PROBLEM-SOLVING ORIENTATION IN EDUCATION

This paper puts the case for Problem Solving orientation in education, particularly school education. After describing what problem solving means, it discusses why problem-solving orientation is necessary and then suggests how this could be introduced in school education.

What is Problem-Solving?

It is common practice in most schools to give "problems" in mathematics to students for drilling the skills. This is not the problem solving we have in mind. Nor is it the kind of "brain-teasers" or quizzes that are published in popular magazines, with the correct answers being given overleaf.

All of us get Involved In some activity. While we can go through most of it, without consciously thinking of it, there are occasions when things go wrong and our thinking process is called into action. The housewife has to prepare tea for a visiting friend. She can go through the acts of boiling the water, taking out the tea leaves, laying the table etc. on "auto pilot", while her mind Is busy chatting with her friend. When she goes to the tea packet, if she finds the packet empty, her mind is suddenly called into action and she has to think what she should do next. Should she make coffee instead, or should she use the "tea bags" the salesman left three days ago? This is a trivial example of problem solving. Every one of us has to solve problems - even the laziest among us solve their problems, often bypassing them.

Every problem is a challenge we face. Most of them we solve easily. The more difficult we tend to postpone or bypass. But rarely do we consciously face a problem as a challenge or an opportunity. If we do and we succeed in solving such a problem, we get the feeling of a breakthrough, and the experience gets etched in our mind perhaps for the lifetime. This is the kind of problem solving we want to be oriented for - where there is a consciousness of the nature of the problem, which evokes a challenge feeling and when solved partially or completely, gives a "Eureka" feeling. After the problem is solved the individual is distinctly wiser and more experienced than before.

At present our education system ignores this kind of problem solving. It assumes that when the required background information is available, it will be applied and the problem will be solved. Most students bring the activity to a halt and wait for further Instructions, while some bypass the problem without solving it. This is often at the cost of the quality. The few who take up such problems and follow them through have the stuff of which inventors are made. And that is the orientation we want to give – every one making little Inventions or big inventions as the problems turn up. The problems that great thinkers grapple with lead to discoveries. The problems that everyday life throw up lead to Inventions. Without belittling the Importance of great thinkers, in our country today we need millions of little inventors rather than a few great thinkers.

Every one, even the dullest, can indulge in problem solving and make little inventions. Many of them may not be even worth noticing by others, but to the individual they do immense good. Today we need to train students to be such little inventors and our progress will depend on how many of them we can turn out.

Why Problem-Solving Orientation?

Problem solving converts information into knowledge. Information is stored in books and libraries and in our memory. When we put information to use, it gets converted

into knowledge. So knowledge is that information which has been stored in memory after testing it in action.

When we are given a formula say: E = m c 2. Where E is energy m is the mass of matter being converted into energy and c is the velocity of light; one cannot be expected to be able to use such an equation straight away - even if one is good in arithmetic. One has to be able to choose the appropriate units that are compatible with the formula. Only after one has used the formula a few times, does one feel sufficiently at home with it. The information about the formula becomes knowledge about its use. In problem solving, design, construction and assembly or other activities are very effective in converting information into knowledge.

When we read instructions on the use of a product, e.g. an adhesive, we have information. When we have used it a few times, we have knowledge about the product – the adhesive, and its use. When we use this adhesive as a part of our problem solving (say to make a prototype) we get insight into what the adhesive can do and, equally important, what it cannot both are important pieces of knowledge. Problem solving always produces knowledge that is m 5:h more useful and valuable than the information on which it was based. The difference is the expertise. Problem solving generates this know-how.

Many students come to halt in their practical project because they do not know how to calculate a certain parameter. In real life situations, there are many things, we cannot calculate and predict; yet there is an empirical method available. One must know when to use the empirical method and when to use calculations and design.

Calculations and design formulae are themselves, as often based on empirical data as on the scientific knowledge. Often empirical knowledge leads to new technology and the scientific understanding follows later. Problem solving gives a proper balance between an empirical approach and a scientific approach.

Problem solving in our. Sense teaches patience, judgement between alternatives, self-evaluation, and all those qualities that are invaluable in real life. This is because when problem solving is part of the curriculum, we are putting a real life situation, chosen for its shorter time duration.

By our definition, problem solving gives the "eureka" feeling when the job is successfully completed. This joy has its own effect on increasing motivation and should lead the students to take up greater challenges. Thus in a way, it induces the pursuit of excellence. Civilisation has been built on this - each one sharpening his own skills doing always better than his best. Problem solving exercises provide an outlet for creativity and thus encourage it.

How to orient: for Problem-Solving:
The weakness of 'exercises' or 'problems' given in the classrooms at present is that they have an answer, which the teacher knows and anything else is considered wrong. Also it does not involve physical activity and gives little scope for action stimulating thought. It provides very little scope for creativity.

On the other hand our problem solving involves physical activity and there are many possible approaches and no body knows the final answer. This is more like a real life situation and gives the advantages we discussed earlier. We can consider these as open-ended exercises. Example: We need to cut a large number of triangular panels with the three sides of the triangle being 1.2 m; 1.23 m and 1.23 m. The steel sheets from which these panels are proposed to be cut come in widths of 3ft or 4ft and

lengths of 6ft or 8ft. What size sheets should we buy and how should we cut the triangles? This is a real life problem. If we adapt it for the classroom, we will be defining every thing and therefore reduce the number of possible approaches, and opportunities for creativity.

It will then be only an exercise in arithmetic. When a problem like this is posed, one could come back with an answer such as finding a good value for the scrap produced or finding a source that give a more suitable size of sheet, then those given, thus enabling a least cost solution to the problem. Thus in problem solving orientation, we remove boundaries not only of the approaches but also the input data. The information given is considered only a guideline and not as complete or sacrosanct. The whole point is to reach the target -in this case the reduced cost.

Another approach for generating exercises for giving problem solving orientation is to try to find new applications for an existing product or technique. For example: we know how to make square nets. What are all the applications where this skill may be put to use? Some of the answers could be: Volley ball nets; baskets, hammocks; sheep enclosures; there could be many more answers, depending on the experience 'and creativity of the students.

It is true that such exercises, because they involve materials, are likely to involve higher costs. But they can also produce physical assets and could be used to offset part of the cost. The cost of such exercises can be reduced by making models, in place of the prototype objects. This however reduces the realism, but does not limit alternate approaches and therefore creativity.

Physical activity has, however, such a stimulating effect on generating new ideas, that once the activity starts, many new ideas for problem solving exercises will suggest themselves.

To facilitate selection of such exercises for this programme, all problems selected, and the different solutions tried should be recorded along with their shortcomings and strengths. Such recording not only consolidates the knowledge but also brings out the scope for new improvements in the problems to be given.

Problem-solving orientation is relevant for all students, but is most essential, and presently conspicuous by its absence in technical education. It may by worthwhile to make a beginning in technical school education, to give problem-solving orientation to education. Other schools could give problem-solving slant in their work experience and social service classes.

Some suggested Projects for Schools:

1. To make a "football", that 4s as near a sphere as possible, (shape)
2. To make a rope ladder for descending into a well. (Light compact, safe)
3. Make a wheel - hub + rim - from straight components, bent into shape, (accuracy, cost, strength)
4. To make a folding 'knife' using spent shaving blades. (Safety, elegance)
5. To make a folding easy chair or scale model, (weight, cost)
6. A "post office" balance for weighing letters upto 100 g. (cost; ease)
7. To make a device for weighing a cow. (Ease of operation; cost)

Such examples could be multiplied. Initially, the teachers and students will find the problems very difficult. This is no cause for despair - it is part of the education. They should start; notwithstanding a high rate of "failures" These are not failures. They are necessary learning stages. Even while they progress, the students could think of new projects. These projects may be taken groupwise or individually depending on the

ease of getting materials, cost etc. The time allowed may also be adjusted, but should not be to long; a month may be a good interval to start with. It is too long; students do not give serious attention, until the time limit comes close.
We expect that once started, problem-solving exercises will be fun and enjoyed by all.

S. S. Kalbag