Environment, Indigenous Technology vis-à-vis Status of Teachers in Engineering Education: An Empirical Survey over Indian Techno-pedagogic fabric

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Abstract –
Technology, being applied field of science, provides knowledge to satisfy human needs at the cost of the environment. Education, Science and technology together provide knowledge through formal curricula and help humanity to produce dramatic improvements. Technological advancement possesses benefits, potential risks and widely varying capacities to handle risks. Third-world countries become worst sufferers of such risks. Engineering education, unlike other types of 'formal' education, hasn't a long history in Indian academia. It developed on the structure, imposed by the Britishers during colonial regime. The paper, in its preface, depicts social scenario in close relation to development. Scope of Indigenous technology, [which mostly follows an oral form of dissemination of knowledge among the ethnic population of India,] in the formal technological education curricula is critically analyzed in the next section. Third section synthesized the need of initiating research on indignations technologies for sake of sustainable development. Fourth section deals with empirical findings of the study, carried over the engineering teachers of India on their attitude towards 'indigenous technology and incorporation of thee in the formal engineering curricula'. Penultimate section depicts methodology and empirical findings of the study carried over psycho pedagogic status of engineering teachers in consonance with indigenous technology.
Index Terms –Curriculum, cultural shock, indigenous technology, psychographic status, sustainable development, technological education.

INTRODUCTION TO THE SOCIAL SCENARIO

Technology, being applied field of science, provides knowledge to satisfy human needs [and sometimes, human greed too] at the cost of the environment. Education, Science and technology provide knowledge through formal curricula and thereby help humanity to produce dramatic improvements to enrich human propensities and needs. Right now, we are in a landmark of human history, accompanied with enhanced intelligence and creativity, we are changing the basic components of our environment and thereby changing the environment as a whole.

Environmental Education in India possesses significant contribution from its history, which is reflected in the rituals of the people of this land since the Indian civilization came into existence. Accordingly, our norms, customs values, mores and over all, culture developed in such a way that follows the worship of nature and its various components, and thereby ensure preservation of the environment.

The basic form of development is to enhance 'creativity', which ultimately generates the potentialities of techno-capabilities. The ultimate significance of the present day is to empower people by enabling them to use and contribute to the worlds' collective knowledge, through 'appropriate curricula'. Recent Human Development Reports utter that richest one percent of the world population owns as much as fifty-seven percent of the resources and income. Therefore the role of technology in creating and generating resources is expected to follow the path whereby inequalities between rich and poor, developed and developing, be minimized. Discrimination among the people from varied ethnicity also needs to be erased.

Now a day waive of globalization is blowing across the planate, which thrives to achieve the objective of 'one-world-culture', also referred to as 'modernization'. The impact of modernization is influencing tradition-oriented societies, along with 'sanskritization' of the mainstream non-tribal folks. Sometimes it appears as a ***cultural-shock*** towards very group of indigenous people, which breaks down their family structure, society and culture. As a result, the groups are marginalized and are facing tremendous psychosocial pressure from the mainstream population.

Irrespective of several psychosocial factors, since the time immoral, tribal groups are positively responding towards the developmental aspects and issues, may be, the

extents of responses are different. They are having their own pattern of lifestyle, which draws a stable distinctive mark among them. However, all these communities are following their own ways of development, which is prominent from their 'lifestyle', and in this way, culture as well as use of indigenous technology is appearing intertwined among the very groups of population. Keeping in view the natural habitation within which they live and grew up, they evolve their own way of development, having significant variation with that of so-called civilized societies. The most distinctive feature of these two forms of development is that while the technology, used by the ethnic population at large is comparatively less expensive, less-dynamic and having less adverse impact over the social structure, the modern technology just possess the reverse features, most of the cases experienced detrimental to the environmental setting in due course of time.

Education is considered to be the key of (and for) development. It is a precondition for development. Unfortunately, even sixty years of intervention since independence in India, with a view to enhance their level of education, success is yet to be achieved. From the existing statistics, it appears to be a distant dream. Participation of indigenous population in formal education establishes the scenario. Shifting the attention from liberal education if one zooms views over technical education, obviously it will be much more shocking experience. Irrespective of special attentions and plans, participation of Indian tribes in technical education is quite meager. But why is it so? Aren't they aware about the fruits of technology? Are not they interested to use technology?

Experience reveals, since the early days various tribal groups, for the sake of their survival, utilizing good many technologies, commonly termed as 'indigenous technology'. In consequence those technologies has made their life 'more comfortable' and 'safe'.

HUMAN CAPITAL: THE EXPRESSION OF FREEDOM

In contemporary economic analysis, emphasis has, to a considerable extent, shifted from perceiving capital accumulation in primarily physical terms to viewing it as a process in which productivity of human beings is integrally involved *(Sen, 2000)*. For example, through education, learning and skill-formation, people can become much more productive in course of time, and this contributes a lot over the process of economic expansion. In recent studies of economic growth, often influenced by empirical readings of the experiences of Japan and the rest of East Asia as well as Europe and North America, there is much greater emphasis over 'human capital'. Human capital helps in enhancing the human capability, and in consequence, enhances the social and economic indicators of human development. Technical education directly contributes for human development. This is the very segment of education, which has its immediate impact over the society at large. Research in the very domain also helps to bring structural change in the society. Therefore with a view to achieve development, proper attention is needed over technical education and research.

Education (which helps human to imbibe both soft and hard skill) makes the human beings more efficient in production of commodity or in extending services, which is a human capital. These should add value to economy and also to the income of a person. But even with the same level of income, a person may benefit from education-- in reading, communicating, arguing, in being able to choose from alternatives in a more informed way, in being taken more seriously by others. The benefit of education thus exceeds its role as human capital in producing commodity. In consequences, if a person can become more productive in making commodities through better education, better health and so on, it is not unnatural to expect that he can, through these means, also directly achieve more and have the freedom to achieve more to lead his life. In this way, the process of development follows a rotating cycle and thereby accelerates the rate of development.

POST INDEPENDENCE SCENARIO

The last a half of century has transformed our environment, perhaps radically, and brought more changes in our lives and thinking than in any corresponding period in history. These are the consequences of discoveries of sciences and applications of technology. The concept of absolute knowledge in the sense of storing all knowledge is perhaps no more relevant today. Our efforts for reconciling the traditional concepts and ways with the demands of technological age, often argued, cannot provide simple solutions for our difficulties and complexities based on such stored knowledge. Frontiers of knowledge are themselves expanding rapidly making it possible to device newer and more efficient methods of solving problems of the society. Education must therefore make efforts for securing knowledge and mastering modern skills and methods than merely storing and distributing the traditional ones. For this purpose of training of mind and mastering of skills and for harnessing science and technology to profitable and productive processes of economic growth and social well being, the technological education system has to be continuously reviewed and adopted. This has indeed been the basis of our efforts during the last three decades, the result is that there is a well-organized structure and a wide network of technical institutions offering different types of programmes: craftsman courses, technician (diploma) courses, graduate and post- graduate courses, etc., catering to the various levels of knowledge, skills and competences required by the economy.

On contrary, the basic requirements for survival of any species may be termed as propensities. A list of human propensity includes *food*, *shelter*, *health* and *safety* (commonly known as survival propensities), *education*, *employment*, and at the present day, possibly the *various forms of agro and industrial development*, which, in the post modern society, shifted towards *development of information technology* and *knowledge-development* for the sake of maintaining life style (commonly known as developmental needs) and *security* as well.

Of course, we don't survive only on rice or bread. As human beings, our needs go beyond the purely physical

aspects and are immersed in social and economic environment as well. We do require meaningful employment and job satisfaction, environment, leisure and sequels of human qualities like respect, care and affection, mostly come under affective domain. Deprived of these, a person may languish just as surely as if deprived of food and water.

Most of our physical needs demand access to natural resources such as land, water and air, which, with the aid of radiant energy from the sun, generate plants and animals. The so-called non-renewable resource such as minerals and fossil fuels, are also needed for human survival and development. All these resources are present on a thin layer of the earth's surface, which we commonly termed as *environment*. It is the environment within which we live. Therefore it is considerably clear that the link remains among the environment, human beings and, their needs.

On the other hand, technology is the applied field of science, which provides knowledge to satisfy human needs and sometimes, human greed too, at the cost of the environment. Education, Science and technology provide knowledge and thereby help humanity to produce dramatic improvements to enrich human propensities and needs. Right now, we are in a landmark of human history, accompanied with enhanced intelligence and creativity, we are changing the basic components of our environment by adding synthetic and chemical products and by-products and thereby changing the *hydrosphere* and *atmosphere*.

Environmental Education in India possesses significant contribution from its history. Our epic ***Isho Upanishad*** uttered long ago, "*…this universe is the creation of the supreme power and is meant for the benefit of all; Individual species must therefore learn to enjoy its benefits by regarding themselves as a part of the system in close relationship with other species; therefore let not any one species encroach upon the right of others.*"

These thoughts are represented in the rituals of the people of this land since the Indian civilization came into existence, and since then, our norms, customs values, mores and over all, culture developed in such a way that follows the worship of nature and its various components, and thereby ensure preservation of the environment. However, this philosophy was attacked since the end of last century with the propagation of exotic-philosophies. As a result, the policy of education got boost from exotic agencies in such a way, which hindered the preservation of environmental resources. Being in Sanskrit, the *Upanishadic* thoughts have remained a close look far from us not only on account of the language barrier, but also due to the lack of good environmental communicators among those who know the *Sanskrit language*.

The basic form of development is to enhance 'creativity', which generates the potentialities of techno-capabilities *(Roy & Naskar, 2004)*. The ultimate significance of the present day is to empower people by enabling them to use and contribute to the worlds' collective knowledge. Recent Human Development Reports utter that richest one percent of the world population owns as much as fifty-seven percent of the resources and income. Therefore the role of technology in creating and generating resources is expected to follow the path whereby inequalities between rich and poor, developed and developing, be minimized. Discrimination among the people from varied ethnicity also needs to be erased *(Roy & Mandal, 2004)*. Each technological advancement possesses potential benefits and risks and also possesses widely varying capacities to handle those risks. The third world countries, as recent experiences says, becomes the worst sufferers of such risks. Technology in coming days is expected to eradicate the inequalities in absorbing or in preventing risks and shocks of technological development *(Roy, 2005)*. But how? To respond the query, one must accept the fact that it is only and only possible to develop a cadre of experts, well equipped with advanced knowledge and skill. Such skill and knowledge may only be imparted through appropriately developed curricula in the arena of technical and technological education and further, the same needs to be incorporated in an innovative manner. It is to be noted here that the terminology 'curricula' itself is an 'innovative connotation', starting from its sketching till its implementation phase.

INDIGENOUS TECHNOLOGY AND SUSTAINABLE DEVELOPMENT

Zooming our view over India, it may be observed that the country possesses massive variations so far its land, population, culture, and society is concerned. Among all those, it is probably the people, who exhibit a significant variation, resulting from massive cultural differences, including norms, customs, values and mores, and finally 'utilization pattern of technology'. The historic base of the nation up till now is essentially tradition-oriented. As a result a strong social-bondage prevails among the population of the country. These may be reflected by the social structure of the ethnic population, especially among various social groups, belonging to various tribes *(Roy, 2005a)*. These ethnic groups constitutes a sizable proportion of the entire population, numbered around nine crores, as estimated by the latest census report [i.e., 2001]. The ethnic communities are rooted with a number of clans; and inter-clan variations in terms of social customs are quite prominent in some specific regions. Whatever the cultural variations exist among them, all of these population-groups are related to unique umbilical cord and are referred to as tribes.

Now a day waive of globalization is blowing across the planate, which thrives to achieve the objective of 'one-world-culture', also referred to as 'modernization'. Modernization is essentially an old process following which comparatively less developed societies use to acquire characteristics of so-called 'more-developed' society in a given time frame *(Dube, 1988)*. The impact of modernization is influencing the tradition-oriented societies even through formal education, along with 'sanskritization' of the mainstream non-tribal folks. Sometimes it appears as a cultural-shock towards the very group of indigenous people, which breaks down their family structure, society and culture, all of which are not desirable, as opined by the sociologists. As a result, the groups are being marginalized and are facing tremendous psychosocial pressure from the mainstream population.

Irrespective of several psychosocial factors, since the time immoral, these tribal groups are positively responding towards the developmental aspects and issues, may be, the extents of responses are different *(Roy, 2005b)*. They are having their own pattern of lifestyle, which draws a stable distinctive mark among them. For example, in respect of formal education and literacy, one of the major parameter of development, while the hill-tribes of northeast India [i.e., the *Khasis, the Mizos, the Nagas* etc.] are quite in an advantageous position, the plane-tribes from the Chhotonagpur [for example, the *kol, the Vill, the Munda, the Bhumij, the Santhal, the Kheriar etc*.] are far behind. This justify that response towards developmental issues are creating 'some' differences among the tribal communities in terms of specific parameters. However, all these communities are following their own way of development, which is prominent from their pattern of house/shelter, sanitation system, use of water resources and its transportation, use of medicinal practices, food habits and drinks, musical instruments, dress habits, pattern of preventing natural enemies, communication modes and so on. Actually all these are the methods and modes of their survival-strategies, which contributes a lot for determining their culture. In this way, cultures as well as use of indigenous technology are appearing intertwined among the very groups of population. Keeping in view the natural habitation within which they live and grew up, they evolved their own way of development, having a significant variation with that of so-called civilized societies.

The most distinctive feature of these two forms of development is, while the technology, used by the ethnic population at large is comparatively less expensive, less-dynamic and having less impact over the social structure, the modern technology possess just the reverse features, most of the cases experienced detrimental to the environmental setting in due course of time.

INDIGENOUS TECHNOLOGIES AND THE SOCIAL SCENARIO

Education in general and technological education in specific is considered to be the key of (and for) development. Infact it is a precondition for development. Unfortunately, even six decades' of intervention since independence, with a view to enhance the level of education of the ethnic population, success is yet to be achieved. From the existing statistics, it appears to be a distant dream. Participation of indigenous population in formal education establishes the scenario. Shifting the attention from liberal education if one zooms his/her views over technical education, obviously it will be much more shocking experience. Irrespective of special attentions and plans, participation of Indian tribes in technical education is quite meager. Following table advocates the very fact, where in rare occasions, the levels of 'formal three-tire technical education system', the figure of enrolment of tribe students goes beyond 4% of the intake of their non-tribe counter folk. Data is also insufficient about dropout rates, if any and extent thereof.

But why the situation is so? Are not they aware about the fruits of technology? Are not they interested to use technology?

Experience reveals, since the early days, various tribal groups, for the sake of their survival, utilizing good many technologies, commonly termed as indigenous technology. In consequence, those technologies have made their life more comfortable and safe, which establishes the fact that the preconceived notion of so-called mainstream about lack of interest of indigenous people towards technology is mere a myth and not a fact *(Roy, 2005)*. Several sphere of life-activities viz. pattern of traditional shelter, room-ventilation and cooling system, protective-devices from enemies in the shelter, sanitation system in the shelter, method of water preservation, its use, and utilization as well as transportation, land utilization, food habit, food processing system, drink and dress habits, use of medicinal plants- all stands testimony to their close association with utilization of technology in different sphere of life; these are also coexisted with their society, culture and social norms. The societies imposed restrictions or taboos in these contexts. Different tribal groups use all these as indigenous-technology. Keeping parity with oral-culture, most of the cases knowledge concerned with indigenous technologies is disseminated from generation to generations mostly through 'verbal communication'. Unfortunately, due to massive waive of globalization, most of the cases these technologies are disappearing quite rapidly, due to its oral form of dissemination. On the other hand, reluctance is quite prominent among these ethnic groups towards so-called modern technology mostly due to the fact that this does not match with the lifestyle and culture of these ethnic groups. Therefore immediate intervention is needed to take up appropriate measures to revive the indigenous technologies. This is possible by identifying these forms of technologies and thereby incorporating those into formal and non-formal system of technical education as the components of curricula. The approach, if adopted, will definitely attract attention of the ethnic groups and will help in enhancing their attention towards technical education. It may be assumed that such education will further contribute toward their development, without effecting their lifestyle and customs.

Since the last eighty years, huge number of researches has been carried out, centering round the domain 'research on ethnic population'. Scholars from numerous fields tried to explore the tribes of India from their respective disciplinary-viewpoint. Sociologists, social anthropologists, historians, political scientists, educationists, economists, social workers, anthologists as well as philanthropists took up studies of varied kinds. Unfortunately the bulk of studies failed to develop these communities up to the level of expectation of the nation; and much astonishingly, technologists and engineers of the day rarely got time to explore the scientific bases of the indigenous technologies, used by these groups.

INDIGENOUS TECHNOLOGY: NEED FOR RESEARCH

In course of time, TRIBAL-EDUCATION has established itself as a well-recognized area of studies since 1950s *(Elwin, 1960).* However a careful analysis over the dissertation abstracts establishes the fact that not even a single study has yet been carried out emphasizing over the ***indigenous technology*** of the tribes in India. Dearth of application-oriented research is also prominent in the area of rural technology, where almost all of the studies have focused over such technology, which can be offered to the interested rural mass, and no way those studies considered indigenous technology and knowledge base, used for the ages by various tribe groups, as a factor. As a whole, out of around 6763 studies in the areas like sociology of education, tribal education, social anthropology and rural technology, it is felt essential to feel the gap of knowledge in the very area through appropriate study for evolving a practical approach for their development in its true sense. Such study needs to identify basic indigenous technologies as the core curricula components, used by the ethnic groups, residing in hills and plains of India, apart from exploring the beneficial impact of identified indigenous technologies among the ethnic communities, vis-à-vis the scientific bases of those indigenous technologies. Scope of accommodating indigenous technological components in the curricula of formal technical/technological education may also be accorded as the aim of such studies. Scope of introducing exclusive curricula at post-school-level technical education, incorporating components of indigenous technology may also be well examined through such research studies. To frame such curricula, basic dimensions to be addressed involves:

- Identification of basic indigenous technologies, used by the ethnic groups, residing in hills and plains of India.
- Exploration of possible beneficial impact to identify indigenous technologies among the ethnic communities.
- Exploration of scientific bases of indigenous technologies.
- Study of applicability of identified technologies for the development of ethnic communities at present juncture of time.
- Modification, if needed, to include in the identified indigenous technologies to accord those in formal technical education sphere.
- Identifying the scope of accommodating indigenous technological components in the curricula of formal technical education.
- Exploring the scope of introducing 'exclusive curricula' at post-school-level/ under graduate level technical education, incorporating components of indigenous technology.
- Exploring the scope of offering indigenous-technical-education for the community development in various tribal blocks of India.

CURRICULAR FACTORS

While exploring scope of indigenous technology, curricular issues and factors, needs to be explored by the curricula planners should essentially include

A. Indigenous technology in relation to-

a. Housing status and allied technology
b. Communication technology
c. Water, sanitation and allied technology
d. Preservation of natural resources
e. Environmental factor and protective-technology
f. Economy-sustaining technology
g. Health-sustaining technology
h. Medicinal/ pharmacy-technology

B. Developing integrity between curricula of existing formal technical education and indigenous technology.

C. Scope of developing/ offering a non-formal technical education curriculum.

In the process of initiating research on the very gamete of curricula studies, some basic axioms need to be taken into consideration by the researchers may be listed as follows:

- The ethnic groups, residing in hills and plains of India, use sizable number of basic indigenous technologies.
- Indigenous technologies posses' beneficial impacts among the ethnic communities.
- Indigenous technologies possess scientific bases.
- Specific indigenous technologies possess developmental-impact among the ethnic communities even at present juncture of time.
- Minor modifications are needed for the identified indigenous technologies to integrate those with formal knowledge base of technology.
- Indigenous technological components can be accommodated in the curricula of formal technical education.

All the possible indigenous technologies, with which they are/were familiar, need to be chalked out separately. Those would be further matched with the respective tribal groups, who are using those.

THE PILOT STUDY

In consonance, in the very direction, a surface level pilot study has already in progress, which hinges on exploring the scope of indigenous technology as formal technical education curricula in eastern and northeastern India.

OBJECTIVES

The study was initiated keeping in view the following objectives:

- To explore the scope of indigenous technology as formal technical education curricula as perceived by the enlightened section of ethnic groups in eastern and northeastern India.
- To explore the scope of indigenous technology as formal technical education curricula as perceived by the students, belonging to ethnic denomination and are enrolled in diploma and degree level engineering education in eastern and northeastern India.
- To explore the scope of indigenous technology as formal technical education curricula as perceived by the potential expert-groups in eastern and northeastern India.

FROM POPULATION TO THE SAMPLE

As in its pilot study phase, population of the study includes

A] **Enlightened sections of ethnic groups**: The group members include mostly the cross-section of tribe population involved in teaching or allied white collared jobs.

B] **Engineering students from tribe denomination**: The group-members are enrolled either in diploma or in degree level engineering education.

C] **Potential expert-group**: This third group includes academicians of the following types and is imparting education at higher education level

a. Curriculum planners
b. Sociologists
c. Technocrats
d. Educationists

The sample for the pilot study was drawn following a situational sampling technique. They are mostly residing in Assam [from northeastern region] and West Bengal [from eastern region]. Apart, forth group of sample is also scattered in Meghalaya and Delhi.

FINDINGS

Initial findings of the study reveals:

Average age of the first group of respondents is 48.5 years [with a variation ranging from 34 to 59 years]. The same in case of second and third groups are 25 and 58 years, respectively.

While grand majority of students group [93.33%] holds that they are not much sure about the possibility of incorporating indigenous technology in the formal curricula of engineering education, rest 6.66% strongly advocates for thee.

Above findings reveal that the existing formal education system is simply de-rooting the present generation students from their heritage and indigenous knowledge and thereby developing them as 'hollow man'.

Cent percent of the first group of respondents opine that tribe societies are having significant number of indigenous technology and such indigenous technology- components need to be included in the formal technical education curricula.

The first and third groups utters possibility of disappearance of important and potential indigenous technology and further adds that some such technology-components are already become 'forgotten' by the present tribe societies of their own.

The third group specifically advocates introducing 'exclusive' curricula, paralally with the existing formal curricula and they are not to that extent in favour of clubbing indigenous technology and ongoing technology curricula. This very observation makes significant difference between the perception of first and the third group of respondents.

Juxtaposition of opinion of the expert group, belonging to northeastern region and outside northeastern region exhibits significant variation in terms of 'need' of introducing formal courses on indigenous technology.

Offering of a 'hypothetical formal technological curriculum based on indigenous technology' while perceived by the first group of respondents as 'aught to be exclusive' for the tribe students only, the second and third group of respondents wants to offer the curricula of the kind to 'those who are interested on it, irrespective of social denomination'. Expert group [third group] expressed their serious concern over possibility of snatching the rights of Indian people in general over 'numerous indigenous technology' by the foreigner-scientists with the help of international patent act, which are, as per their version, 'yet to be recorded'.

It should be accepted by almost each and every hand that participation of tribal population in higher education in general and that too in higher technical/technological education, in specific, is too merge and needs to be enhanced. To ease the task, unitary technical universities needs to be established in the midst of natural habitation of the tribal population. As an alternative, the affiliating universities may also thought of developing 'technology-campus' in such zones, with a view to make 'indigenous technology' popular to them and others too, and thereby attracting them towards advanced technology through appropriately framed technology-curricula. Sooner the policy makers and curriculum framers took the issue as a serious concern, better it would be for the ethnic people initially, and for the nation, in course of time.

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