EDUCATION IN PHYSICS FOR RURAL CHILDREN

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Educationally, we must know that concepts of physics grow gradually. There cannot be light all at once. For example we all know that force is a mass of an object multiplied by its acceleration. But do you know how long it took Newton to reach at that simple equation. And before him, Galileo's ideas on motion of objects. It took centuries for the common man to accept the idea of zero. Light is a wave was not accepted for a long time. Einstein was never awarded the Nobel Prize for his ideas on relativity.

First, we note that our target is rural children. We shall look at the deficiencies of physics curriculum planning which I had experienced as an administrator. Then we shall make a few assumptions for designing a physics course for the school children of rural areas. But before these postulates, we must look into the rural conditions as prevalent today. And also, what is physics?

The last question appears ridiculous? Who does not know that physics is a study of matter, energy and the effects of energy on matter. I recall the topic being discussed is 'physics education in rural areas'. The word 'physics' qualifies the noun 'education'. I think that there are three features of physics. One, the content of physics by which I mean facts, concepts, principles, models, i.e., hypotheses, equations relating different physical quantities. These equations represent the epitome of experiences over centuries. We can describe facts by observation, check them by experiments, i.e., acquiring information, and explain them by a theory. The second feature is the method of physics. No one method is known to us. But some steps of the method can be noted, namely:

1. Observation and measurement
2. Comparison
3. Drawing inferences (discovering a relation between physical quantities)
4. Interpretation.

The third feature is the values of physics which constitute the scientific temper. Some values of physics are:

1. To be fair
2. To keep mind open
3. To discard superstitions
4. To develop the spirit of enquiry.

The only way to learn these values, is through the example and practice by the teachers in the

classroom.

Science and Basic Education

Early attempt to teach science including physics is incorporated in Basic Education. Mahatma Gandhi proposed Basic Education for rural India. Its main feature was craft. All subjects, including physics, were correlated with craft. Most people came to regard this Project as designed for the backward classes. It failed educationally also. The difficulty was in the correlation. Once I discussed the correlation of humidity (a topic of science) with weaving craft. The science teacher described the co-relation in terms of experiments of the composition of air by volume. Was it a correlation? Any villager knows that the presence of water vapours in air affects the strength of cotton fibre.

Physics Education and Human Resource Development

The USSR launched a satellite in 1954. The Americans and the Britishers were spurred to think on improving the quality of physics education. In mid-sixties India felt the need of science education when China invaded. For human resources development, one priority sector was basic education. The education policy devotes one para or so, to science education. The policy requires to develop manpower with scientific temper. The first step is to frame the syllabus for different classes. But who frames the syllabus? A school teacher? A college teacher? A university teacher? A teacher-educator? Perhaps, all together. A college teacher regards each student as a potential doctor, an engineer or a scientist. A teacher-educator thinks that the classroom teacher has a limited teaching ability to pass on the knowledge of physics owing to the varied nature and nurture of the rural students. This is an inherent limitation. The syllabus is finally agreed. But the issues, for example, whether the concept of speed or velocity be introduced in the primary courses are hardly discussed in the light of the educational needs of the society. These issues are crucial for classroom teachers.

But what are the rural conditions? In general the conditions of the rural people can be described by their characteristic poverty, illiteracy and social backwardness. Apart from the superstitions, the non-availability of safe drinking water and epidemic of common diseases are hard facts of rural life.

We know that 77% of our population is rural. It is broadly agriculture labour or self-employed in non-agriculture. Both sections are poor. They differ in the degree of poverty. So, poverty factor must be considered while planning physics curriculum for rural children. It does not mean that physics is different for rural people. The ideas of physics are the same but we can give a certain level of concept which is really useful for improving their quality of life.

Literacy

About mid-eighties, the literacy was 36% in India (47% M; 25% F). Again the school enrolment was 54%. This means 46% children did not join any school and are likely illiterate parents of the next generation. This figure is significant. It implies a constraint on physics curriculum. It is a known

fact that for every 10 children who join a school, 7 drop-out before they reach high school. So physics must not scare them.

Social Backwardness

Added to this is the stigma of the class system which has developed a permanent set of contempt for one status below the other. Not only that, the top class exploits the lower class. For example, many taboos, superstitions and traditions are simply to perpetuate the class system. The atrocities on Ambedkar are an example. The stigma sticks to a class like a scar on a body. Physics must help in breaking this habit of thinking.

Educational Facilities

In many primary schools in rural areas, the classes are held in the shade of a tree, may it rain or storm. Operation Blackboard is an index of the dismal educational conditions in schools. The teaching of physics must be appropriate to these conditions.

Model Schools

Is the idea of model school educationally sound? What is model about them? A particular dress; enormous fee and funds; a heavy bag. Middle class families consider it a privilege to send their children to model schools. It appears to be anathema in an Indian society, particularly in rural areas. The idea exploits the middle class commercially. Kothari Commission never recommended the idea. Anyone can find that a model school child learns the facts of science without comprehension. For example, a model school child knows ebullition as boiling of a liquid. But what is boiling? He may not understand. Since the young mind is very fertile and sharp, he can remember the facts by heart. The parents are satisfied. And here lies the tragedy. Do you want this kind of physics for the rural children? Perhaps this physics is not suitable for rural children. This is the kind of liberal education which no doubt broadens the mind but has limited employment opportunities especially for villages. I call this 'babu education' which alienates the children from their own rural society.

Science Education Programme and Experiences

The NCERT prepared the physics curriculum for different classes. It was felt that the teaching of physics required doing experiments. And for that, the idea of science kit was accepted. Thus the science kit was the mainstay of the Project, 'Science is Doing' was the slogan.

To start the programme, the UNICEF gave some aid and science kits to the pilot schools. This kit contained a few tools. The purpose was to let teachers innovate, improvise and design their own experiments, if and when required, to explain or describe a concept of physics. But the teacher never accepted the idea of 'doing' in practice due to the social prejudices against doing work
with hands.

Once, on my visit to a rural school, I found that the science kit was kept locked away from the school. The teacher said, "Sir, the students spoil the kit items. So, I do not allow them to touch these." Thus the provision of a kit did not materially change the style of teaching towards

'doing' science in the classes. It was you-read-method.

Educationally, curriculum planning suffered from inadequacies. For example, the idea that solid consists of tiny particles, called molecules, was demonstrated in the class with the help of marbles in a tray. At the end, to a question, what is a molecule? Quick came the answer 'Marble, Sir'. The classroom teacher was satisfied.

Again, one objective of the Project was to develop an enquiring mind. This implies answers to the questions raised by the children in the classroom. But we all know that no teacher likes questions in the classroom. Indeed the teacher is oblivious of this objective. The spirit of the programme seems lost somewhere.

Lastly, the School Board played little role in the planning of science curriculum. I have an experience. In the middle school examination a question was set in the science paper: Describe the gold leaf electroscope and label its parts on a sketch. One boy, in a pilot school, made the diagram as he had seen in the science kit, i.e., rectangular shaped. The teacher awarded him zero mark. The sketch did not conform to the bell-jar shape given in the textbook prescribed by the school board.

Further, the inability of States like U.P. to supply the science kits gave forth the idea of using environmental situations and local resources. The 'doing' element was retained. But this innovation, too, did not succeed. It was a difficult challenge for the teachers.

So my experiences convince me that any idea for rural physics education will find acceptance only if viewed in the light of its usefulness, rural needs and the teaching abilities of the rural teachers.

Assumptions

Considering the above discussion, we make three assumptions for designing a physics course:

1. Primary education is likely to be the whole education for most of the Indians for their whole life. Very valid, even after 45 years of independence, we have not been able to fulfil the constitutional obligation of providing elementary education to all school-going children. That is why the added problem of the swelling number of illiterates; increasing population, poverty and social backwardness. So, physics must be useful and meaningful.

2. Educationally, we must know that concepts of physics grow gradually. There cannot be light all at once. For example, we all know that force is a mass of an object multiplied by its acceleration. But do you know how long it took Newton to reach at that simple equation. And before him, Galileo's ideas on motion of objects. It took centuries for the common man to accept the idea of zero. Light is a wave was not accepted for a long time. Einstein was never awarded the Nobel Prize for his ideas on relativity.

3. The laws of the nature are the same for rural people as for urban people. Also, rural needs are not different from urban needs. The basic requirement is 3 R's. The science at

most can be descriptive and/or experimental within the social and physical environment of rural people. Observation and measurement should be at the heart of the classroom lessons. So, I postulate that the development of the descriptive ability is the foundation of physics education and must be dominant in the teaching of physics.

Physics Course

With these assumptions, we propose a physics course for the primary schools. It is open to be accepted or rejected or altered to suit rural needs. We can choose our own path, i.e., course, method and values of physics provided we keep to the national goals and the rural needs. The path will shine if we follow Buddha's advice – observe yourself and think in the light of your own observations.

1. Some properties of matter and forms of energy
2. The effects of energy on matter i.e., a substance expands: a solid melts: a liquid boils. The concept of temperature.
3. (a) Machines e.g., lever and wheel
   (b) Thermometer
4. (a) The measurement of distance, mass, time and temperature.
   (b) The idea of speed as distance over time (distance-time relation).

The suggested topics have a tremendous scope for teaching physics as discussed in the paper. Useful and smart, and not fat, courses can be popular. The beauty lies in the classroom planning. And this implies support for teachers. It is the power of the argument and not the argument of power which wins the people to your corner. Therefore the concepts of physics should be educationally researched, experimented and debated well. Here lies the role of the IAPT which can set up a few consultancy centres of physics education to provide opportunities for meeting of teachers and specialists.

The Education Experts

'Know thyself', Socrates said. We, as technical experts, can be strong forces to bring about educational change. Non-experts give ideas which are often not fruitful. Recently, an idea of a Rural Model School was floated to prevent standards from deteriorating at +2 level. I fear this idea is conventionally to look at the problem upside down and that too laterally.This thinking disregards the foundation, i.e., the primary schools upon which the whole structure of education and in turn the welfare of the society depends. We know that the political idea of Adarsh Schools in rural Punjab did not succeed as expected.

Also, the imported idea of science kit introduced without a debate on its educational potential vis-à-vis rural conditions did not yield the desired results. Again we know that under the UNICEF and UNDP Programme a large stock of science apparatus and equipment was distributed to the Teacher's Training institutes. The stock contained very ordinary items like wooden metre rods, test-tubes, beakers, etc., for which abundant, cheap and best quality substitutes were available in India at Ambala, a town known for its scientific educational industry. Not only

that, the electrical equipment after sometime became junk: the Bakelite was not suited to tropical conditions and also the pin points were rectangular unlike cylindrical in India. But none was made accountable for this mistake.

In conclusion we may say physics should largely be descriptive or experimental. The curriculum must be smart and flexible especially for elementary education. The methods and values of physics must form part of the classroom lessons. And this requires the support to the rural teachers. For this support, the centres of Physics Education should be set up by voluntary organisations and teachers' unions. The school Boards can also be approached to set up similar centres where the subject experts debate on issues and resolve the problems of curriculum development.