Economic Science And Technology Education For All Through Low-Cost & No-Cost Teaching Aids

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1. Introduction :

Ours is a developing country and Indian economy is mainly based on agriculture. Our strength is human knowledge recourses. Knowledge recourses can be manifested in to power only by the menace of proper Education to all. Govt. of India has taken a good project- ***'Sarba Siksha Avijan'*** to provide ***Education to All,*** a few years back and it is in action all over the country. But how far the aims and objectives of this project have been fulfilled after implementation!

In our country Education is under the concurrent list; both the State and Central Govt. are responsible for imparting the education for educating our children to make them a resource of the country. No doubt, Education system in India is quite well planed. But question arises- whether all of our young generations are being provided equal or at least proportionate opportunity to make their education? whether all educational institutions are not being provided equal or at least minimum infrastructure for imparting education to their students?

We have to find out our answer. In fact, Educational Institutions/ schools, those who are providing primary and secondary educations have been divided according to the socio-economic status of the citizen. And accordingly all schools in our country can be broadly categorized in to four groups. The first group (A) of schools may be called as elite schools; having huge infrastructure, well equipped laboratories with hi-tech instruments, libraries, good number of teaches and other amenities too; these are mainly for children of well to do families. In second group (B) of schools having adequate infrastructure, more or less well equipped laboratories with essential instruments, libraries, adequate number of teaches and

other amenities also. In these schools children of high ranking official and high middle class families. On the other hand third category of schools (C) having no adequate infrastructure, poorly equipped laboratories, with out bare minimum instruments, no so called libraries, and no adequate number of teaches. Most of the schools situated in village/ rural areas may be classified in this group. Condition of forth category of school (D) are worst; having no adequate infrastructure, class rooms and even teachers. They can not think about laboratory or library or play ground. Mainly children of slum dwellers and poorest of the poor families are coming to these schools.

All of us are well known that students of a Board or Council of a particular class have have to follow the same syllabus; whether he/ she is studying in category 'A' or 'B' or 'C' or 'D' schools. We also know that this is the area of Science and Technology. At school level up to class X, all students have to learn all subjects, including science, mathematics etc. So how the students of categories 'C' & 'D' schools would be able to learn Science and technology with out any laboratory or even any instrument, infrastructure? But in fact, it has been revealed that many famous scientists, technocrats, engineers, doctors have completed their school education form these third or forth categories of schools! How these miracles have been possible? it is the contribution of some of our dedicated teachers, having innovative ideas. They have developed their science, technology and mathematics lesions with the help of hand-made low-cost or no-cost teaching aids and sometime using the locally available toys and games. They great teachers have been using the nature and natural recourses, available in their surrounding environment as the open laboratories to make their life-science, geography and even technology classes. They have used the mental images of the students, created during their playing with toys and games out of school for developing the relevant classes.

It is indeed that motivation, dedication and obviously, innovative imagination and sweet relationship of both teachers and the taught can develop a lesion meaningful with poor infrastructure. In the present article it has been highlighted that how the science & technology teaching can be fruitful with the low-cost,

no-cost science kits/ teaching aids and toys & games.

For example- playing toys and games have an active role in the field of education, specially, in case of joyful science and technology learning. Methodologies of learning have emphasized on past knowledge and previous experiences. Progressive use of folk toys and games of increasing difficulty has a great didactic use as well as scientific and technological values. And these are very useful for changing children's 'non-scientific' ideas to start from the ideas they already have. Construction of toys and designing of games with the help of low-cost or no-cost scrap materials have the great importance for developing knowledge, understanding and skills of science and technology education. Previous familiar mental images help to clarify difficult concepts. Low-cost or no-cost teaching aids and toys & games can be used and make as demonstrative tools for developing mental images, which work as the facilitator and physical demonstrator. In developing countries, like ours, use of these types of Low-cost or no-cost teaching aids and toys & games would be helpful in illustrating complex concepts of science and technology lessons more simple and tangible; and help the children more accessible.

2. Playing is an Instinct; helpful for learning Science and Technology :

All most all children of all over the globe are fond of toys and like to play games; and it can be treated as an instinct. We also used to offer various types of toys to new born babies. Kids are not only play with toys; they like to see the toys, observe the movement of toys, or can hear and enjoy the sound of the toys. Even, crying babies also began to laugh after seeing movement or hearing the sound of the toy(s). They use to express their happiness with their tiny legs, hands and through laughing.

Growing babies try to hold the toy with their little soft fingers and legs, and try to play with the toys. They began to bite the toys frequently. Different baby chooses different types of toys. Love, affection and attachment of babies with toys are gradually developed by seeing, hearing, touching, smelling their favorite toys; which are basis of learning Science and Technology.

There are four stages of learning; i.e.- knowledge; understanding, skills and applications, which can be scientifically developed through activity based teaching learning process. Young children are clever enough to learn a lot, without being taught.

Majority of the rural children in our country, like India, are using low-cost and even no-cost folk traditional toys and hand-made toys and games. In some schools toys are being made by the children, particularly in work-education classes.

In village festivals various types of traditional and folk toys and games are being sold; most of which are made by villagers. These little economic toys and mere games are playing active role in the field of education, especially in case of Joyful Science and Technology Learning. In this connection it is to be noted that various experiments can be designed with the low-cost, no-cost and even household disposable materials; e.g.- Pin-hole Camera can be designed with the disposable squire box (either made up of hard-paper or metal), experiment of transpiration of a plant can be made with a piece of used transparent polythine bag and rubber band, and so on.

3. Traditional use and playing of Toys and Games:

All most in all countries, among all communities it is found that during festive seasons provide the greatest impetus for giving and receiving of Toys and Games to and from their relatives and friends. From the Archeological findings it has been revealed that Toy-making existed over 4000 years ago. And interestingly, it has also been revealed that many of the toys, which were used at that ancient time, are still being used today in one form or other.

In our childhood we are used to prepare toys, made up with papers, wood, clay, and other stay way / scrap materials; particularly during Puja Festival. We used to make kites and play with kites during September-October. We also prepared small chariot with the pieces of bamboo sticks, jute sticks and banana barks; simple telephone with two pieces of empty match boxes and a piece of string (cotton). We used to play *'patinga'* made-up of waste paper as well as bamboo

strips. We also made flutes of coconut leafs and of bamboo pieces; small cart with the scrap wooden pieces and whirls. We had also prepared flowers, birds, and animals, with scrap as well as coloured papers too. We used to learn these techniques and processes of hand made toys and games traditionally from our grand mother, uncles and the seniors of our neighborhoods. We also played *'Pittu'* (seven pieces of broken tiles and a cheep rubber ball); *'Kanamachi', 'Guddi', 'Ha-do-do', 'Sita Haran', 'Thief-Police', 'Tang-guli'* and so many traditional folk games.

4. National Curriculum Framing for Science and Technology Education:

During 1960s and early 1970s the major curriculum development activities in primary school science had been carried out in UK and USA. The UNESCO publication *'New Trends in Primary School Science Education-2'* indicates that both the countries had emphasized on 'Child-centered Inquiry and Discovery Learning'.

In developing countries curriculum development had been flourished during 1970s. In methodology it had been emphasized on past knowledge and previous experiences, which in many cases would be toys and games, then the new arrivals. Moreover, home, nature and natural phenomena have the great role in fostering Science & Technology Education; but for this students have to develop the observation ability/ power and have to make it in practice. Okeke(1984)[1] had discussed how home can act as supportive agents to science education of children drawing attention to the potential for science & technology teaching through day to day common house-hold activities. These activities can be developed in rural schools, and even schools of town and cities, where economically poor students are taught for developing their understanding, skills and problem solving abilities (application) of science and technology education (i.e.- counting, measuring, observing, comparing, inferring etc) among the children.

5. Process-vs.-Concepts of Teaching Science & Technology:

One of the most important issues of teaching science and technology, particularly in primary level, is relative emphasis upon *process and concepts*. The process skills are observation,

interpretation of observations and of data inference, prediction, hypothesis, classification, communication, planning, investigations and combination of all these; which have to be developed for carrying out investigations.

The associated attitudes of science and technology are generally including respect for evidence, curiosity, critical reflection and sensitivity to living things and environment. When process and altitudes are considered as the main focus, then the role of specific content is played down.

A class room research done by *Osborne and Frecyberg (1985)*[2] about interaction of *process and concepts* in learning has shown that children often maintain *'their own ideas'* despite having been 'taught' ones which are more scientifically 'correct'.

UNESCO[3] has pointed out that *"the best way to change children 'non-scientific' ideas, it is suggested, is to start from the ideas they already have and to help them to test out both their own and others ideas, using evidence to decide which ideas are most useful for making sense of things around them. So the use of process skills is fundamental to development of more acceptable and useful concepts".*

And so children have to be encouraged to observe different things about objects and events they play, they act and they study. Students should be encouraged for making, designing science and technology experiments and teaching aids/ kits; and also toys & games by using low-cost, no-cost and household disposable materials. Through these play-away activities all steps of learning process (i.e,- knowledge, understanding, skill and problem solving abilities) will be developed spontaneously within the students.

The interdependence of process, skills and concepts in learning and development of each has to be pursued simultaneously in children's science and technology experiences. So activities to be designed for encouraging process skill development in isolation from concept development.

6. Progressive use of Toys, Games, Low-Cost and No-Cost Teaching Aids for learning Science & Technology:

Progressive use of low-cost, no-cost teaching aids/ science kits, toys and games of increasing difficulty would be very useful for developing Science and Technology Lessons. However, these to be selected from the materials which are available from the locality, or to be made from the no-cost or low-cost materials.

"Before children can understand a thing, they need experience: seeing, touching, hearing, tasting, smelling, choosing, arranging, putting things together, taking things apart, experimenting with real things". (Gupta. A 19, retrieved on 20.05.2011)[4].

Low-cost, no-cost teaching aids/ science kits, toys and games to be selected not only for introducing new topics on science and technology, but also for developing some of the process skills with definite concepts. Use of above noted economic materials can also facilitate the transition of knowledge, understanding and skills of science and technology learning from primary level to secondary level. Construction of economic science kits and toys, assembling, cleaning, re-assembling of part of those kits and toys, designing of games generally develop the science and technology literacy (STL). These types of economically affordable experiments, teaching aids, toys and games to be selected from the existing one, or to be developed locally from the low-cost, no-cost or scrap materials, applying traditional or improvised methods. Individual student or a group of students may be encouraged to do the play. So that economically backward students would be able to take proper Science and Technology Education, even from the 'C' or "D' grade schools.

7. Didactic use of Low-Cost, No-Cost Teaching Aids, Toy and Games:

Each and every economic science kits, toys, either folk toys or sophisticated hi-tech toys or game; and even computer games and toys, have a great didacticism, as well as scientific and technological values. Because, often all these teaching aids and toys are being made up of various materials utilizing physical principles, based on mechanisms and obviously made by hand. These children are very much interested and get motivated by designing experiments, making science kits/ teaching aids or building toys, as well as playing games. Through these active participation play-

ways process students do easily and quickly learn various techniques and methods of using different tools. On the contrary, modern sophisticated instruments, toys and games do themselves everything; children are spectators only; they have no such active participation in making or designing the experiment of playing toys. But making science and technology kits, designing experiments with the locally available materials and using traditional folk toys and games have an inner valuation with the children.

Preparing/ designing/ assembling science kits, toys and games with the collected throwaway materials provide great opportunities to both parents and teachers to get down in the children and tuning themselves into the same frequency as their won childhoods and students-lives. And these help them for communicating in a more pleasant way. Teachers can also utilize toys and games for making science and technology lessons an interactive and joyful one. Teachers can involve and introduce students in designing and utilizing no-cost or economic science kits, toys and game as the tools for training scientific and technical abilities, and explain what technology (mechanics) and science are behind these activities.

In higher classes group research project can be conducted on designing experiments, projects with the easily available low-cost/ no-cost materials as well as description of toys and team games, which are played in their own neighboring localities. Comparison between technological variants and of the rules of the experiments, toys and games from different socio-economic and geographical areas may be made; which has an anthropological value too.

Playing with hand made/ economic science and technology kits, toys and games may be of individual or team work. But team works/ activities have the great values for developing team spirit, cooperation attitudes and decision making skills. Through these team-activities children learn cooperation and develop friendship. But on the other hand, those who are playing hi-tech/ computer games, they probably are in isolation and will have faced problems for dealing with others.

In this connection we should recognized contribution of Armando Borchi[5] who has collected and had making various toys, and had also displays toys in village festival. Another notable person Anna Busacchi, a junior high school teacher in Bologna, had contributed a lot by designing making various simple hand made toys and also presented a descriptive text books of the toys.

8. Role of Low-Cost, No-Cost Teaching Aids, Toys and Games in Science and Technology Education:

Making, designing and playing with low-cost, no-cost teaching aids, toys and games have a great role in early development of childhood. Play is a means of working off aggression; as a means of learning basic skills of survival and social behavior as well as means of relaxation. In the modern era, hi-tech instruments, well equipped laboratories are being used in 'A' grade schools. Computer games become more popular and as a result software components related to video/computer games have been developed quickly. Children can rapidly learn how to operate computer through exposure to games as they are motivated to do so. Computer games can stimulate the children which are being reflected in the classroom and laboratory when young students learning science and technology in the later years of school education.

But most of the rural schools (categories 'C' & 'D') in developing countries have no such opportunities for using hi-tech instruments or well equipped laboratories and even computer facilities for the school children. Again most of the rural children have no exposure to the computer, even out schools. These schools can facilitate their early experiences in learning science and technology through toys and games. Most of the rural students are used to play folk toys or hand made toys, and traditional games at their early age of development. In schools they used to learn science and technology subjects as per directions and instructions of their teaches concern.

Experiences of participation in games, playing with toys and doing/ designing of experiments can be scientifically used for teaching and learning science and technology in and out of school. Different types of low-cost and even no-cost materials or scraps are being used for

making kits, preparing toys and games, which are used as teaching aids. In this process students may be encouraged for actively participate in collecting the materials, designing experiments, science kits, toys with or without help of a teacher to arouse their interest understanding and skill for the said purpose.

Above mentioned activities and playing may be individual or group activities. However, group activities to be encouraged for developing co-operative behavior, shearing of ideas, respect to other and motivation for discipline maintenance. After the group works individual student may be asked to design and frame similar (not same) science kits, experiments or toys and games to arouse their interest in science and technology education. Through these active participation creativity and problem solving skills of the students should be developed in a scientific and harmonious way. In this process they may associate the mental images, understanding and past experiences of their early childhood.

9. Comments:

Generally science and technology teaching are being held on the basis of explaining abstract concepts. But a physical models (both descriptive and functional) and demonstration have more effective in Science and Technology Education (STE). Sometime previous familiar mental images help to clarify difficult concepts.

For the development of a country only **"LITERACY"** movement can not do much alone, unless all citizens are covered under **"SCIENCE AND TECHNOLOGY LITERACY (STL)"**. It should be noted that Science and Technology Literate citizens are the resource of a country; and prosperity of a country depends upon the literacy as well as science & Technology Literacy rate of its citizens. Slogan of ***'Sarba Siksha Avijan'*** should be ***"education for all and make all Science & Technology Literate'***.

To achieve this goal Science and Technology Education should be ensured at school level in all schools, whether it is situated in cities or town or at remote village.

For disseminating ***Science & Technology Literacy*** among all and universal elementary ***Science & Technology***

Education at all schools for all students low-cost and no-cost teaching aids, Science and technology kits and even folk or locally available common toys, games and common house hold appliances, even scrap, can be used as demonstrative tools for developing mental images of students. This type of teaching science and technology may be taken as a movement and slogan may be ***"Economic Science and Technology Education For All"*** with the help of low-cost, no-cost teaching aids and folk toys and games.

In this connection it may be noted that often a mental image (previous experience) works as a facilitator or physical demonstrator. Use of low-cost or no-cost or toys and day to day objects help in illustrating complex concepts of science and technology lessons more simple and tangible; which help the children more accessible.

Mental image of childhood playing with toys and games, day to day experiences and examples help children to visualize or manipulate the concepts in simpler way and promotes more effective learning, particularly in case of Science and Technology Education to make it a joyful learning.

No-cost and easy available material can be used for explaining various scientific and technological phenomena, for which no cost will be needed. As for example- if colored flowers put in milk, after sometime white milk will be colored, process can be explained and demonstrated by the teacher. China-rose (Jaba) petals may be used for preparing litmus-paper, which can be used for testing of acid and base. 'Wind-wheels' may be used to explain the use of force of air. In toy-cart wheels are reducing friction, etc. These type of teaching-learning process be called as ***"Activity Based Economic Science and Technology Education"*** with the help of low-cost, no-cost teaching aids and folk toys and games. In this process of economic science and technology teaching role of teachers as well as State and Central Governments are concern. Government has to ensure for providing minimum infrastructure and proportionate financial assistance to all schools. Teachers have to be dedicated, motivated, active, innovative and student-friendly. Guardians have to be cooperative and

sympathetic. Students are always receptive, but our duty to make our students active by involving them in ***Activity Based Economic Science and Technology Education.***

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