts and technology as problem solving activities (Dewey, 1934). Power of imagination and severing mind from what is real is another very important similarity (Eisner, 2004). These very worthwhile competencies would best be developed within the context of art education program. Art education, it is suggested, could even be regarded as a thoughtful proxy for technology education in the early years of education.

- ***Special teacher training program***

Just as is the case with any other sovereign learning domain training specialized teachers, is a vital component of a comprehensive technology education program. It must be clear by now that qualified science teachers are not necessarily good technology teachers. This very fact is probably one reason why technology education has not taken roots in education systems. Reconsideration of existing pre-service teacher education or empowerment of working science teachers through retraining is a prerequisite to any concrete achievement in this realm.

- ***Promoting the culture of innovation at the school level.***

Sustained support and encouragement for innovative ideas on the part of school administrators, classroom teachers, parents and community members is the last point raised in this respect. Innovation and technological thinking, In other words, must become a rule of conduct and the more innovative students receive more support and recognition. To put it differently, the "hidden" curriculum, along with the "explicit" curriculum, need to be a source of concern when engaging in the development of the competency in question. The least that should be guaranteed is that the overall school culture explicitly communicate the value associated with technological thinking reflected in, for example, challenging the existing routines in accomplishing the established ends. The extant "null" identity of the technology education curriculum reflected in the title of this paper, would permanently and powerfully be removed if both types of curricula or learning experiences ,that is explicit and implicit, are taken into account in this pursuit.

Conclusion

The lag currently experienced by Islamic countries with respect to science and technology development is a calamity that should be resolved in the most efficacious way. Although different solutions are in sight and different proposals are made, this paper adopted an educational perspective in explaining this rather stubborn situation and took technology education to be the Achilles hills of the respective education systems. Due attention to technology education and the development of technological thinking or problem solving, therefore, was argued to become a national priority. The priority in mind for these education systems has a special meaning attached to it which was thoroughly explained in the paper by examining different meanings attached to the concept of technology education. The attention to technology education in this spirit is an intervention or an innovation that could have a great bearing on the scientific and technological productivity of Islamic countries and could effectively reverse the current trend in the future. It is worth repeating that “Education for Innovation” (technology education) is different from “Education for Understanding” (science education) when it comes to goals and strategies. Understanding scientific concepts and theories may be considered the necessary condition for engaging in the process of innovation, but by no means does it furnish the sufficient condition. Scientists do not and should not necessarily pursue technological ends. The reverse also holds true. To be an innovator too, I’d like to add, you don’t need to be competent at solving scientific problems. An innovator could, and expediently should, rely on the products of science to pursue his/her interests and ends.

To sum up, the aim was to present a case for technology’s sovereign existence in the school curriculum and to secure its freedom from a current parasitical or subservient existence mostly on the edge of science curriculum with no clear well stated objectives and intelligently fabricated learning opportunities.

To end with an optimistic note, although in the developed world, is to refer to a newly released report containing a framework for science education in the American schools (National Research Council, NRC, 2012). What is encouraging is that the framework specifies core ideas in four disciplinary areas -- life sciences; physical sciences; earth and space sciences; and engineering, technology and the applications of science -- that all students should understand by the time they finish high school. The explicit inclusion of technology and the applications of sciences is a hopeful sign to produce the next generation of scientists empowered by technological competence. Other countries are advised to follow suit to make sure that their fellow citizens are indeed comfortable with the idea of being expected to demonstrate technologically literacy.

References:

- Barry, K. etal. What Is TRIZ? Retrieved from: http://www.realinnovation.com
- Daniels, H. (2001). Vygotsky and Pedagogy. Routledge, Falmers. NY
- Dewey, J. (1934)(1958). Art as Experience. Capricon Books. G.P. Puntanm's Sons. NY.
- Eisner, E.(2004). The Arts and the Creation of Mind. Yale University Press.
- Eisner.E. (1994). The Educational Imagination: On the Design and Evaluation of School Programs. Macmillan Publishing Company. NY.
- Egan, K. (1997). The Educated Mind: How Cognitive Tools Shape Our Understanding. Chicago, the University of Chicago Press.
- Egan, K. (2003). Start with What the Student Knows or with What the Student Can Imagine? Phi Delta Kappa International.
- Henry, D. (1982). Vocational Education in the Comprehensive High School.Found in ERIC: ED233159
- Hourani, A. History of the Arab People (Cambridge, Mass.: Harvard University Press, 1991), p. 308
- Islamic Educational, Scientific and Cultural Organization (ISESCO). STRATEGY FOR THE DEVELOPMENT OF SCIENCE AND TECHNOLOGY IN ISLAMIC COUNTRIES, updated version. 2000. Hay Ryad, Rabat, Morocco
- Kilpatrick, W. H. (1918). The project method. Teachers College Record,19, 319-335
- Knoll, M. (1997). The project method: its origin and international development. Journal of Industrial Teacher Education 34 (3), 59-80
- Levesque, K., Lauen, D., Teitelbaum, P., Alt, M., and Librera, S. (2000). Vocational Education in the United States: Toward the Year 2000 (NCES 2000–029). U.S. Department of Education, National Center for Education Statistics. Washington, DC : U.S. Government Printing Office.
- Mansouri, R.(2007). How an Obsolete Concept of Science Impedes the Development of Islamic countries: The Example of Iran. APS Physics
- Martin.R.(2007).Opposable Mind: How Successful Leaders Win through Integrative Thinking" (2007)
- Meek, A. (1991). On Thinking about Teaching: A Conversation with Eleanor Duckworth. Educational Leadership, v48, n6, p30-34.
- Mehrmohammadi,M.(2010). A Conceptual Model for the Curriculum Component. In: National Education Development Document; Theoretical foundations. Higher Council for Cultural Revolution. I.R.Iran.
- Millar, R. and Osborn,J. (1988). Beyond 2000: science education for the future: a report with ten recommendations. King's College London, School of Education.

- National Research Council; Committee on Conceptual Framework for the New K-12 Science Education
- Oakes, M.M.; Gantman, R. and Pedras,M.(2000). Technological Literacy: A Twenty First Century Imparative. In Oarkay, F, and Hass,G.(Eds.). Curriculum Planning: A Contemporary Approach.Allyn and Bacon, Boston.
- Standards (2012). *A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas.* National Academies Press. Washington DC
- Postman, N.(1995). The End of Education: Redefining the Value of School. Vintage; A Division of Random House, NY,
- Schwab, J. (1970) . “The Practical: A Language for Curriculum.” In Westbury and Wilkof 1978, 287–321.
- Schwab, J. 1941. “The Role of Biology in General Education: Biology and the Problem of Values.” Bios 12:87–97.
- Segal, A. (1996). Why Does the Muslim World Lag in Science? Middle East Quarterly. pp. 61-70
- Seo, Hae-Ae (2011). *New Approach Of Scientific Creativity and Science Education For the Gifted in Korea*, July 10-12,, Kish island-Iran
- Solomon,J.(1993). Teaching Science,Technology and Society (STS). Buckingham, Open University Press.
- Stamey, J.W. and Peterson, R. TRIZ in Technology Education: Perceptions of Future Teachers. June 2006. Retrieved from: www.osaka-gu.ac.jp/php/nakagawa/TRIZ/eTRIZ/eforum/e2006
- Tapscott, D. (2008). Grown Up Digital: How the Net Generation is Changing Your World. McGraw Hill Company, NY.
- Taylor,E.(2011). Philosophical Aspects of Socially Responsible Science Education for Sustainability. Paper presented in the International Conference on Science and Technology Education. Kish Island, Tehran, Iran.
- Wadsworth, B. J. (2003). Piaget's theory of cognitive and affective development: Foundations of Constructivism (5th Edition). Pearson, NY.
- White,J.(2004)(Ed.). Rethinking the School Curriculum ; Values, aims and purposes. Routledge Falmer, London
- Zlotin,B. and Zusman,A. TRIZ and Pedagogy. July, 1991. Retrieved from: http://www.ideationtriz.com