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This is a journal on education that is brought out annually. It is an anthology of writings by educators, teachers and thinkers exploring a new vision of education in its many dimensions—philosophy, psychology, classroom experience, curriculum, nature and environment and contemporary issues. It lays special emphasis on J Krishnamurti's principles of education. It will be of use to teachers, parents, educational administrators, teacher-educators and to any individual interested in education.

Contents

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Teachers or educators are human beings. Their function is to help the student to learn not only this or that subject, but to understand the whole activity of learning; not only to gather information about various subjects, but primarily to be complete human beings. These schools are not merely centres of learning, they must be centres of goodness and bring about a religious mind.

All over the world, human beings are degenerating to a greater or lesser extent. When pleasure, personal or collective, becomes the dominant interest in life—the pleasure of sex, the pleasure of asserting one's own will, the pleasure of excitement, the pleasure of self-interest, the pleasure of power and status, the insistent demand to have one's own pleasure fulfilled—there is degeneration. When human relationships become casual, based on pleasure, there is degeneration. When responsibility has totally lost its meaning, when there is no care for another or for the earth and the things of the sea, this disregard of heaven and earth is another form of degeneration. When there is hypocrisy in high places, when there is dishonesty in commerce, when lies are part of everyday speech, when there is the tyranny of the few, when only things predominate, there is the betrayal of all life. Then killing becomes the only language of life. When love is taken as pleasure, then human beings have cut themselves off from beauty and the sacredness of life.

Pleasure is always personal, an isolating process. Though one thinks pleasure is something shared with another through gratification, it is actually an enclosing, isolating action of the ego, of the 'me'. The greater the pleasure, the greater is the strengthening of the 'me'. When there is pursuit of pleasure, human beings are exploiting each other. When pleasure becomes dominant in our lives, relationship is exploited for this purpose, and so there is no actual relationship with another. Then relationship becomes merchandise. The urge for fulfilment is based on pleasure, and when that pleasure is denied or has not found means of expression, then there is anger, cynicism, hatred or bitterness. This incessant pursuit of pleasure is actually insanity.

All this indicates, doesn't it, that man, in spite of his vast knowledge and extraordinary capacities, his driving energy and aggressive action, is on the decline? This calculated self-centredness with its fears, pleasures and anxieties is evident throughout the world.

What, then, is the total responsibility of these schools? Surely they must be centres for learning a way of life that is not based on pleasure, on self-centred activities, but on the understanding of correct action, the depth and beauty of relationship, and the sacredness of a religious life. When the world around us is so utterly destructive and without meaning, these schools, these centres, must become places of light and wisdom. It is the responsibility of those who are in charge of these places to bring this about.

As this is urgent, excuses have no meaning. Either the centres are like a rock round which the waters of destruction flow, or they go with the current of decay. These places exist for the enlightenment of humanity.

From *The Whole Movement of Life is Learning, J Krishnamurti's Letters to the Schools*

Editorial

The world over, we lament the state of education. We might observe directly the plight of a generation of young people weighed down by the burden of seemingly meaningless academic curricula and indifferent teaching practices, alongside spiralling aspirations for securing the 'good life'. One might be provoked to ask, 'Is this really what education is about?' We might also piece together our collage of impressions about the socio-political landscape we live in and sense the growing inequities, the lop-sided priorities of decision-makers, and the marginalization of individuals, communities, social groups and even nations. And we may wonder: what does education have to do with all this? Or we might see in our mind's eye a vision of the impending man-made travails on our home planet, and wonder whether we are sealing our own fate in darkness. We could ask: are there sensibilities and capacities we might yet call forth in the human species that could avert greater disaster and make a new dawn possible? Can education respond to such an unprecedented challenge? And how might this relate to the burden we now habitually impose on young schoolchildren?

This is a journal for teachers, parents, educationists, and anyone else concerned with the issues of our times. It presents the outcomes of a broad range of inquiries that include the everyday acts that go into making the culture of our schools and our lives, as well as the underlying assumptions, dichotomies and attitudes that we might unknowingly harbour in giving structure and sustenance to our educational systems. There are also articles that share specific approaches and practices that have been attempted in various contexts of school education.

In this, the twelfth volume of the Journal, a clear sub-theme that emerges is the role of science in our lives. This is explored from multiple

perspectives. In the first series of articles, Dr. Krishna reflects on the nature of scientific inquiry and the relevance of what he calls the 'scientific spirit' in the search for truth or wisdom through self-knowledge. He sees this as a necessary quest, if humankind is to become responsible in holding and utilising the burgeoning and deadly power of scientific discoveries. Shailesh Shirali attempts to evoke the beauty and sense of order that underlie the disciplines of science and mathematics, and exhorts teachers to feel and to share with students the aesthetic qualities and sense of wonder that are intrinsic to these domains. And yet another science teacher, N.J. Krishnan, confesses his occasional feelings of helplessness in the face of hardened attitudes to learning science and mathematics, which come in the way of appreciating science as a 'way of thinking' with implications well beyond the particular physics course one might be studying. Kumaraswamy's practical primer for teachers—with examples taken from physics—suggests that studying for an examination need not come in the way of learning a subject well, and shows how a thoughtful teacher may guide students of various abilities in this process.

With regard to the teaching of school subjects, we find two very different but complementary perspectives presented by two practitioners of environmental education, V. Arun and V. Santaram. One highlights an approach that draws lessons from Krishnamurti's teachings, while the other suggests a wide range of practical ideas for making the subject meaningful and relevant to students' lives. Both clearly believe in the seminal importance of this area of the school curriculum for developing students' sensibilities with regard to contemporary issues.

Many of these articles offer a critique of the current emphasis on rigid syllabi and examination requirements, which have the effect of greatly narrowing the scope of education in schools.

A wider critique of the underpinnings of school curriculum comes in the form of an enquiry into the philosophy of vocational education, by Patrick Foster. He shows the school curriculum to be deeply shaped by dichotomies and a selective valuation of one set of human capacities—the intellectual and literacy-based variety—over others. He finds that this manner of selective valuation towards a university-bound educational track, militates against a holistic education.

Chakravyuha is the metaphor employed by G. Gautama to articulate his

poignant picturing of the entrapment experienced by students and teachers alike, once they enter the school system. He is sceptical of the cosmetic reforms and restructuring which schools may periodically undergo and raises questions about the deeply held attitudes that continue to sustain the trap. In a more anecdotal vein, Krishna H. takes us along a journey into his own ruminations on the nature of schooling, teaching and learning, which ends up questioning the limiting identities and boundaries that we perhaps need to transcend.

Outside the purposive frame of schools and their curricula, we have individual inquiries into a range of life concerns. Radhika Neelakantan explores the nature and place of art in our lives; T.M. Krishna engages with the meaning of culture in our lives; and Anya Van Zijll Langhout points to the limitations of the tools of science—in this instance, the social sciences—in understanding the stories of human lives.

In 'Rules for Living', Yasmin Jayathirtha shares an inquiry of a different sort, sparked by issues that arose around the framing of a few rules in the context of a small school as well as a residential community. This leads her to uncover the possible value of participation in framing and amending 'rules' as a basis for an education in citizenship.

From three very different contexts we have accounts of specific initiatives that are small harbingers of hope. The story of a group of tribal schools in Kaigal Valley, by Sudha Premnath, speaks about the organic development of an educational programme that seeks to sensitively bridge the boundaries between the marginalized world of tribal forest dwellers and the wider socio-economic context of an industrializing world, so that they may seek livelihoods of dignity, while preserving their inborn natural sensibilities. The teachers in these tribal schools are seen as the crucial factor in the success of this venture. And so too it seems with the story of mixed-age group learning in an urban middle school, a pilot venture undertaken by Akhila Seshadri and S. Padmavathy, where a change in the structures of learning is premised on the ability of teachers and students to learn to work together in a non-hierarchical group, where listening, questioning, collaboration are encouraged, together with self-directed learning. And lastly, from a university setting, we have an article by Raji Swaminathan on 'action research' in schools. This shows the possibility of teachers educating themselves, and coming upon refreshing

insights that can carry their educational work deeper. The common factor in all three cases is 'the teacher who is also a learner'.

Though these writings emanate largely from a small but diverse group of teachers, parents, former students, and educationists associated with the Krishnamurti schools, such critiques and constructive initiatives are equally relevant to educational questioning and change on a broader scale. For systemic change to happen there needs to be a deep and sustained shift in the nature of educational discourse—in its underlying assumptions and the socio-political and human values that govern it. While the larger educational systems impinge on the work of those who may feel the urgency of change, they, in turn, cannot but engage with and attempt to add vitality to the processes of change in the educational discourse.

Alok Mathur

The Scientific Spirit and the Quest for Wisdom

P Krishna*

Science and Society

Though modern science is of relatively recent origin in human history, it has made very rapid progress and transformed outwardly the manner of our living. It is said that our life outwardly has changed more in the last one hundred years than it did earlier in thousands of years. And this is largely because of the scientific knowledge accumulated over the last three centuries, and its application in the form of technology. The impact of science on society is very visible; and the results of progress in agriculture, medicine and health care, telecommunications, transportation, computerization and so on, are part of our daily living.

Despite this progress in science, and the consequent development of technology and industry, with the attendant comforts as well as power, in no part of the world are human beings happy and at peace with themselves, living without violence. It was hoped that the development of science would usher in an era of peace and prosperity, but that has been belied. On the contrary, if we look at the level of violence throughout the world during successive ten-year periods since 1900, in every decade, in every country, the crime-graph continues to go up. What we see on the one hand is greater economic prosperity, but on the other, greater violence, sorrow, anxiety along with acute ecological imbalances and new diseases.

Krishnamurti raised the question: Has there been any psychological evolution at all in the last several thousand years? Have we progressed at all in wisdom, or the quest for truth, or inwardly, in our consciousness? Science has generated tremendous power; knowledge always gives power and is useful because it increases our abilities. But when we do not have love, compassion and a feeling of brotherhood, which are all by-products of wisdom as self-knowledge, then power is used

destructively. Sixty-five percent of all the scientific research being done currently is directly or indirectly meant for developing weapons and is supported by the Defence Ministry in every nation. In the last century, several million people have been killed in wars, which is without precedent in any previous century.

So, does humanity have the capacity to handle the knowledge which science is generating? Are we not like children playing with fire? For, without wisdom, might we not set the whole house on fire and burn ourselves? There is hatred in our motivations; we are badly divided into groups—caste, national, linguistic, religious and other groups. We have been at war for thousands of years; and we now have nuclear weapons making war a million times more disastrous. Is the new knowledge taking us in the right direction? Through genetic engineering we might develop new power, but can we ensure that we will use that power for the benefit of mankind? All the nations of the world are spending huge amounts in developing scientific knowledge as if that is our priority. Are the problems of humanity today caused by not having sufficiently fast airplanes or computers or are they because of the psychologically primitive state in which we find ourselves due to a lack of the understanding of ourselves? Is it then responsible of us to pursue greater knowledge, giving more and more power, without the wisdom to use it rightly? Responsibility from a holistic point of view is universal responsibility. We are responsible for the whole of society, all of humankind, and also the earth.

The purpose of science

It is said that Einstein regretted the fact that his equation e = mc square—which stated a great truth about nature, that mass is just another form of energy—led to the development of atomic bombs that killed large numbers of people in Japan. So, why do science? Here we must distinguish between science and technology. Science is the quest for truth about nature. Its aim is not to produce technology, but to understand how nature works and discover the order and intelligence operating around us. If nature were chaotic, if on being released a stone sometimes went down and sometimes up, then there would be no science. But definite causes produce definite effects, and that is why science is possible. The scientist does not create order; he merely studies it. Newton only discovered gravitation, which existed a million years before him and will exist a million years hence. The laws of Nature are independent of the scientist. If we ask why Nature is ordered, the scientist cannot answer that question. He can only say, 'I am a student of nature. I observe and find that it is very orderly and I am studying the laws that govern that order.' The technologist takes the knowledge that the scientist discovers and uses it to make guns, or a motorcar, or generate electricity. Technology is a by-

product of science, but science itself is the quest for truth about Nature.

Before Faraday, who discovered electromagnetism, it was thought that electricity and magnetism were two completely separate things. But he discovered that if you push a magnet towards a loop of metallic wire, a current is generated in it as shown by the deflection of a galvanometer. He was very excited about this new discovery. After he demonstrated this in a big hall, somebody asked, 'All this is very well, but of what use is this discovery?' And he replied: 'It is a newborn child. Of what use is a newborn child?' Today we know that that discovery made it possible to have electric lights and fans, motorcars, airplanes and so on. But that was not the reason why Faraday discovered electromagnetism; he was just studying nature.

Humanity has succeeded in its quest for discovering the order in nature, because that order is already there. We are living in a very intelligent universe. Our own body is an example of it. A million things take place in perfect order within our body without any conscious voluntary effort on our part. But we have not discovered order in consciousness, which is virtue, peace of mind, love, happiness, compassion, freedom from conflict, non-violence. Socrates wrote that there is only one virtue, which is order in consciousness, though we may describe it in different words in different situations. And the quest for truth, and wisdom, which is the essence of self-knowledge, is the quest for order in consciousness. If there is wisdom, we will not use knowledge for destructive purposes. And if there is no wisdom, we are violent and selfish and we use the knowledge in a destructive way.

So is there anything we can learn from science as people interested in wisdom, in coming upon a deeper understanding of life and of ourselves? Science, or scientific knowledge, does not deal with values per se, with what is right and what is wrong. It does not say that you should be kind. Scientific knowledge is said to be value-neutral. And yet one must discover what is called the scientific spirit, for this may have something to teach us. The spirit is always more important than the technique, the knowledge or the method in any activity.

Although in society we have valued scientific knowledge and its application as technology, we have not really valued the scientific spirit, without which it is wrong to call ours a scientific society. We are really a very unscientific society. Science tells us that we all have originated from one common source, that all life on the planet is interdependent, and that the whole earth is one. Yet we divide ourselves and say, 'This is my culture, this is my country and I will work only for this.' We give tremendous importance to where we are born, which is just an accident of birth, and cultivate nationalism as a virtue. Then for the benefit of our nation we have armies to exploit other nations. This is not scientific.

War is not scientific in spirit though it may use the gadgets produced from scientific knowledge.

What is the scientific spirit?

What can we learn from science that is precious? To understand this, let me take the example of physics. It begins with observation, for understanding any phenomenon in nature requires careful observation, honest documentation, measurement, and recording. Then having collected a lot of data about the phenomenon, a scientist looks for correlations among them. From empirically found data, correlations between two variable quantities are first established. Then the scientist guesses a model of the underlying reality, which would explain those correlations. That is where his insight or his genius manifests, for he has to guess what is unknown. Whenever scientists talk about a theory they are talking about an imaginary model of the underlying reality. Nobody has seen electrons actually going around a nucleus inside an atom. That is a conjecture, a model, about the underlying reality. To this model they apply logic, using the existing known laws determined from previous work and a peculiar form of logic called mathematics, which is a product of the human mind. With all this they develop 'a theory', and try to explain all observed facts and also predict new facts that have not been observed until then. Then the scientists go back to observation and do experiments to check if their predictions are correct. If the experimental values do not tally with the theoretically predicted values, they either modify the model, or they discard it altogether and start all over again.

It is a deep quest because they are not accepting reality as they see it. They are saying there is an underlying reality that is not visible, and we are going to describe it. But since it is not visible, we have to guess, to imagine it, and that constitutes the model. Sometimes people argue that scientists keep changing their models so why not wait till they have made up their minds and only then read what they have to say! This view is incorrect because the successive models are closer and closer approximations to reality. Thus Einstein's model of the universe is a better approximation to reality than that of Newton but Newton's model still applies and is used in circumstances where it is valid.

So a scientist begins with saying, 'We do not know the truth about nature. We are making a conjecture and we have found a method by which we can test whether this conjecture is correct or not and to what extent it is correct.' That is how science has progressed—without accepting truth on authority. A young student can question Einstein, and point out an error, and Einstein will agree and thank him if indeed he is right. So nothing is accepted on authority. Science demands proof, observation, testing with experiments; and the truth must be something which

is universal, which everybody can be convinced of. However, scientists limit themselves to studying phenomena that are measurable.

There is also much in life that is not measurable, which is the field of religion. But there are a number of values that are inherent in the way science is done, which we can learn from science. The spirit of science is one of great humility. Scientists are not humble but science is humble! It encourages observation, testing what is observed, questioning, doubt. And the truth is the same for everybody. There is no such thing as an American truth and an Indian truth. There is no Indian mathematics and American mathematics. So, it is a global activity, a dialogue among thousands of people who have never met, because the experiment is repeated in another country by another group of scientists who write down their results and publish them, and everybody reads them. Thus there is a process of international dialogue, constant re-examination, testing and correction going on all over the world and the ultimate truth is always posited as the unknown. There is a beautiful definition of science given by Feynman which emphasizes this: 'Science is a body of knowledge some of which is nearly certain, some that is quite uncertain and none that is completely certain.'

A scientific approach to religious truths

Truth is global, universal; it is not the private property of any individual. It is the same for everybody. These are values constituting the scientific spirit. In order to settle a dispute, violence is not used, nor authority. So the spirit is one of non-violence, of dialogue. It is also a truly democratic endeavour, based on cooperation, humility, and mutual respect. All scientists may not be true scientists if they do not work with that spirit, but that is the way of science. Unfortunately, the scientist adopts the scientific attitude as a policy in the laboratory but does not extend it to other areas of life. Krishnamurti once made an interesting statement related to this. He said: The religious mind has no beliefs; it has no dogmas; it moves from fact to fact, and therefore the religious mind is a scientific mind. But the scientific mind is not a religious mind. The religious mind includes the scientific mind, but the mind trained in the knowledge of science is not a religious mind. To discover the truth about nature, this scientific mind is competent. The same spirit is also valid for discovering religious truths since religious truths are also universal, not different for different people. But the scientific method of experimentation is not possible in this inward inquiry, since the observer is not separate from the observed and truths cannot be demonstrated to all and sundry. However, we can in the religious inquiry too posit the truth as the unknown, rely more on observation than on assertion, enquire together with humility and conduct dialogues about our perceptions, doubt

them and attempt to discover for ourselves what the truth is. The true essence of religion is the quest for wisdom, and wisdom means seeing the deeper inner nature of how our consciousness functions. That is precisely the spirit of the scientific quest with regard to nature.

As educationists we must inquire whether science can be taught in such a way as to inculcate the scientific spirit in the student and not merely the knowledge of science. That would require a very different approach to the teaching of science than what we have at present. Unfortunately, science is taught as a technique, to carry out our narrow purposes. Science has become the servant of society and not its architect. The politician illogically, irrationally and in ignorance decides to go to war; and scientists, as employees, help to do whatever the government wants. The same kind of mistake is made in regard to religion; we have not imbibed the spirit of religion. When we really care for the spirit—whether of science or religion—and delve deep, we will discover that the true religious feeling and the scientific spirit are not separate. Indeed, great scientists like Einstein and Schrödinger have come to the religious feeling through science, through the perception of beauty in Nature. Whichever aspect of the earth or this universe you explore deeply—whether the human mind or the tree—you will discover marvellous beauty there. When you go deep, truth becomes beauty and beauty, truth; and that is also wisdom. The form without the spirit belies wisdom. Only in the depths is there truth, wisdom and therefore peace and harmony.

The true religious quest is a quest for wisdom and any feeling of antagonism between the scientific and religious quests is a product of a narrow vision. To quote Schroedinger, the founder of wave mechanics, who was also a serious student of Vedanta:

I consider science an integrating part of our endeavour to understand the one philosophical question which contains all others: who are we? I consider this not one of the tasks, but the task of science, the only one that counts.

Honorary Scientist, Indian National Science Academy, New Delhi.

Aesthetics and the Sense of Wonder in the Teaching of Science and Mathematics

Shailesh A Shirali

In the silence of deep night and in the quiet still morning when the sun is touching the hills, there is a great mystery. It is there in all living things. If you sit quietly under a tree, you would feel the ancient earth with its incomprehensible mystery. On a still night when the stars are clear and close, you would be aware of expanding space and the mysterious order of all things ....

J Krishnamurti

I consider that aesthetics and the sense of wonder occupy a vital place in the teaching of the sciences and mathematics, and that without these our learning has no 'soul' and no creative expression.

There is a great deal of lament these days about the poor teaching of the sciences and mathematics, and with good reason. Its effect at the national level is all too visible; we have become a nation that specializes in doing well at examinations, but fails to carry the momentum beyond that point. The learning of technical skills (with, pragmatically, the first place being given to the skill of answering examination questions) has come to occupy a central place in our curricula. This pattern stretches far and wide, and the well known coaching centres for the various entrance examinations in this country are among the worst offenders.

The 'cure' for this, if there is any, has to start at the school level. The teaching of the sciences and mathematics must leave behind a sense of wonder and reverence for the great beauty and intricacy of the world—the world of

the very small and the world of the very large; but this feeling must not be limited to the physical form of the world. Here is what Henri Poincaré wrote about the scientific endeavour:

> *The scientist does not study nature because it is useful; he studies it because he delights in it, and he delights in it because it is beautiful. If nature were not beautiful, it would not be worth knowing, and if nature were not worth knowing, life would not be worth living. Of course I do not here speak of that beauty that strikes the senses, the beauty of qualities and appearances; not that I undervalue such beauty, far from it, but it has nothing to do with science; I mean that profounder beauty which comes from the harmonious order of the parts, and which a pure intelligence can grasp.*
>
> *It is because simplicity and vastness are both beautiful that we seek by preference simple facts and vast facts; that we take delight, now in following the giant courses of the stars, now in scrutinizing [through] the microscope that prodigious smallness which is also a vastness, and now in seeking in geological ages the traces of a past that attracts us because of its remoteness.*

What are we to do with Poincaré's words? Surely it is possible to engage students in a way that heightens the appreciation of the 'harmonious order of the parts' of the world, and that engenders a delight in 'simple facts and vast facts'? Surely it is possible to teach in a way that science and mathematics become poetry?

When a child is young, it is absurdly easy to bring about the sense of wonder; one only has to bring the child into contact with nature, with the enormity of life and the universe; and nature herself will teach the child in the best way possible. Rachel Carson said this very poignantly:

> *I sincerely believe that for the child . . . it is not half so important to know as to feel. If facts are the seeds that later produce knowledge and wisdom, then the emotions and the impressions of the senses are the fertile soil in which the seeds must grow. The years of early childhood are the time to prepare the soil. Once the emotions have been aroused —a sense of the beautiful, the excitement of the new and the unknown, a feeling of sympathy, pity, admiration or love—then . . . knowledge about the subject . . . has lasting meaning.*
>
> *The winds, the sea, and the moving tides are what they are. If there is wonder and beauty and majesty in them, science will discover these qualities. If*

they are not there, science cannot create them. If there is poetry in my book about the sea, it is not because I deliberately put it there, but because no one could write truthfully about the sea and leave out the poetry …

But as the child's intellectual abilities mature, the teacher has to strive a bit further, for now a new kind of beauty comes within reach of the mind—that of the *principles* that seem to govern the development of nature and the wide world, and which science and mathematics seek to find and describe in the simplest terms possible. These principles are part of the poetry, and there is great joy in coming upon them.

What is it about principles that appeals to us so much? It is important for the teacher to ask this question, and to determine what leaves behind the deepest impression on a growing mind, particularly at the middle school and high school levels. In my own teaching I have found the following to be of great significance:

- Appreciation of the beauty and economy of good description
- Appreciation of predictive power, and of the power of unifying principles
- The pleasure of finding unexpected connections
- The pleasure of seeing the simplicity that results from good translation.

Examples from science

Here are some examples from the world of science, of principles and unifying themes that carry great predictive power. As one studies them, one marvels at the power of principles!

1. The **principle of levers**: so absurdly simple a principle, so easy to state, and yet it allows us to grasp the mechanisms of such a varied set of household devices!—from crowbars, to kitchen tongs, pliers, can openers, nail cutters, scissors, bicycle hand brakes, …
2. The **kinetic theory of gases**, and the model of heat and gas pressure that it creates in our minds: heat is understood as the energy of movement of the gas or liquid molecules, and pressure as the effect of the incessant bombardment by molecules. Using the model one quickly sees why the gas laws simply have to be true—at least qualitatively; e.g., why, when we increase the temperature of a fixed amount of gas, while keeping its

volume fixed, the pressure also increases. And one sees the possibility of heating a substance by making its molecules 'dance' using microwaves, as in a microwave oven.

3. **Bernoulli's principle** (The total energy in a steady flowing fluid system is constant along the flow path. With an increase in speed comes a decrease in pressure)—a non-obvious principle that helps us make sense of such varied phenomena as the lift of airplane wings, the functioning of a perfume spray bottle, the laterally curving trajectory of a football when it is suitably kicked (this is the 'banana kick' of David Beckham fame), and the phenomenon of swing bowling in cricket.

4. **Conservation laws**—of energy, momentum, and angular momentum; the scope of phenomena that they allow us to understand is truly vast, stretching from simple daily life phenomena to stellar evolution, to how NASA sent its Voyager spacecraft on a journey to the stars with some help from Jupiter, and to the strange discovery that the Earth day was shorter during earlier eras, and the moon closer to the Earth than now.[1]

5. The **periodic table**, and the intricate patterns it reveals in the properties of the different elements. There is the stirring story of Mendeleev's prediction of the existence of *Gallium*, which he had named *eka-aluminium* ("first after aluminium"). Apparently when it was discovered by a French chemist, its reported density differed from the value Mendeleev had predicted. This provoked him to ask for a fresh measurement of the density, and when this was done, the value coincided with his predicted value!

There are so many more such themes which can be listed, and each opens up a whole new world: Darwin's theory of natural selection; Mendel's laws of heredity; the mechanism of DNA replication, and how it explains heredity; the phenomenon of mitochondrial DNA, and how it allows us to uncover the pathways of human evolution; Bohr's model of the atom, and the understanding it provides of spectra associated with various atoms, and the

1 This happens because of tidal friction and the resulting slow but steady loss of energy. The person who first predicted this effect was George Darwin, son of Charles Darwin. It means that the dinosaurs would have had a twenty-two hour day; so they would have had to hurry through their tasks a bit faster than we do! They would also have seen the moon at closer quarters than we do.

notion of quanta; Le Chatelier's principle, and the way it enables us to predict the effects of changing the conditions of a chemical reaction.

There is a quote of Richard Feynman's which belongs here: 'The world looks so different after learning science. For example, trees are made of air, primarily. When they are burned, they go back to air, and in the flaming heat is released the flaming heat of the sun which was bound in to convert the air into tree, and in the ash is the small remnant of the part which did not come from air, that came from the solid earth, instead... These are beautiful things, and the content of science is wonderfully full of them. They are very inspiring, and they can be used to inspire others.'

But, having said all this, it is wise to end on a cautionary note. The pleasure and happy abandon we feel when, armed with just a few principles, we are able to make sense of the world must not make us lose touch with the essential mystery of the world. It is one of the traps we human beings fall into—that of substituting words for the actual and then feeling that we have grasped the real thing. Feynman was fond of narrating a conversation which his father had with him: 'See that bird? It's a brown-throated thrush, but in Germany it's called a halzenflugel, and in Chinese they call it a chung ling, and even if you know all those names for it, you still know nothing about the bird. You only know something about people—what they call that bird. We could easily trap little children with this human tendency. Ask a child, "What makes things fall down? ", and you get the textbook answer, "Gravity makes things fall down." Push a little further and ask, "What is gravity"; then you get, "Gravity is the thing that makes things fall down." ' Well.

Substituting real phenomena with words a bit too early in one's schooling can kill questioning. It would be a wonderful experiment if we can get children to try explaining phenomena without using catch-all words like 'gravity' and 'energy' and 'evolution'. Who knows, it could be the beginning of a real scientific adventure!

Examples from mathematics, the 'science of patterns'

Mathematics is rich in elegance, simplicity and interconnectedness. It is difficult to give illustrative examples, if only because there are so many of them! The examples we give seek to show beauty and interconnectedness rather than the power of any overarching or unifying theory.

1. Euclidean geometry has been studied for well over two millennia; Euclid's great text, *The Elements*, which lays down the structure of the subject through precisely stated axioms, postulates and 'common notions', is not only an extraordinary model of presentation but also of axiomatic development. That it continues to serve as a model for mathematical writing more than twenty centuries after its publication is a testimony to how great a work it is.[2] Here is a comment on the book:

> *Euclid's 'The Elements' form one of the most beautiful works of science in the history of humankind. This beauty lies more in the logical development of geometry rather than in geometry itself. It is not the diagrams that excite our interest; rather it is the way the concepts interconnect... The 'Elements' are elegant. Elegance in mathematics is characterized by simplicity and clarity. An elegant presentation is easy for the reader to follow. But elegance is not only in the presentation, it is in the selection of definitions and proofs. The elegant definition is the one that makes the rest of the theory easy. The elegant proof is the one that is easiest to follow, one that is designed just right to fit the goal.*
>
> *David Joyce, Clark University*

One of the gems in Euclid's '*The Elements*' concerns prime numbers. Prime numbers have long been a subject of intense curiosity, for they are easy to define and yet contain a vast number of secrets. A question that readily arises is: How many of them are there? The answer is that they are limitless in number, and Euclid's proof of this is "by contradiction". The proof is a masterpiece of economy; it achieves its purpose without getting trapped by the question, What is the next prime after a given one? Hardy remarks that the proof remains ...as fresh and significant as when it was discovered—two thousand years have not written a wrinkle on [it]; he adds: The proof is by reductio ad absurdum, and reductio ad absurdum, which Euclid loved so much, is one of a mathematician's finest weapons. It is a far finer gambit than any chess gambit: a chess player may offer the sacrifice of a pawn or even a piece, but a mathematician offers the game.

Here is a fact that brings home the mystery of the primes. Recently it was found that $2^{32582657}$-1, a number with nearly ten million decimal digits, is prime. But Euclid assures us that beyond this monster, there lie infinitely more primes ...

2 *The Elements* is second only to the Bible in the number of editions published (over a thousand).

Sadly, the trend today is that many mathematics teachers in India and elsewhere have never read Euclid (or any of its equivalents); so it is not surprising that geometry is now one of the most poorly taught portions of the curriculum. One of the pedagogically most convenient ways of introducing a formalized style of logical reasoning, and of the notion of elegance in mathematics, has been cast by the wayside.

2. Pythagoras's theorem has been known since very ancient times, and in cultures widely separated in time and space. It has the distinction of having been proved in a larger number of ways and by a more varied class of people than any other proposition. One such is a 'proof without words' attributed to the twelfth century Indian mathematician Bhaskaracharya (author of *Lalavati*); another one is from James Garfield, a former president[3] of the USA![4]

We are given a right-angled triangle with legs a, b, and hypotenuse c; we must show that $a^2+b^2=c^2$. Note that the area of the triangle is ½ (base'height)= ½ ab.
Garfield's proof may be illustrated using these figures:

Using the formula for area of a trapezoid (half the product of the height and the sum of its parallel sides), we find that its area is ½(a+b) (a+b). But the area is also equal to ½ ab+ ½ab+ ½c^2, as it is made up of two copies of the original triangle and half of a c x c square. Equating these two expressions, we get $c^2= a^2+b^2$, as desired. (Bhãskarã's

3 He was a senator when he found the proof, and went on to become President later in his career.

4 One longs for a time when presidents and prime ministers of powerful countries would exhibit some interest in geometry. Imagine a session at a UN summit meeting being devoted to an exchange of experiences with problems of geometry rather than problems of terrorism; how peaceful such a world would be!

proof is similar to this, but it uses four copies of the given triangle.)

3. A primitive Pythagorean triple ("PPT" for short) is a triple of coprime positive integers such that the sum of the squares of the first two is equal to the square of the third one; for example, (3,4,5) and (5,12,13). PPTs are related to Pythagoras theorem in an obvious way. Interest in such triples goes back to further than 1600 b.c., as can be seen from the Plimpton clay tablets excavated in ancient Babylon.

   The way PPTs are generated is a nice illustration of the theme of interconnectedness. If we divide the first two numbers of the triple by the third number, we get a pair of rational numbers which yield a rational point on the unit circle (one whose coordinates are rational numbers). Conversely, each rational point on the unit circle yields a PPT. So, finding PPTs is equivalent to finding rational points on the unit circle. One such point is Q (*1,0). Now consider a line * through Q, with a rational slope t. It will intersect the unit circle again at a rational point whose coordinates can be found by solving a pair of equations. By giving arbitrary rational values to t we get an unlimited number of rational points on the unit circle, and from them an unlimited number of PPTs. Example: $t = \frac{2}{5}$ yields the point $\left(\frac{21}{29} , \frac{20}{29} \right)$, and the PPT (21,20,29). This solution 'attaches' to each PPT a rational point on the unit circle, by an invisible thread as it were.

   What is 'elegant' about this solution? Observe how we transformed the problem from one about integers to one about a line and circle, using coordinates; we mapped the problem into a domain which we know much better (coordinate geometry), and so were able to use results found earlier.

   This analysis illustrates an important aspect of mathematics—its compressibility. Here is mathematician Bill Thurston: 'Mathematics is amazingly compressible: you may struggle a long time, step by step, to work through some process or idea from several approaches. But once you really understand it and have the mental perspective to see it as a whole, there is often a tremendous mental compression. You can file it away, recall it quickly and completely when you need it, and use it as just one step in some other mental process. The insight that goes with

this compression is one of the real joys of mathematics.'[5]

4. Another nice instance of interconnectedness is seen when we study ordered partitions. Pick a positive integer n, and list all the ways in which it can be written as a sum of positive integers, with the understanding that the order in which we list the summands is to be taken into account; so 1+2 is listed separately from 2+1. Also, a 'sum' of just one integer is acceptable. The different expressions so obtained are then the 'ordered partitions' of n. So the ordered partitions of 2 are: 2, 1+1; we write these for convenience as 2, 11 (read this as "one one" and not "eleven"). The ordered partitions of 3 are: 3, 21, 12, 111; the ordered partitions of 4 are: 4, 31, 13, 22, 211, 121, 112, 1111. And for 1 there is just one ordered partition, namely, 1 itself.

   If we list the number of ordered partitions corresponding to each number, we stumble upon something very pleasing indeed:

Number	1	2	3	4	5	6
Number of ordered partitions	1	2	4	8	??	??

   We see a wonderful pattern taking birth here: 1, 2, 4, 8, ...; surely the next number 'ought' to be 16? And so it is; the ordered partitions of 5 are 16 in number: 5, 41, 14, 32, 23, 311, 131, 113, 221, 212, 122, 2111, 1211, 1121, 1112, 11111. What a pleasing discovery!

   What has happened here is a typical mathematical experience—the discovery of an unexpected pattern. It is certainly one of the great joys of studying the subject. But the analysis must not stop here; now we must explain why such a pattern manifests, when there is nothing in the statement of the problem that would suggest it. If we are able to do so, what a supreme moment it would be!—to understand the hidden geometry of a problem, as it were, and to uncover its links with other problems.

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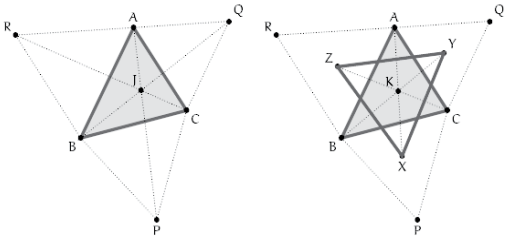
5 Quoted by the Mathematics Focus Group for the National Curriculum Framework 2005.

5. Transformations in geometry are a strongly unifying theme, powerful and elegant at the same time. They connect a modern theme in mathematics, that of function, with an ancient one, Euclidean geometry. Concepts from abstract algebra are easy to see in action when we study transformations.

Euclidean geometry for long was regarded as absolute, perhaps because of the way it connects with daily life, and it was only in the middle of the nineteenth century that its liberation came; then it spread its wings and manifested in diverse forms. It was Felix Klein, a German mathematician, who first put forward a unifying way of viewing these different geometries, using the notion of transformations. This change of perspective had an enormous influence on the development of the subject.

A nice example of a theorem that is elegantly handled using transformations is Napoleon's theorem (supposedly discovered by Napoleon, but more likely by one of his generals; he was fond of taking along mathematicians on his campaigns). Given a triangle ABC, we construct equilateral triangles BPC, CQA, ARB on its three sides, all lying outside the given triangle. If we now draw the segments AP, BQ, CR, we find that they have the same length and pass through a common point—the Fermat point of the triangle. This has many attractive properties; for example, if A,B,C are villages, and we wish to put up a rural dispensary that can be accessed by all three villages, then the best location to use is the Fermat point. Moreover, the six angles created at this point are equal to one another.

Next, we locate X,Y, Z, the centres of BPC, CQA, ARB, and draw



the segments AX, BY, CZ; we find that these three lines too meet at a point (marked K). This is the Napoleon point of the triangle.

Even better: we find that XYZ is equilateral, and this remains so regardless of the shape of ABC.

As earlier, we can continue quoting examples indefinitely; but we have to bring this section to a close. A key question is whether these examples can be adapted to constructivist pedagogy; but this is readily done.

Closing remarks

There is poetry in science, and there is poetry in mathematics. And every child should have a taste of it. Only a small fraction of the children who study these subjects in school will study these subjects later in life, but it is surely every child's right to experience—if only for a day, or a lesson—their power and beauty, which lie within every person's reach. I think that as teachers we owe this to our students.

In the past it has seemed to some that by delving into the mysteries of nature and explaining them in terms of simpler phenomena, we spoil the poetry of God's creation. Keats reflected this feeling when he wrote:

There was an awful rainbow once in heaven:
We know her woof, her texture; she is given
In the dull catalogue of common things.
Philosophy will clip an angel's wings.

Why would Keats have had such a response to science? Could it have been because of the rise of technology and the fever of industrialization in England during his day, and the terrible working conditions of the common people? Or because of a know-it-all attitude on the part of post-Newtonian era intellectuals whom he had met? Or because he had seen how when we place a beautiful phenomenon in the 'dull catalogue of common things' we tend to lose our child-like sense of wonder and our reverence for life? It is hard to say; such spill-over attitudes are common, and they say more about our mental makeup than about what we do. And to lose this sense is to not live at all.

What about the feeling that to 'unweave' a rainbow is to destroy it? Surely, the truth is not so weak that it will diminish in stature when one explains it?

'To live at all is miracle enough.'[6] And if along the way one also gets a glimpse of the intricate workings of nature and exults in its incredible beauty, it is only a bonus we have been granted.[7] So, when with Keats we 'Behold upon the night's starred face / Huge cloudy symbols of a high romance', why not see this as an invitation to enter into a romance that will enrich us so greatly? On this journey we will also delve into the rich historical tradition of science, with its many stirring stories.

Richard Dawkins writes about his book *Unweaving the Rainbow*: *The title comes from Keats, who was talking about Newton unweaving the rainbow and thereby spoiling the poetry, which I think is nonsense. When you do explain something, you usually uncover still greater mysteries, which are even more beautiful. The unweaving of the rainbow eventually led to spectroscopy, and spectroscopy is how we know what the stars are made of, by detecting what chemical substances are in the stars. Looking at red shift in the far distant parts of the universe shows us that the universe is expanding; that shows us when the universe began, it shows how big the universe is. A great deal of what we now know about the universe has come to us from unweaving the rainbow.*

But there is another aspect to what Keats wrote, and it would be foolish to pass over it. In today's science there are also questions of ethics involved—much more so than in earlier eras. Are there boundaries beyond which one must not tread? Are there experiments one must not do? Though such questions may not appear to form part of the scientific endeavour, it is important that students think about these matters, though answers may prove elusive to find; and this should be done as part of the learning of science, not separately. In the hands of a thoughtful teacher, such questions can integrate in a natural way with those of mainstream science and leave in its wake an appreciation of the potentially overpowering complexity of human life and civilization. But this is an area that needs to be dwelt on at length, separately.

I shall let the last word be that of John Muir, my favourite naturalist-author:

> *This grand show is eternal. It is always sunrise somewhere; the dew is never all dried at once; a shower is forever falling; vapour is ever rising. Eternal sunrise, eternal sunset, eternal dawn and gloaming, on sea and continents and islands, each in its turn, as the round earth rolls.*

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6 Mervyn Peake, poet.

7 Whether we deserve this bonus is not very clear.

Yet Another Confession of a Science Teacher

N J Krishnan

I am sure all of us have had occasions when we have felt a sense of dissatisfaction; days when we wonder why we are doing what we are doing, days when we wonder whether it is any use at all, whether teachers have anything to do with the learning of the child. Maybe, we wonder, there is no point in what we do; maybe one is better off doing something else. Fortunately, for me at least, this does not happen often.

Rereading Colin Foster's article, '*Confessions of a Science Teacher*' in Volume 10 of the *Journal of Krishnamurti Schools* recently, I could instantly identify with much of what he had to say—the lack of engagement, the feeling that even students who were engaged did not see the point of it. Colin Foster raises three issues (he calls them the 'hidden curriculum') that he suggests are implicit in the teaching of science—particularly when this teaching is designed to terminate in an examination. I summarise them into three aphoristic phrases: 'science is content', 'science is eternal truth' and lastly, 'science is non-contextual'. There are three closely interconnected attitudes at work here. The underlying assumption is that *what* you think about can be separated from *how* you think. There is then the immediate corollary that our thought is not conditioned by our beliefs.

Anyone who has any idea of the history and development of science would immediately see how muddleheaded this is. That science is essentially a creative process rooted in the culture where it grows, is evident to most people doing science.

If science is content and is immutable then by definition it is eternal, true and non-contextual. By similar processes of immaculate logic we can start with any one of these aphorisms and arrive inescapably at the other two. The

fallacy of this circular argument is precisely that it is circular and it is not the logic that is at fault so much as the premise.

Curricula tend to ignore this, and the student as well as the teacher are caught in a trap that appears inevitable and false at the same time. The strait-jacket that the curriculum appears to place on the teacher—and the student—makes exploration of these assumptions seem impossible. The student no longer engages with the subject; and looks at the subject, at best, as a stepping stone to a career where this engagement has no role to play.

It is only in the last few years that I have been working with younger children, formally and informally, and I find to my dismay that this disillusionment with the learning process and the separation of the learning at school from the 'real world' appears even earlier. It is clear that the curriculum and its constraints do cause a speeding up of this separation but the infection sets in much earlier. What is it that makes children believe that they cannot do science, that it is too difficult? I think the issue here is not just the subject and its content but how it is to be done and the demands made on the child. I believe there are multiple issues here.

Is mathematics necessary for understanding school science?

The first strand is the belief that mathematics—its grammar and its syntax—is difficult and the sciences, in particular physics, are inextricably linked with mathematics. Even we teachers see this as being true. When I started teaching I would insist that mathematics must be taken as a subject if one wished to do physics even though most examination boards do not require it, and a number of children wanting to do medicine do not see the point of learning mathematics as they do not require it later. I still think we must do it, but not quite for the reason I believed in then. I used to insist then that physics is taught in the language of mathematics. I am not so sure now.

Physics is a way of looking at the universe and trying to understand it. What does this mean? One could go on and on but essentially, it means to observe, abstract meaning and generalise from limited observation, to predict cause and effect, validate such induced meaning and build on a series of such meanings. When we start to do physics we start from certain axioms and move on from there (the existence of space, time and matter are taken as self-evident properties—we do not spell it out consciously but this is implicit in that the learning of physics starts with measurements of these quantities). At every

step, we observe the real world and try to make sense of it by abstracting only those aspects that we see as significant and ignoring others, either to simplify or to extract some meaning. In doing this we try and define aspects of our observations as convenient tools for later use.

Mathematics is a valuable tool in this exercise but it is quite possible to understand significant aspects of physics with very basic mathematics. I must add that there are sections in physics where our normal language quite fails us and the only way in which we can comprehend it is by using the tools that mathematics provides. However these are aspects which do not normally impinge on our day-to-day living.

The invaluable learning that anyone acquires in appreciating this process is not the facts or the models, but a way of thinking. It leaves one with a respect for rigour and a sense that everything must be explained within the parameters and axioms we use. We cannot ignore paradoxes by saying that these are 'exceptions to the rule'. If an explanation cannot explain what we see, or if there are exceptions to the rule, we must assume that our explanations are wrong or are not general enough.

How does school science connect with the real world?

The second strand relates to the cry we have heard from so many children, 'I cannot understand it. I cannot relate it to what I see. As it is taught it has no relevance to the real world. I do not have to use it to deal with the real world.' This is a very real problem. How do we relate the idealised, non-realistic content of physics with the real world? When I say that every object continues to move with uniform motion I am saying something that seems obviously untrue. When I say that things fall with the same acceleration, it is not what we observe if we drop a stone and a piece of paper. If physics is an explanation of cause and effect, some of the causes are not clear—gravitation, electromagnetic force and so on. How do we explain to the child that our explanations are idealised and we need to see them as approximations in understanding the real world? How do we show that physics is useful?

I think these are real issues that need to be addressed. Is there a way by which the child can recognise that doing science is a creative process that is aesthetically as satisfying as any of the arts? Can we show that it is rooted in the culture and history that we are a part of, that the ideas of model building and the approximations we learn here are relevant to so many other things,

that the rigour of thinking that is acquired here is invaluable everywhere?

Here I would like to indulge myself in a piece of conceit. I would like to imagine the corpus of learning as a magnificent structure of which we have some glimpse, some understanding and that it is our responsibility to be a guide—a tourist guide, say—who hopes to interest some of the visitors into staying back and immersing themselves in understanding or being with this wonderful edifice. We can choose different strategies.

The first would be a dry as dust recitation of the facts and figures. They would all be very true and correct but can never give us a feel for the beauty. No catalogue can ever make anything real, can ever make us understand the blood and sweat and tears that went into the making, can ever get us emotionally involved.

The second strategy would involve the enthusiastic guide in waxing eloquent on his interests. He would tell the visitor everything he knows, bury her in facts and figures, overwhelm her with his emotions and exhaust her with his passions. Would it work? In a soil already prepared and waiting, maybe. It is, however, more likely to put off the person, scare rather than attract. It also has the great danger of possibly making the visitor believe that the vicarious knowledge she has acquired is true learning and understanding.

The third possibility: give the visitor space to look around; point out some of the interesting aspects, suggest the interesting lanes and by-lanes she can take to explore the edifice—preferably by herself. Give her the time and space to do so, but also provide her with the certainty that you are available when she needs you. Be with her when she needs you; let her loose when she does not.

In this lies the possibility of true involvement and understanding.

Culture in One's Life

T M Krishna

As Indians, we honestly believe that culture is in our blood and that this gives us an edge over other nationalities. We make statements like: 'They have no culture in their country', 'It's all about money there', 'They don't have roots', 'They don't have values'.

Very rarely do we actually try and define our culture. Is our culture based on our religion? Is it based on our clothes or our behaviour? Is it our movies that determine our culture? What is it?

Old timers would equate culture with our religious or artistic heritage. A young teenager may add 'Bollywood'. A middle-aged person equates it with listening to Mohammed Rafi and watching Satyajit Ray's movies. I remember telling a friend in the U.S. that it's so sad that people there think that Indian culture is all about temples. He looked at me and asked, 'Then what is it?' That was an eye-opener. I realised that everyone holds on to one aspect that is convenient and flaunts it.

We always see culture as an external object or thought process that we need to imbibe or respect. One who has learnt the Koran or the Vedas is said to have gained an understanding of culture. Thus culture is often related to a religion. Therefore when we refer to Hindu culture, Muslim culture and so on, what we are talking about is religious customs and practices. Just because we practice them does it make us culturally rooted? Do any of us know the meaning of these rites or their social contexts? Most of us do not. So what does it really mean?

I am a Carnatic musician and most people believe that there cannot be a better way to be rooted in Indian culture than that. They may have a point, since culture, to some, means being able to practise ancient traditions and rituals

in today's context. Many lead lives as information technology professionals or businessmen and also believe in pujas, attend classical music concerts and, of course, want their children to master all the arts. Does this mean we are cultured people?

What about me? I am a musician practising an art form of great tradition, aesthetics and philosophy. Does this mean I have culture in my life? No, it just means that I practise this art for a living. Whether this has led to a sense of culture in my life is a different question.

To me, culture is awareness, sensitivity and absorption. How many of us are actually aware of our every action? Most of our lives are a mechanical process of actions. What is this awareness? I drive my daughters to school every morning. I take the same route but is life the same every day? No. But how much am I aware of this? The only time I notice a difference is when it affects me. For example, if there is more traffic on the roads it bothers me as I don't want to be late to school. Awareness is not in relation to benefits or problems that may arise from the changes but it is the capacity to observe without passing judgement.

What has this got to do with culture? Culture is about the growth of the human being. The more aware we are, the more we celebrate life. Every nuance, every action is seen as a dimension of life.

Often I am asked, 'What is it that you look for in young musical talent? Is it the voice, the intellect, the presentation?' The answer is—I don't look for any of this. I look for sensitivity and taste. This may sound vague but let me explain. When a true artist performs, his sensitivity to music is so high that every musical expression is an aesthetic experience. The raga unfolds like a slow motion film in his mind. Every movement is seen. He sees the change and he is the change. This, to me, is the highest level of sensitisation. At this point nothing else matters.

If I see the possibility of this in a youngster, I see talent. The intellect can always be developed, but this other dimension has to be experienced. Instilling this process is much harder. If we extend this to life what happens? Imagine if we are sensitive to every thing around us. Then there is an internalisation of this awareness, yet it is not judgemental. To be sensitive is to be able to be aware—to actually experience it. Thus we not only see but also experience life as a continuous process of change. To put it differently, we see reality at

every moment. Culture is not about gains and benefits; it is about experience and absorption. With experience and absorption comes a respect for life.

So what about change? We see change in the light of this awareness and hence our decisions are of a holistic nature. Will our actions be judgemental? No, they will be respectful. Our perspective of the past, present, future will be an unbroken chain and hence the respect. This is culture.

All enjoyment of aesthetics that we celebrate as culture, is born from this sensitivity. Therefore it is not that we do not have it in us; we do not recognise and harness it. We have compartmentalised our lives, and hence, cannot extend experiences from one to another.

Another problem is the lack of openness. We do not see the difference between response and reaction. A reaction is usually an action born from a personal emotion, positive or negative. Response is born from an understanding that is sensitive. How do we develop this? First, we need to believe that all actions and changes are connected. We do not live in isolation. Life is not just about myself, my family, my house, my money and my fame. Every action of ours affects life. I think that my house is dirty so I throw my rubbish on the road. That's not a solution but a new problem. This understanding gives us a true sense of ourselves. To be sensitive, or to empathise, we need to experience; and unless we let our minds grow beyond our own self-centred world, nothing will change.

Just because we have a beautiful history of art, music and dance, it does not make us a cultured people. Some people say, 'But aren't our temples and music a stimulus to our culture?' Yes, of course, but isn't life itself a stimulus to culture? We can live in the most aesthetic surroundings and yet be devoid of inner cultural development. As a musician I believe this is a process of change that needs to take place. It can start from your art but has to move to your life as a whole. Only then does it have any meaning.

We are cultured only when we are culturally awakened.

The Philosophy of Vocational Education

Patrick Foster

The U.S. has its own history and tradition of vocational education. This history may or may not be similar to what has occurred in other modern industrial nations, but the philosophy underlying it is worth exploring for the future of education.

The U.S. in general and California in particular have material infrastructures, public and private, that are wearing out rather quickly because of lack of proper maintenance over the years, the stress of overpopulation, the impedance of inefficient bureaucracies, catatonia caused by fear of litigation, and an American attitude of solving problems and creating products quickly (ahead of competition, on the cutting edge of fad) and then forgetting about them in the rush for new creations.

Renewals of vocational education have traditionally been attempts to address these periodic infrastructure needs. So today, not only does the neglected infrastructure need help, but the baby-boomer generation of tradespeople—workers who will repair and expand the infrastructure—is beginning to retire. Consequently, politicians in California are pumping new money into vocational education in a panic to ward off the coming scarcity of tradespersons. In my opinion this is promoting vocational education for the wrong reasons.

I am myself involved in vocational education. I direct a program in Santa Barbara, California, at the local community college, which trains young adults in the building trades. Local building contractors desperately need trained workers to keep up with the building needs of the community. And in the U.S., one of the charges of the community college system is to serve its local community in any educational way it can. In addition, Santa Barbara County is beginning to train at-risk youth (high school drop-outs, potential high school drop-outs, post-incarcerated youth) in the construction trades.

So this latest round of vocational education activity is certainly serving local, state, and national needs. And this is a good thing. But it is doing so under a traditional attitude that separates vocational or hands-

on learning from academic education. This attitude has of course existed throughout history in most countries. It is what has sustained an ignorant, impoverished labour class and a ruling intelligentsia (whether in monarchy, state religion, or aristocracy). It is what values 'head' learning over 'hands-on' learning, intellectual competence over practical skill.

So societies have educated the elite in all matter of intellectual directions, and either allowed vocational training to happen on the job (as in apprenticeships) or at special vocational schools created to satisfy an unusually high need for tradespeople. In Europe, fortunately, the trades have managed to maintain their dignity and value—chefs and carpenters, for example, get excellent training, good pay, and the respect of the rest of the population. In the U.S., at least in the last fifty years, trades are considered lesser careers, and only youth who cannot succeed in the dominant intellectual track (elementary, secondary, four-year college) go into vocational training.

In the rest of this piece, I want to talk about human dignity and educational opportunity a little more, but also about hands-on learning and intelligence *and* about hands-on learning and being a complete human being.

A false dichotomy

It seems modern civilization has valued the mental over the physical. It pays you more if you solve problems with your mind instead of with your body. In capitalist countries this has evolved into the 'mental' work of managers and the 'physical' work of labourers. (To be fair, managers also take more risks, have more responsibility, must be literate and articulate—but these are differences in skills and not necessarily in innate value.) But how does valuing 'mental' over 'menial' square with our hard-won ethical sense of fairness or equality of opportunity? Are we less dependent as a functioning society on the vocationally educated than on the academically educated? Is it any less difficult to create a beautiful piece of furniture or a comfortable house than to teach Shakespeare or engineer a bridge? The amount of experience a master plumber has and uses daily is every bit as useful, complex, necessary, and proven, as that of the academician who teaches writing to freshmen.

Actually, it's not so easy to distinguish the mental and physical skills that go into *any* activity. My dentist uses very similar skills on my teeth as I do doing finish carpentry. Keenly observing the world in the process of writing poetry is very similar to observing the material make-up of a piece of wood. (Some of the dimensions to a piece of wood that can be observed or sensed while being worked are its grain pattern [its beauty, direction, stainability, sealability, workability, matchingness], its colour [hue, shade, contrasts, sheen], its

hardness, its density, its smoothness, its stability, its brittleness, its smell, and its vibrational quality. How many poems do you know that describe an object in this much detail?) Creativity is a universal process that treats all divergent perceptions and articulations as equal, whether material or ideational.

Traditionally, our disciplines were filled with overlapping skills and knowledge. An artist did not simply paint, and a scientist did not simply crunch numbers or dream up theories. Fine art and carpentry overlapped: artists had to build canvas frames, scaffolding, easels, and make all kinds of tools themselves. Architecture is in fact a complete superimposition of design and construction. Theoretical science and technology overlapped: scientists had to make the material apparatus for their experiments. (Galileo, Newton, Faraday, Hertz, Michelson—to name a few—were quite skilled at designing and making experimental instruments.) Of course medicine and craft have overlapped: the medical profession is full of instruments and material supports for its practices. The field of Drama involves playwriting, acting, costume design, set design, lighting and staging. Today, computer literacy involves understanding and use of hardware, software, programming, game skills, graphics, and so on.

Perhaps the only place we actually don't use many overlapping skills is in school. Subjects are so segregated as to mental and physical practice, that when a student wants to escape the verbal or symbolic straightjacket he or she just goes to an art class. When I taught at Oak Grove School, the most popular subjects were arts, crafts, and the non-academic winter projects. In modern philosophy of education, it was Maria Montessori (a physician by training) who first articulated the connection between hands-on and sensory exploration *and* intellectual learning. Many of her conclusions and techniques have been adopted by educators throughout the world. Jean Piaget, another twentieth-century pioneer in developmental psychology, showed the relationship between sensory-motor experience and the development of intelligence in the young child.

The truth is, humans not only use their senses and their bodies (motor skills) to initiate intellectual processes when they are young, but they use them all the time throughout their lives. All knowledge is an assessment or manipulation of information based directly or indirectly on the sensible forms in our material environment. Human language is fashioned around articulating and communicating these forms. Over the long haul of human evolution, language has incorporated more and more abstract features, so that now information comes also in mathematical, logical, and purely symbolic structures not found in the observed world. Yet even this kind of knowledge has been logically derived—no matter how complexly or discursively—

from physical forms. And often we need to work physically with these forms in order to explore them adequately.

Not only is there a necessary connection between 'abstract intelligence' and sensory-motor wisdom, but there seems to be one between language development and physical activity as well. Some anthropologists claim to see a quickening of tool development in early humans around the time when language was thought to have begun. There are theories that suggest that the ability of language to point to distinctions and to command action enabled early tool production (handaxes, spearheads, arrowheads, scrapers, etc.) to refine itself. And that, conversely, the need for more and more discrimination in flint-knapping led to further language development. This, of course, is speculation (for none of this historical development was recorded), but we do see physical activity/brain development connections in experiments with rats where physical challenges (learning mazes, solving problems) create new synaptic connections in their cortices.

I am giving these examples to try to blur the traditional division between mental and physical intelligence. If we see the complete interaction and thus necessity of the senses, motor activity, verbal skills, and symbolic manipulation, then we cannot artificially separate and value one factor over another—and then cannot sustain a civilization which unfairly, undemocratically, and unrealistically biases one type of skill/knowledge over another.

Learning styles

However, just because we don't want to unjustly favour one type of skill or knowledge over another doesn't mean we can't appreciate the variety and uniqueness of skills. In fact cultures tend to value the fact that we are all so different and unique—it makes life much more interesting and gives us a challenge to put all those disparate pieces together in a family or school or community or nation. In education, we finally discovered learning style differences, and these were related not just to various abilities to access information or skills, but also to the unique ways each of us feels, thinks, and chooses to do things. My own experience with integrating learning style differences into daily academic classroom teaching techniques has been disappointing. In academic, college-prep classes, it's difficult to encourage the learning styles and practices that don't involve verbal and math skills because our society encourages the latter so much. You can't just drop a balancing idea into an educational world that thinks it's open but actually adheres to a strong underlying societal tradition.

Multiple-learning-style education will probably not be significantly successful until it occurs in a culture where all types of intelligences and artistic and practical skills are valued equally. But even this way of looking at it is not quite right. We

don't just all have *particular* learning and performing skills. Actually, we all have all learning styles and all performance skills—only in varying degrees and in varying kinds of combinations. Much of real learning involves problem solving, and one solves a problem any way one can. And we usually utilize many kinds of learning styles and performance ways to grapple with it. Galileo was trained in academic natural philosophy as well as math and medicine and became suspicious of the then-accepted conclusions of the Greek philosopher Aristotle. He then built inclined planes to test accelerating motion, constructed better telescopes to see what was going on in the sky, began creating a philosophy of science to try to establish a meeting ground for both science and the Church, and wrote scientific books with imaginative dialogue between characters of opposing points of view. Michelangelo—ostensibly a painter and sculptor, a "fine artist"—had to design and build scaffolding to get him up to the ceiling of the Sistine Chapel, to formulate and prepare frescos that would be permanent, to repair previous cracks in the chapel ceiling and walls, to geometrically transfer small cartoon drawings to actual-size paintings, to supervise the construction of the dome on St. Peter's, to find and help carve out the massive slabs of marble for his sculptures, to design and build carts and boats to move these slabs.

In other words, the painter needs to be able to mill canvas frames and learn the chemistries of his or her media. The scientist needs to be able to design a material apparatus to test an abstract theory. The archaeologist needs to know history, geography, geology, material excavation technique, computer science, etc. The philosopher needs to have created and manipulated examples of the forms he or she will analyze and write about. To be fully human is to explore the world profoundly—with eyes, ears, nose, taste buds, skin, muscles, viscera, imagination, computation, reflection, and words.

Creating a wholistic curriculum

Though vocational education is set up to train for necessary vocations, the skills it teaches have importance far beyond career guidance and economic necessity. 'Hands-on' learning should accompany all levels of education because all learning involves the senses and muscles. No human problem is purely 'mental' or purely 'physical'. This has been a political dichotomy and not a natural one, and with it we have created a world of lop-sided people and segregated institutions and careers. 'Renaissance' men and women were not simply 'geniuses'; they were individuals with a passion to solve certain problems (artistic, scientific, literary, philosophical)—problems that required a multi-pronged approach. It is the problem (perhaps even the passion behind the problem) that is important—not any specific method, discipline, point of view, or tradition. The well-rounded individual of the Renaissance should be our norm, and

we should not settle for a world of pallid specialists.

John Dewey, considered by many to be America's foremost philosopher of education, early in his career was offered a job at the University of Chicago to head the School of Education. Upon his arrival, he set up an experimental lab school (elementary through high school) for the children of the university faculty. The entire curriculum consisted of the standard content (history, science, math, literature, etc.) taught through some kind of 'hands-on' project. The students made cabinets and clothes, grew and cooked food, dug clay and made kilns to fire pots, while incorporating math, science, history, and art into the activities. Dewey was insistent this was not vocational education but a wholistic approach to understanding the human endeavour, and one in which students would learn better.

In fact the term 'hands-on' belies the dichotomous tradition in education. It's as if one could simply add a 'hands-on' component to a subject and make it more complete (or, as is usually the motivation, more inviting). It is not the material aspect of knowledge that is so compelling, but the wholeness of it. You can't 'integrate' a curriculum by joining parts already separated by tradition, just as you can't throw alternate learning styles into a curriculum designed by verbal and math-science societal needs. The tradition has to be rethought wholistically, breaking down old divisions, and establishing only practical, heuristic units.

If we felt the necessity of this approach, we could redesign curricula accordingly. We would teach the history of all subjects (not just political history) and their material foundations and technological evolutions. Rather than just teaching abstract math, for example, we could teach the history of geometry (or algebra or trigonometry or arithmetic) and the actual historical methods (3-4-5 right triangles for field layout, 'similar' triangles in typical roof design, the geometry of ancient astronomy, and so on). We would teach the philosophy of each discipline (philosophy of science, philosophy of religion, philosophy of economics): how this discipline fits in with other disciplines, how it addresses fundamental philosophical problems, what are the alternative approaches within the discipline, how it might be negatively impacting the human project. Krishnamurti often stressed the value in exploring the impact of traditions (especially specialization) on the sanity of culture, and there's no reason why we can't do it a little in the younger classes and a lot more in high school.

The real issue is thus not between 'academic' and 'hands-on'—an artificial distinction—but rather one of 'wholeness'. Traditional education is one-sided—as is vocational education. Whole humans experience the world as a whole and solve problems wholistically. The traditional

curricula we continue to operate by separate the whole of life into compartments with more or less value. Educational efficiency requires us to package content in accessible ways, but the traditional disciplines and their separateness may not be the best way. We should reconfigure and reintegrate knowledge and curricula into what we now understand are more wholistic and natural and expedient divisions.

Advocates of college-preparatory education are often those wanting to continue the status quo world that this education has brought (namely economic advantage and world power), or those who are afraid their children can't succeed without such a competitive training geared toward available jobs and remunerative careers. These are both selfish goals (individually and nationally) and are part of the problem. The problem is an unjust and inequitable world full of narrow individuals. The biases underlying the artificial separation of the mental and physical, academic and vocational, intellectual and practical, verbal and hands-on—have played their part in creating this world.

There are so many changes going on in the world right now, but so few speak of the need for radically changing education. Yet everything comes from how we are educated. Krishnamurti put so much of his life energy into trying to wake up educators, parents, and students to the need for truly revolutionary education. The Krishnamurti schools have taken up the charge of integrating his psychological insights into the school program. But Krishnamurti left the curriculum up to the school, and so it is up to us to continue this revolution. There is no one else who can and should do it. So, once we see the false underlying roots of our educational traditions, we are morally obligated to rethink the entire institution—not to maximize our personal gain but in order to help create whole human beings. For only whole human beings can make the planet whole again.

Thinking about Art

Radhika Neelakantan

Art will remain the most astonishing activity of mankind born out of struggle between wisdom and madness, between dream and reality in our mind.

Magdalena Abakanowicz

This article about art may turn out to be an article about my thoughts about art. It is difficult to write about something like art, especially if one is not a 'writer'. I hope the reader will be patient enough to read through this.

I have been given enough time to write; and what do I do? I wait, go about the regular acts of living and hope that soon I shall have something profound and earth-shattering to say. Finally, I can only write about my thoughts, and experiences of art while being aware of their limitations.

There is much writing on art that one browses through in the hope of finding that magic that will change perceptions. This never happens. All those who write try to convey through words what has made sense to them and what has worked for them. Each person begins from where he or she is and proceeds further.

I read poetry, forewords by poets, autobiographies of interesting people, newspapers and novels. I watch films, and all that I see in front of my eyes. Interesting shapes, colours and sounds constantly bombard the senses with images. Some of these, I believe, lock into place in the canvas of our brain. Others fit in over a period of time, although time is irrelevant.

Who is an artist?

So, what is it that allows you to call yourself an artist? I have wondered

about this. Is it public recognition or is it the number of works you have produced? Or, is it the fact that you are drawn to gather your energies very often, in spite of everything else, to create something for the eye to see? A musician, an electrician or a window cleaner—they can be artists in their own right.

And at the same time, bills have to be paid, food needs to be cooked and eaten, problems of the world have to be allowed to enter the brain and be assimilated, and one's own thoughts and feelings have to be dealt with constantly. Interactions with others and the peace and conflicts these bring have to be gone through. And in all that, there has to be a desire of wanting to put pencil to paper. This is sometimes difficult. If there is patience, however, and not just a desire to churn out work, all one's thoughts and experiences will influence, direct, guide and inform one's work.

What is an 'arty' type? I don't know. Are there people who can be put in this category? Not just for the fact that they do art but because of behavioral traits, moods and biases which are plastered on to such people. Many people say they 'dabbled' in art when they were younger, but they do not anymore. They feel there are too many things to do—something has to give way. It was just a hobby that could be returned to sometime later when there is the time.

It saddens me to hear things like this. Perhaps because I see the power of art, the deep sense of joy and contentment it brings, the way it causes time to fold into itself and disappear. It definitely creates an awareness that allows one to focus on the reality of the moment. Often when I look at something I have worked upon in the past, it is difficult to believe that it was this 'I' that created that particular thing.

And how does one look at a painting? Is it different from the way one looks at everything else around? Does the fact that it is within a defined space or the fact that it is framed help us to focus? Is the rest of the world a mere jumble in our heads? And after a while does the painting that caught one's eye also become part of that jumble? How does one look afresh at everything? Is it possible?

Working with children

Am I an artist? Well, yes and no. It is easier to say that I teach art. Even

this is not an accurate statement, as I do not think it is possible to *teach* art. What is actually possible for me to do is to invite the children to think in an unusual way, to allow pictures to take shape in the brain, to have the space to explore in any way they want to. But explore and be alert—they must.

After working with accuracy and measurement, it may seem like the much-needed break to have an 'art class'. However, for a few children, it can be their worst nightmare—having to sit with a blank piece of paper and do something 'creative'. Often, I feel, that the adults around help to create this feeling of inadequacy. Sometimes children are praised lavishly for something quite ordinary. On the other hand, they are taught to draw in laboured, prescribed steps. Is it possible for a teacher to encourage but not interfere? Is it possible to demand discipline and regular work habits and yet be supportive, affectionate and allow for exploration?

I continue, every once in a while, to remind the older student who is studying art that there are these points to keep in mind: the capacity to work seriously, a grasp of technique and, most importantly, the ability to visualize and execute your ideas. And behind this of course, one needs an active brain that is alive and alert to the world around.

Over the years, I have seen that the fuddled and unresponsive brain produces art (like all else it produces) that seems to be lacking in something. A piece of art is largely subjective but when one is not involved and not relating to what is around, that art becomes insipid for oneself more than for anybody else. It does not occupy or lead the artist into understanding. It becomes as ordinary as our perception of the rest of the world.

Joy and pleasure in art must not take away the beauty in the seriousness of the work. Often I have found that when there is seriousness, something beautiful is produced. So, it is possible and very important to focus not on producing something but on working with attention. I have realized this again and again whether it is in the children or in myself.

In their busy lives, children move from one activity to another. It is difficult to get them to experience the beauty of working in depth on anything, including art. Is it because our lives are so broken up or is it that they need to, at a young age (unless there is a strong tendency from within to move in a particular direction), be exposed to various things? Or is it that they are working as 'in depth' as possible given the limiting nature of our brain? I

wonder about this. Meanwhile, all that can be done, for now, is to expose the child to what one considers to be important and meaningful in the interactions that take place. The rest of the time, the world at large will be either bearing down upon the brain or stimulating it.

Art is seen by many as a means of improving one's 'creativity'. This is very difficult for me to understand. Isn't every response to the world a means of improving creativity? The art room I work in is a beautiful little structure, on the edge of the school campus. It has enough light and wall space for displays inside and outside. There is an open verandah with an excellent view of distant hills. There is the pottery shed close by. Neither the simplicity of the built structure nor the fact that there aren't any fancy gadgets, come in the way of the children enjoying what they do. Children enjoy working outside when it is not windy or raining. Sometimes, I do not say anything if I find a child sitting quietly and looking at the horizon. This is a luxury possibly only the art teacher has!

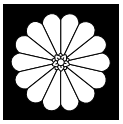
There is no dearth of ideas about what to do in a classroom. All sorts of exercises, using all sorts of materials can be thought of or found. Some children would like the easy way out. Arguments about how they prefer 'abstract art' ensue. I have always discussed with them how anything in nature is an excellent example of how beautifully abstract things can get. The abstract nature of the work is enhanced if one has the patience to draw from nature. The ideas don't become monotonous if you spend a long time observing and drawing. To observe carefully is as important as drawing from the imagination.

Methods may differ and people may differ but the attention is what finally allows you to enjoy and explore what you do. Deciding what the child is going to work on is a very interesting process. If the child is part of this process, the ease with which something can be gone into at most times is wonderful. This does not mean that things can be approached casually. A serious commitment—that the child works at something and sees it through to the end—is demanded. Also, beginning this way often makes the resistance in the child, and thus teacher intervention, minimal.

Talking with children allows them to learn slowly, often non-verbally, what is acceptable and what is not in an art class. Such an atmosphere is created over a period of time. The most important thing is for the child to think in a creative way and be able to execute the thought with seriousness and joy.

Chakravyuha

G Gautama



The formation called Chakravyuha was used in one of the battles of the Mahabharata. It is a secret and complex formation which is easy to enter, but requires extraordinary knowledge and valour to exit from. Abhimanyu, it is said, heard about the Chakravyuha while in the womb. His father, the great warrior Arjuna, was telling the story of Chakravyuha to his wife. She fell asleep just as he was about to explain the art of getting out of a Chakravyuha. Arjuna stopped. Abhimanyu therefore knew how to enter the Chakravyuha but not how to get out. He perished, a brave young lad.

It can be said of the school system, and society, that we have little choice about entry. We all think that the traps can be avoided. However, once in, one rarely gets out—all the elements of the structure work in unison and in complex ways hold one tight. Peers, parents, society, and one's own nature will ensure bondage. Pleasing people who are around one, reacting to them, resisting them, fearing consequences and such experiences shape one's patterns of responses. The urge to belong, the ridicule when one steps out of line, hurt, dependence, finding oneself in dangerous situations, acting completely contrary to one's wisdom in a group—are potent experiences. Potent because they effectively condition.

When Krishnamurti says that he is concerned with 'setting man unconditionally free', we see the beauty and the power of such an expression. However, as grown-ups, we think this statement is relevant mainly to adults. We do not consider it of much relevance in schools or where young people gather.

We need to meet this challenge. The matter becomes poignantly important if we take note of some reports, some facts and some experiences that are common to children and schools. We will try, without being comprehensive, to examine these without anxiety or hurry to see a way out, or to find an answer.

The peer group as a measure of normalcy

Society expects each of us, as we are growing up, to behave largely like all

other people of our age. If a child is quiet or dreamy, or another seems to be overly interested in serious matters such as the origin of life, religion, some academic question that is not easily answered, society looks upon these children with some anxiety. 'Is something wrong?' masks the disturbing questions—'Have we done something wrong?' and 'Who is to blame?' And in life one is likely to encounter severe situations where something may be really wrong, where due to unknown reasons the growth of a child is impeded or development is hindered, situations where normal solutions do not hold. So there is a high premium on 'normalcy'.

In families, as children grow, the main parameter of normalcy is behaviour like other children of the same age. This expectation is natural. How would any of us know for sure that our children are on the right track but for this comparison, this looking left and right? This response to check out seems as naturally programmed as the primordial scan in the periphery of vision by animals in the wild. So it does seem that the checking for reference has validity and some soundness.

Since schools reflect society and the family, the concerns of society are bound to have played a part in shaping the school and its processes. Thus, in the ways schools have cast themselves in the past 150 years, the notion of equality and similarity have played a great role. Both these are sound principles in themselves.

For the purpose of implementing these principles schools had to define their purpose. Learning was readily equated to assimilating handed-down information, and gathering some skills. Though it was recognized that there were more elements involved, the hope was that intelligent handling of knowledge and skills would take care of the rest. In the preoccupation with structuring schools around these principles, in pursuing the idea of an educated population, the reality—that learning is more than assimilating handed-down information and gathering skills—was neglected. And this has made its impact felt.

Children in school are usually clustered together in the same age group. This seems to be born of the assumption that children of the same age learn better or are easier to instruct. And yet the image of the classic truant schoolboy, adorable, human, suffering, laughing and somehow surviving in the midst of expectations, somehow emerging, has surely left its impact on all our minds. We all know this student well. Probably the archetypal girl student is less well known. We know that this highly structured school system has not won the unquestioning loyalty or willingness of students. Many rebelled. "I never let schooling interfere with my education." said Mark Twain. School, as we know it now, has had a good bit of sadness and drudgery, bordering on injury to the human spirit. Around the folklore of school, less

recognized than its achievements, has grown a rumble of voices carrying stories of people lost, surrendering their spirits, reduced to submissiveness and mediocrity. These voices are not strong—these are the voices of the defeated because the system in failing them has left them with a sense of their inadequacy rather than suggesting possibilities.

But why this trauma? Why can't one just drop out if one finds the going rough and taxing? The answer to this question is very intriguing. As most teachers and parents know the greatest blow to a growing child is that he or she has to leave a class of friends or peers. Peers can often be nasty and difficult, but they offer a sense of belonging—a place where one can stand and be connected to one's present and future. As a school-leaving student said, 'My class is a savage and a holy place at the same time.'

Under threat and insecurity what does the student have except his tribe? And when a group of people are put together, all of the same age, all being taught the same thing, all being set the same work, all wearing the same uniform, there is a message driven in at every turn. The message is clear. 'You belong here, and however difficult you find it to measure up, this is where you stand. In fact, the more difficult you find it to measure up to adult expectations, the more you need the peer belonging.' Thus the greater the torment in the young hearts, greater is the bonding with peers.

The peer group as a ladder to success

Furthermore, for jobs and opportunities it matters who you go to school with more than what you learn. Thus if future prosperity and well being are dependent on peers, particularly if the values have been shared and accepted early, peer relationships would naturally matter a great deal. Is it surprising that schools are known by their alumni? People often want to know where the alumni are. This will raise the chances that the students will fit into the upper echelons of society and be taken care of, however poor in academic or achievement terms. The name of the game is 'rising up the ladder, making a name and finding fame and wealth'.

A recent survey in the U.K. showed that 54 percent of the top 100 newspaper editors, columnists, broadcasters and executives were educated privately, despite fee-paying schools catering to only 7 percent of the school population. That figure has increased from 49 percent in 1986, when the research was last carried out. It is further speculated that the situation must be the same in other walks of life. 'How can people from 7 percent of the population adequately represent the entire population in a democracy?' is a difficult question to answer. This survey shows a facet of school life that has hitherto been understood only through the old boys' network and through the P.G. Wodehouse stories. An empirical survey may not reveal

the situation in Indian elite schools and colleges to be very different. Who among us has not heard the words 'recommendation' or 'influence' for getting an admission, or a job or contracts?

How reminiscent of fairy tales! Go to school, mix with students from other homes who are strangers, belong to a class of students, go through many tumbles and agonies, a necessary rite of passage. An invisible fairy godmother smiles through this process. Lo and behold, the magic kingdom opens its gates: good clothes, wealth and power and a life that fulfils all one's desires.

School teachers, one must say, have tried hard to stay true to their mandate, the education of a man and woman in values such as goodness, generosity, care. They have tried hard to support the processes of honesty and sincerity, despite the push of deeply ingrained mythology that one must gain wealth and power at any cost. But the social die was cast a long time ago, and it is difficult to bend its directions. As Krishnamurti says so poignantly—'the unconscious is under the weight of centuries and cannot be turned aside by an immediate necessity.'

The refrain of success

The social die, and the deep mythology of human history, has found new moorings in the last quarter century via the television. Newspapers and books needed effort from the reader to read and digest. The theatre and film medium needed a walk to the venue. Television has converted each home into a theatre, and an animated message board. Each home has become a place to sway opinions, to grab eyeballs—please note, attention is not needed, neither thinking, just eyeballs. The medium of television has mastered the art of bypassing the reasoning faculties, to plant an idea, a notion, and an action-potential node directly in the brain. It has found a way of touching us somewhere deep, a place that is difficult to reach easily through the daily exchanges we have with each other. Television has thus gained great potency and prominence. The message reaching beyond the eyeballs and the eardrums is the ancient refrain, reiterated, re-echoed, re-intoned, resounding with little or no confusion, that 'success is important, rise above the mass; the good life means having good things, riding in shiny cars'.

Young people in our times, children, are being programmed to proceed in an ancient direction. Education at school, while attempting feebly to impart some wisdom, has become the springboard for reinforcing the deeper social programming. The ancient thrust for survival and conquest is reinforced in the places where the children gather. Children, through the structures of school, including the same age classrooms, internalize the Orwellian message that each is a clone of the other; all difference is an illusion.

Variation from the norm will attract

stringent correction or exclusion measures, much like a quality control process in a manufacturing factory. Once the structure is in place—the large buildings, the corridors and the classrooms holding rows of benches and tables—it is difficult to think in another way.

This is school and this shall be school. Another structure is not school. Small variations on the theme are acceptable. Trees, fountains, gardens are acceptable. Change anything, the colour of the walls, the shape of furniture, and yet nothing will change. The fixed assumptions remain.

This is the Chakravyuha, easy to enter and almost impossible to leave whole. It is learnt almost in the womb, the art of entering the Chakravyuha. Krishnamurti says, 'a child comes to school at the age of three already conditioned.' All the steps in one's life, the patterns of behaviour, of conditional care, of affection turning violent, of friendships that demand compliance in behaviour, of seeking security in a group, of targeting the outsider, of gloating about and lamenting the state of affairs alternately, seeking success, harmless success, of wanting to be above others, seeking recognition and power, of desiring what the neighbour has, of gender stereotypes, are from parts of the Chakravyuha. In other words, 'I am what others wish me to be', however much I may wish to be otherwise. The market forces are powerful and insidious, with media and advertising forming a faceless cloud that surrounds one and strips one of the intelligent senses of sight, hearing and discrimination.

Is there a way out?

For the student, the little warrior, the exit is the space to think afresh, the opportunity to question, the examining of the handed-down legacy. Such observation needs space that is free of compulsion and fear. Only there can the thing examined reveal itself in its many hues. However, the challenge does not end here. Even should a new thought surface, it is not easy to act upon it. The tug of belonging, and fear of exclusion, keeps the growing student tethered to the yoke, pulling, huffing, puffing, toiling— feeding the societal mill. Man is in chains everywhere, struggling sometimes, and often giving up, accepting the utter hopelessness of his situation.

For the teacher, the lonely warrior, the struggle translates into the system vs. the individual. All is well as long as one sees that the academic streams keep flowing, the marks stay within permissible limits and the surface of the social mandate is not disturbed. If, unfortunately, this happens, the teacher warrior has to pay the price— banishment or ridicule, not very different from a tribe. Subverting the given mandate is an expression of spirit: refusing to meekly yield to the given rules, rules that demand that one punish and humiliate students; refusing to believe that coercion is the only way out; refusing

to use rewards and manipulation. The only other option is to function in the classroom enclave, where secretly, one subverts the social juggernaut.

The lone warrior can inflict only a little damage to the body of the ancient juggernaut, since more is not possible. One can have the satisfaction of not having yielded, of having given fight. But the little wounds become much like dry skin, part of a ritual of renewal, of the gathering of strength. Opposition only serves to strengthen the thing opposed. Subversion enhances the potency of the juggernaut. All is well, as long as the Chakravyuha keeps spinning, drawing each of us in, student, teacher or parent. We are drawn inward, slowly and inexorably, to the centre, where we become fodder for the mill, an ancient mill. Our bones and sinews feed the mill, so do our struggles. Our struggles and protests are not enough to get out of the Chakravyuha.

Examination without prejudice, questioning without fear, finding out for oneself rather than repeating what has been handed down, looking at things as they are—these are recognized virtues. Paradoxically, the entire system works to undermine these. Do we dare as teachers and administrators to crack the mould? Individual teachers have done much, but for the collective of teachers this is a dead end. This is the Cvhakravyuha.

Opportunities are rare for an overhaul, a fundamental refreshing of the palate. Meeting the double bind of educational thinking, where are the people who will remind the student that his thinking is conditioned and offer the opportunity of reflection without compulsion? Who is to do this in the classroom, in a school, all the while fulfilling the mandate of academic education? Are there bands of teachers who find the holding and sharing of such questions, travelling on these 'paths with heart', as the most important thing in their lives?

Who will dare to question the supremacy of knowledge, handed-down knowledge? Who is going to open doors of thinking that will make the existing system transform through wisdom rather than continue with habit? The subscription to the 'norm' bridles at looking and questioning. Who is there to invite the student to cross thresholds of belonging and loneliness that permit one to think afresh and question clearly?

Who will invite the examination of humankind's legacy, and the flaws that have made it monstrous? Who will discover how to access the youth, who are conditioned so skilfully by the market forces? Who can find the words and non-verbal ways for such an invitation, for such a communication?

Who is going to 'show' that it is possible for human beings to do things 'differently'? Who is going to find a viable alternative to the deeply entrenched 'system' of rows and columns in buildings, timetables and in our

thinking? This requires that there must be a rearrangement of the elements of school and schooling so there can be a freeing instead of binding.

Are there teachers who will, together, hold this challenge selflessly; who will gladly and choicelessly travel beyond preferences and dislikes? Individual teachers cannot do much. This is the time for teachers to work together and in concert. It is the difference between living and existence. An exit from the Chakravhyuha is crucial.

Understanding the Story of Our Lives

The Limitations of the Tools of Science

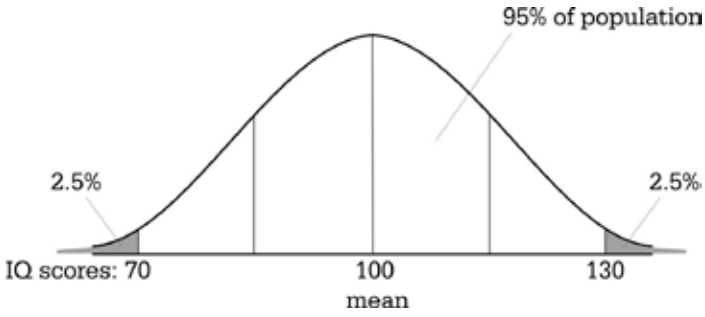
Anya Van Zijll Langhout

The story of life is lived by us. It is experienced first hand from day to day. Stories want to be told and shared, passed on during campfire nights or written in painting, sculpture or scripture and kept for generations yet to come. The lessons and insights that are hidden inside them are waiting to be discovered. But there are many roads and paths to discovery. They all lead to a better understanding of life and the disclosure of a paragraph or chapter of the great story. Among them there are roads with organized checkpoints and watch houses, to observe from a distance, while trying to discover the truth about life. But there are other roads that have a less structured form, that follow the riverbank, the mountain slope, twisting and turning as it goes. How do these different journeys bring us to the understanding of our story?

Science claims that its only function is to discover and expose the truth. Its main tool is logic and in logic it accepts chance. With the acceptance of chance it always leaves a possibility for unexplained and rare phenomena to exist. The chances of rare events are small and negligible. They are the dark and unknown spaces shown in the graphs of statistical chance and must be limited as much as possible in visible representations of the truth, as they only

add uncertainties, not knowledge. The focus of study is on the main outcome of research, the mean score, the average that is true for most people in most circumstances.

Psychology, pedagogy, sociology and other social studies try to make visible the processes of human acting, learning and living, personal and interpersonal. When statistics are known they may help professionals as they try to improve the quality of life. When people suffer from trauma after a tragic event, psychological knowledge can be a tool for finding ways to help them in their healing process. But do these tools also help us to understand the story of our lives? As science is trying to unravel the unknown it starts by looking at how it will measure things and therefore it needs to focus on the development of clear and reliable instruments. After trying out our plans we measure again, gain understanding, create new plans and this process continues endlessly. When we look at our work and life through scientific eyes, what we do is calculate, measure, explain and conclude. We observe life, from our well-designed watch houses in the mountains. But as we watch, we may forget that we are also a part of the mountain. And the unexpected, hidden parts of



Picture 1: The Normal Distribution Chance Graph shows the score results of, for instance, people's IQ levels. The dark and unknown spaces shown at the beginning and end of the graph are small and negligible in statistical chance calculations. Focus is on the 'mean', where truth is supposed to be found.

life are also a part of our truth. Only if we try to delve into what we cannot explain, without focusing on measurement, statistical chance and logic, can we begin to grasp what otherwise stays hidden. Then we will begin to see a glimpse of reality in a holistic view of life that includes all aspects of being. In a holistic view of life there is space for every being to exist.

Without measurement and explanation there is a world where everything has its place and truth does not lie in observable chances. In order to grasp the unmeasurable aspects of life we should first be aware of them, and allow them

the space to exist, not hide them in a dark, small corner of a graph. Once we approach the unmeasurable in silence, through awareness at a different level, we can allow it to be expressed through us, in the shape of art, story, song, dance or even silence itself.

We learn from our own life experiences. They teach us about life and about who we are. If twenty children are able to write, and one can only listen, we cannot start teaching the one to write before we know how he listens. He may the beautiful sounds and voices, creating the brightest imagination that teaches him all about life and the world around him. Why should we, because we cannot measure his imagination, look only at how he differs from the majority? When we teach him without knowing his reality he will only learn what he is not. When we observe him as he is—listening—we too will learn. We will learn more than if we merely study or try to teach language structures and cognitive science. The watching then becomes our life experience and our teacher.

Can this approach of watching and learning be added to our education and remain, and not be crushed under the high pressure of the logic of science? Measurement and record keeping have their place as tools of science. Science has its place as a tool to help improve the quality of life and should be seen as just that: a tool that aids us, but not as an ultimate truth that teaches us what life is. In order to understand life we need to experience it. In order to experience we need to watch and listen. We listen to stories and create our own. Stories express our life experiences and become life experiences for others. May our evaluation records be filled with stories. May our school halls, meetings, and our own hearts be filled with stories. And as our own story of life reveals itself to us, let us sit along the riverbank, watch the mountain peaks, and learn.

An Approach to Environmental Education

Lessons from Krishnamurti

V Arun

This article is based on my experience of teaching Environmental Education for Classes 9 and 10 for the past ten years.

In our school, students are exposed to environmental education right from Class 1. Children grow up learning about nature and with an appreciation of it. In younger classes children seem to have an inherent interest in the world of nature and love going for nature walks and watching insects and other life forms. They are alert and alive to the little changes around them and notice much and derive great fun from it. As the years go by other worldly interests seem to take over, such as video games and play stations and Formula One racing.

However, as they grow older they also seem to gain some understanding of social and environmental issues, as in the present times it is difficult to grow up without hearing about these. On the face of it, it doesn't seem such a bad thing for children to grow up with some such awareness. However, the relevance of information, particularly of the kind that indicates irreversible damage, at an age where one is neither the cause of it nor can do anything about it, needs to be seriously questioned. Invariably by the time children reach Class 9, more often than not, their sensitivity to most issues has got buried under cynical views they come to hold—and this is easy to understand.

My own strong feeling is that young children should grow up learning about the natural world, about the weather, forests and rivers; without having to hear about global warming, deforestation and pollution. I am not arguing that they should be shielded from what is happening in the world around them—I am merely saying that they should learn about the world in its natural form and be able to connect to it, before they learn about all the

terrible things we human beings have been doing to ourselves and to the rest of the world.

For children to feel connected to the world they should have a feeling for it. We start Class 9 trying to build this connection through feeling. Here is where I would first like to draw from Krishnamurti:

> *One must have great feelings. The feeling for beauty, the feeling for a word… One must have strong feelings, because it is only the feelings that make the mind highly sensitive.*

Class 9 begins with the study of nature. We study ecology which is a frontier science. Ecology has a holistic approach. In ecology we study about whole ecosystems and the relationship of each component with the other and the whole. I believe that each and everyone has a feeling for nature. The attempt here is to uncover the student's feeling for nature; not just to appreciate nature from an aesthetic point of view but to also understand the extremely complex and intricate relationships, the interdependence, the design, the variety, the origin and meaning of such variety. Students watch films, listen to fascinating anecdotes and take trips to places where their study is brought alive. Slowly their interests are uncovered. This part of the course continues for as long as it takes.

I would like to quote a few examples here. Take the concept of an 'ecological niche'—every single organism in any eco system has a unique role to play which no other organism plays. I find that fascinating. It is difficult to imagine that each of those millions of species have a unique role. For example, the woodpecker's most important ecological role is to keep a check on the population of wood boring beetles. The larvae of these beetles live inside the tree and the woodpecker has evolved to find them, remove them and eat them. Woodpeckers are present in most places in the world, in different sizes, and they carry out this task. However, there are no woodpeckers in Galapagos, New Caledonia and Madagascar and in each of these islands another species has taken over the job of the woodpecker. In New Caledonia crows do the same job; but since they don't have the necessary inbuilt tools they use cactus needles to dig out the larvae. In Galapagos finches do the same and in Madagascar one particular lemur called the aye-aye does that. The aye-aye does that with a long middle finger! These are called 'ecological equivalents'.

Another concept is that of 'succession', which indicates that if we leave

land alone and do not interfere, nature will spring back and a natural ecosystem will grow there. To understand this we look at Krakatau. Sixty years after the volcanic implosion of Krakatau a small part of the island emerged out of the sea called Anak Krakatau, – 'child of Krakatau'. When it emerged from the sea this piece of land was completely barren. It has been studied for the past eighty years to understand how life returns. A python swam in from one of the nearby islands. A number of birds flew in and brought seeds with them. The most astonishing find was that of spiders which were found in good number. How did they come? It was found that spiders looking for new territories climb to a high position and start making their thread and the wind catches this. They hold on to a hard surface until the thread is long enough to carry them and when they are ready they let go and are carried on it as in a parachute to some new place.

We also look at natural selection and co-evolution with suitable examples. One such is the partnership of the ant and acacia. The acacia tree hosts thousands of ants on it, providing shelter, baby food, and nectar for adults. In return the ants protect the tree from predators.

The value of field trips

At the end of this part of their study we go on a trip to the Palani Hills region. Students participate in the trip with great joy. Just to be outdoors in vast open spaces or in verdant forest or along gurgling flowing streams opens the heart and allows for great feelings. This gives students an opportunity to engage with something other than themselves and even if just for a moment or two, to allow themselves to be a part of the larger reality.

Over the years we have learnt that this is not such a simple process. One cannot assume that if we take students to say, a rainforest, that they will immediately be struck by the beauty of it and will enjoy the experience. In fact I had assumed this and did go with such an expectation only to find that the students experienced a whole range of other emotions from outright dread to indifference.

Growing up in an urban setting there seems to be an alienation that happens with the world of nature and I found that nature has to be introduced in small doses and students should be helped to get over their fear or aversion or whatever they feel and should be helped to connect with nature. Even over a five-day trip – the visit to the rainforest is saved for the last day – a sort of

climax to the trip with the preceding days being used for a gradual build up and connecting to nature through simpler contacts and exercises.

> *And as you watched the light on that river, somehow you seemed to lose yourself, and as you closed your eyes there was a penetration into a void that was full of blessing. This was bliss.*
>
> J Krishnamurti

I feel that when an individual is touched by something living outside of himself, then he becomes sensitive towards it and acts with care. Almost all the people I have met who work with environmental issues have started with a strong feeling for some aspect or the other of nature—bird watching for some, mountaineering for others.

Through this whole study we deliberately steer clear of problems and focus on nature in its pristine form. Even as we start looking at the problems or when they inevitably come into our consciousness, we focus on the positive developments and maintain a positive feeling. Many students by now would be more open and wanting to learn more. On this solid base other things are developed.

We normally proceed to the study of agriculture. This proves a very good intermediate aspect to learn about before plunging into the present world crisis. After all, human beings have been practising agriculture for thousands of years. Understanding the role of agriculture in mankind's changing relationship with nature allows for new insights and perspectives. For instance, we may understand agriculture as the first violence of humans against nature; and also as the first act which freed us from nature's grip, even if only to some extent. We also understand that agriculture brought with it many other features which shaped societal development—such as settlements, ownership of land, and the need for standing armies.

While studying any aspect of environmental education, we need to develop a historical perspective to understand how the present came to be. We need to be deeply aware of our journey through time, not romanticise the past or the present, look objectively at all aspects of our relationship with nature and with each other and understand all its implications without having to justify, blame or judge in any way. For instance, we aim to look at the white races' decimation of the coloured people of the world, to look at what happened thoroughly without having to chastise the white race or the coloured races or

to romanticise the actions of either. Later, colonialism and industrialisation loom large in discussions on several aspects of environmental education.

We keep in mind here a second aspect of Krishnamurti's teachings:

> *Let us not think in terms of principles and ideals, but be concerned with things as they are, for it is the consideration of 'what is' that awakens intelligence.*

I find that some students have an inclination towards nature and often are quite insensitive to human issues such as poverty; and there are others who are inclined to human issues and they feel that to care about nature can only come second to the care of humans. It takes quite a struggle to make students see, if they see at all, that to be sensitive is just that—that one is sensitive—not sensitive to this or that but just sensitive. While each of us might feel inclined towards different things they do not have to be pitted against each other.

Studying developmental issues

From here we move to the study of developmental issues. The students learn that the present developmental model is one paradigm and that there are other alternative models possible, which have been tried with varying degrees of success and are still being tried.

And now we come to a third aspect of Krishnamurti's teachings.

> *Education is intimately related to the present world crisis, and the educator who sees the causes of this universal chaos should ask himself how to awaken intelligence in the student, thus helping the coming generation not to bring about further conflict and disaster.*

At the core of Krishnamurti's teachings is relationship. This relationship is not only between us humans; it is also with nature and other living things. While this needs to be seen at the level of individual responses, we also need to see how human beings have responded as a whole. While we need to look within ourselves, it still involves looking at the external world. We try and help the students realize that ultimately many of today's issues have reached a state of crisis due to the ever-growing consumerist lifestyles and choices one makes in life. Can these choices be informed and intelligent?

By the end of Class 10 students have gone through a journey of sorts and have a fair understanding of issues. When one learns about something, one experiences a need to act and often this is quite strong. Now comes, perhaps,

the most critical aspect of Krishnamurti's teachings, which is the challenge of acting intelligently. Krishnamurti has spoken about total action. Do we really understand that? How then do we act? Or do we not act at all? What is the right thing to do? Can I watch my need to act? Can I watch my need to do something, to feel that I have done something?

In this enormously complex world the limitation of action, or the fact that most action is limited, is nowhere more clear than in the realm of the environment. Here is a rich opportunity to watch ourselves and the need for self-aggrandisement. Through all this the student can still be taught to act meaningfully, to do simple things because she understands the rightness of the action—like not littering, segregating garbage, conserving water and other resources. Even as this happens the student can watch for signs of self-righteousness, and self-projection.

There is an opportunity to be an individual here and do the right thing.

Drawing Students into Environmental Education

V Santaram

Teaching environmental education has been part of our curriculum at the Rishi Valley School well before the subject was made mandatory for all students as per the orders of the Supreme Court. Earlier it was both an optional subject at the ICSE and ISC levels, as well as part of curricular learning that students experienced from the junior classes onwards in various subject and non-subject contexts. Environmental Education has now been introduced into the ICSE/ISC curriculum as a compulsory subject since 2005-6 with

a wide range of well-meaning objectives from understanding, caring for and nurturing our environment, to developing skills, analytical abilities and leadership qualities in tackling environmental issues. In this article, I will try to show that a meaningful approach to environmental education lies more in developing school-specific environment-related activities, with a built-in environmental ethic, rather than treating it as another subject, with a syllabus for an examination.

Many students and teachers currently view this subject as an additional burden on them. The syllabus is repetitive and this makes it less interesting to the students. For example, in Class 10, Unit 1 (Restoring Balance in Ecosystems) and Unit 3 (Pollution) have several topics in common. Similarly Unit 1 and Unit 4 (Striving for Better Environment) have topics in common. Between years too, topics are repeated. Topics of immediate relevance that concern the day-to-day life of the students do not get discussed. Often environmental education emphasizes the problems but not much discussion goes into the possible solutions. The students also have to complete a case study and a project to fulfil the internal assessment requirements. When put together with a lot of similar such requirements in all the other subjects, this can be quite stressful to them. The examination at the end of the year tends to be more like a quiz and very often emphasis is given to fanciful terminology and irrelevant details. The spirit of the subject is lost in this futile exercise and it becomes just one more subject to study and secure pass marks. Hence environmental education loses out on the relevance it was intended to highlight. From the teachers' point of view too, this additional subject takes more classroom time and there is a lot of pressure on the academic timetable. Many schools do not have the necessary staff to handle the subject and often the existing teachers have to bear the responsibility. The subject itself is so vast, encompassing several facets from pure science to humanities including economics, commerce and sociology, that any one teacher may find it difficult to do justice to it.

In my view, a more fruitful approach would be to involve students at all levels in environment-related activities and also incorporate environmental themes while teaching other subjects. This would enable students to see the inter-relations between various subjects and develop a conceptual grasp of the issues. For example in the case of economics and environment, we may

examine issues such as how we can increase economic growth without bringing about an ecological disaster; or in history, we could study how past civilizations have collapsed due to environmental neglect. Attempts in this direction already made in some subject curricula have shown that students develop a more situated appreciation of environmental issues. For example, we have tried to incorporate a biodiversity and conservation ethic into our history curriculum and published books such as *Our Tribal Ancestors*; *Shepherds and Farmers,* used as history textbooks at Class 7 level. These texts present an evolutionary perspective that links together all human beings with each other and other life forms, and raise awareness of the impact of human technological developments since the Stone Age. Economic applications at Class 9 level includes a study of the environmental implications of economic development. More can be done by way of incorporating various units into the existing subjects without creating a feeling of being over-burdened. Eco-literature could be studied in English and regional languages. Changing agricultural practices, impact of the Green revolution and current issues of seed preservation and food security, may be included in the geography syllabus. Various forms of chemical pollution and the safeguards required may be discussed in chemistry, while biodiversity and ecology could find a more central place in biology. For those keen on pursuing environmental science as a career, it could continue to be offered as an optional subject in Classes 11 and 12.

Having made some general recommendations I will share, in the rest of this article, several practical ideas for schools and teachers. Though some of my examples are specific to Rishi Valley School—where I have been involved in environmental education for several years—I feel that these could be applicable in any school. With some thought given to it, I am sure each school could come up with original, context-specific activities that may enrich the learning process of the subject.

Fortnightly wall-newspaper

A fortnightly wall newspaper was launched by the students of Class 11 in December 2006 through March 2007. This wall newspaper was collated and put up each fortnight by a group of students, and everyone in the class got a chance to participate. The contents included: a round-up of environment-related news for the fortnight gathered by the group from various newspapers and magazines; local campus notes of environmental significance, including

weather records of the campus; cartoons, quotes, book reviews; glossary of environment-related terms; as well as editorial tips and suggestions for an environment-friendly lifestyle. This project became a success with students and allowed a lot of self-learning to take place. Students were also able to keep in touch with the latest developments in the subject around them as well as in the country and the world. It also gave them opportunities to read books and magazines in the library on a regular basis and share the information gathered with the rest of the school.

Addressing a local environmental crisis

An opportunity for rich learning may occur when the school or its neighbourhood faces an actual environmental crisis. This may be related, for instance, to increased noise pollution, garbage build-up, or water problems. In 2004-5, our school went through a severe water crisis. Since we had had successive years of deficit rainfall, things were looking ominous. The situation was discussed with the students and staff, and several decisions to drastically cut down on the consumption of water and monitor the situation were taken. The Student Council then debated the issue and decided to raise the general awareness about water conservation in the school. Several posters were put up at strategic locations; monitoring, reporting and repairing of leaky taps was taken up; and strict monitoring of water consumed by the households and hostels on the campus was initiated on a weekly basis by students, who went around reading the water meters that had recently been installed. The readings were displayed and erring staff and hostels were warned about their exceeding the permissible limits. As a result of these measures, the water consumption on the campus was brought down significantly and students were left with a heightened awareness of the preciousness of water. This drought provided a unique opportunity for students as well as staff members to gear themselves to face the challenge and we succeeded in our efforts at averting a major crisis.

Educational trip to an eco-friendly community or campus

There are, today, a number of NGOs and other concerned groups who are exploring alternative lifestyles and establishing sustainable communities. Schools would do well to identify such communities in their vicinity and expose students to the practices and values that underlie these. Close to our

school campus is a village that has been declared as 'smoke-free' since the entire village uses solar cookers and bio-gas to meet its energy demands. A visit with the students to the village, spending a few hours with the villagers who were hospitable and willing to share their experiences freely, was an eye-opener. We were taken into the houses of the villagers which were clean and spartan. They explained to us the working of the solar cookers and bio-gas plants. They showed us the way they use the slurry from the bio-gas plant along with other organic wastes in vermi-composting and how the compost then is used in the fields instead of artificial fertilizers and how this has proved economical as well ecologically friendly. They explained the role of drip irrigation in conserving water. The students learnt the amount of firewood saved, the health benefits that result due to smoke-free kitchens and households, and incidental benefits like vermi-compost. All this learning took place, *in situ* in the most natural way, without being made into the drudgery of a classroom lecture and notes. The students then shared their experiences with others in the school through an assembly presentation. Similar walks are also organised on the school campus itself where we have several eco-friendly technologies at work—such as bio-gas, solar water heaters, parabolic solar cookers and organic farming practices.

Reducing the Plastic menace

Managing and disposing plastic waste is a big on-going problem, whether it is in an urban environment or an isolated rural campus such as ours. The chief source of plastics we found was from packaging of foods that were brought in. Initially we involved the students in litter-picking, where the plastics in the campus were removed periodically by students and teachers. Plastic bins were then installed to collect plastics generated and attempts were made to send much of this to a recycling facility in the nearby town. Some houses (hostels) displayed the amount of plastic generated by the residents each term, and students were made to realize the quantity of waste generated by them. More recently, a food policy was announced that banned bringing in packaged food items from home and instead the school provided the children with snacks freshly made in the kitchen or sourced from local suppliers. This helped reduce the problem to some extent but it needed constant reminders, especially to the parents. Children were also involved in making paper envelopes which reduced the amount of polythene covers used in the hospital and dining hall stores. Items found to have too much of

polythene packaging were substituted with those that had lesser amounts. For instance all the packaged and branded biscuits and chocolates as well as ball pens and gel pens were replaced by locally-made biscuits and chocolates and fountain pens, respectively. The senior students were also involved in the discussions and were a party to some of the decisions taken. The problem still exists but we hope with constant reminders and discussions, the amount of plastics can be further reduced. The educative value of such practical efforts and policy shifts is that it raises awareness of our own lifestyles and habits, and the impact these have on the environment, in a more direct way than a classroom discussion would have.

Running an environmental campaign

An interesting way of educating children on environmental issues that affect them, while getting them to articulate these and seek reforms, is through running a campaign. I will briefly share two examples of initiatives that students were encouraged to take.

The first has to do with excessive packaging that has become the trend among manufacturers of confectionary products. We had noticed that Britannia—a company that purports to be eco-friendly and lends its name to the 'Save the Tiger' campaign--had increased the plastic and metallized packaging content of its popular biscuits (which are among the few available in our tuck shop). The students in my class were encouraged to write a letter to the company, and then get it signed by the whole school. Despite initial hesitation and even cynicism ('Who will answer our letter?'), the students took it up. In order to persuade other students and staff, they had to research the topic and make a convincing case about the harmful effects of plastics and the alternatives available, which was then presented at an assembly. A carefully worded letter was then drafted and signatures of all students and staff collected. The letter that was sent off to the Britannia Company officials did not initially draw a response; but it was then published in the 'Letters' section of *Down to Earth* magazine (November 15, 2002 issue). In April 2003, the school received a letter from the Britannia Company referring to the letter published in *Down to Earth* magazine, commending the children for taking an active interest in the area of environment improvement. They also sent a list of environmental initiatives taken by their organization including packaging. The students then really felt that they had driven their point home.

Subsequently in March 2006, another batch of students took up the issue of a proposed canal that would destroy the last-known habitat of a highly endangered bird—Jerdon's Courser, known to occur only in Andhra Pradesh. The letter was sent to the chief minister of the state and was signed by all the students and staff of the school. (Several other organizations like the Bombay Natural History Society and environmentalists and naturalists too were sending in petitions to defer the decision of allowing the canal to go through the habitat of the birds.) Though we did not get any reply to the letter, the children were elated when they read in the paper a few weeks later of the government's decision to realign the canal.

I feel that the exercise of going through the various stages of a campaign had several sides to it. It promoted educational values since they had to be thorough with all aspects of the issue for which they needed to read and research. The students also had to develop good communication skills since they had to face the audience in the assembly and answer questions put to them. But most importantly it gave them a feeling of satisfaction and hope that it is possible to influence the decision-makers or at least communicate one's views to the people who mattered through the medium of letters.

Themes for project-work

Rather than making projects into an academic exercise to meet ICSE requirements, we could strive to get students to take up projects that are immediately relevant to them, of interest to them and those which can be pursued at home during the vacation. Some of these topics could be about actual local issues. In the course of their research they could interview officials of the government departments, NGOs, scientists or corporate managers. They could also make visits to sites and gain first-hand experience. Some students prefer to do hands-on work and could construct working models of solar cookers, windmills and such like. A few could gather data through observations of the amounts of waste generated and electricity/water consumed in their colonies; they could photo-document environmental issues in their neighbourhood/cities. Some students could even run campaigns in their apartment blocks to reduce plastics or water consumption or to segregate wastes, and document these as their projects.

Using the resources in the internet

There are several good environmental websites to supplement our

classroom and outdoor activities. Though there are sites that give excessive, redundant or biased information, with a little patience one can unearth good sites, which not only give information that teachers need to look at (to supplement the meagre information given in the textbooks and to update themselves on certain topics), but also contain ready-made worksheets, printable handouts, and interactive websites that make learning fun.

I would like to particularly mention here two interesting websites that we use often. One of them is the www.myfootprint.org, based on the concept of 'ecological footprint'. This website asks the readers to answer a set of questions on the web and based on this calculates his/her ecological footprint. The website also gives the background information on what an ecological footprint means and also gives useful suggestions on how one can reduce the size of one's footprint through various practical actions.

A second interesting website is the site hosted by the Michigan Technological University: http://techalive.mtu.edu/meec_index.htm. This site has 19 modules on environmental issues under three broad categories: Water, Energy Resources, and Ecosystems and Biodiversity. Each module has several interactive pages which use animation, games, review quizzes, activities, all attractively designed to engage the attention of students. I feel some of these units could be used as a substitute for a field visit (when facilities are not available) or supplement it. Though the units are strongly biased towards the needs of students of the Michigan area, quite a lot of general concepts are presented in these modules that are useful for students in India. We have used these units to allow students to grasp concepts as a self-learning exercise and many children found them interesting and useful.

Outdoor activities and field-based programmes

Annual treks to the Himalayas and Nature Camps to places like Sikkim, the Western Ghats, besides shorter trips where camps are organised in forest areas, are very valuable in placing students in direct contact with the grandeur and beauty of nature. Class excursions to areas where NGOs are working either for sustainable development in tribal areas, or for environmental restoration work (e.g Navadarshanam near Bangalore, ACCORD in Gudalur, Gram Vikas in Orissa, Neyveli Lignite Mines, Pichavaram Mangroves) give students a first-hand feel of the means of addressing various environmental issues. Project Tiger reserves where eco-development activities are helping

integrate local communities with the conservation of forests and protecting the wildlife are other sites for a rich exposure.

At our school, ecology related activities like weekly bird-watching sessions have been another means of sensitizing students to the processes in nature. Students are also involved in monitoring and charting butterfly populations on the campus. They also assist in making bird counts of water birds during the annual Asian Waterfowl Census programmes. They were also involved in monitoring and gathering details of wetland areas for the Salim Ali Centre for Ornithology and Natural History (SACON), Coimbatore.

Interactions with ecologists and environmentalists and discussing issues

Whenever possible a school could invite ecologists, environmentalists, experts as well as officials, to share their experiences with students through talks, slide-shows and workshops. In this manner, over the years students at the school have come to meet people as diverse as Shekar Dattatri, Vandana Shiva, Anna Hazare, Dr Suhel Quader, Gopi Sunder and Mr Narayan Reddi, among several others. Engaging students in debates and encouraging them to listen to different perspectives on environment-related issues and alternative points-of-view is another means of getting students to think about contemporary issues such as the bio-diesel, nuclear energy and GM food crops controversies.

Conclusion

We must abandon the false concept of life on Earth, rather than the more appropriate concept: life of Earth. The Earth is not a non-living planet with some accidental life upon its surface; it is a living planet of which we are an inseparable part.

Elisabet Sahtouris

Environmental education must indeed echo this truth and bring about a change in the lives of students as well teachers. Rather than making it another subject to be learnt to secure marks, the students should view this learning as something fundamental for the survival and sustenance of life on the planet. Environmental issues must be viewed holistically rather than as fragments. If we can incorporate environmental consciousness in all our subjects deliberately, bring in context-specific learning activities and learn, ourselves, to lead an environmentally friendly lifestyle, there would be no need to teach it as a subject for an examination.

The Evolution of the Sanctuary Schools at Kaigal

Sudha Premnath

It is nine in the morning at Kalligutta, a remote tribal settlement just outside the Kaundinya Wildlife Sanctuary, Andhra Pradesh. A group of colourfully dressed children with their school bags runs towards a thatched hut. Except for the mooing of stray cattle and the chirping of birds, their chatting is the only sound. Beyond the school stand the rocky hills and dense forests. The children enter the school, leave their bags and go about their duties. Some of them clean the place, while the others open two large metal boxes that contain all their school materials and set them up. The teacher is present, helping them, and soon they settle down to get ready for their morning chanting and singing. The mornings at the Sanctuary Schools of the Kaigal Centre begin with this joy of children coming together everyday. Five such primary schools are located in different tribal hamlets that lie on the fringes of the sanctuary.

A week for a child in the school incorporates activities such as yoga, games, art, clay and other craft work, singing and chanting in addition to reading, writing and numerical skills. The schools invite participation from the people of the community in activities related to health and hygiene, forest studies (where students go into the forests and study the bio-diversity), working on land (maintaining small flower and kitchen gardens around the schools and homes) and story telling. Adults and children thus get an opportunity to come together to share and value each other. The children's nutritional needs are also met by the ample lunch available for them at school all through the year.

The beginning

During our involvement with the forest conservation and livelihood

programme with some of the elders of the tribal communities, they expressed the need for schools in the area. While they helped us in documenting the floral composition of the forests and collecting germplasm (seeds, cuttings, root suckers etc.) for the seed bank and forest nursery, ideas on reaching out to the children of the community were taking shape in us. The adults collected forest produce such as fruits, leaves, roots and honey and we helped in the value addition of some of this produce to generate income for them which later developed into the livelihood programme for the community. At the same time, the need to engage with the larger community in a meaningful way was beginning to emerge.

These tribal communities, who live just outside the forest boundary in small hamlets in conditions of abject poverty and malnutrition, remain untouched even today by the 'progress' and 'development' that modern society boasts of. The children in these hamlets help their parents graze livestock, gather fuel and take care of younger siblings apart from other 'menial' chores. The existing government schools are at least a few kilometres away from their homes and there is obvious discrimination against them. Children below six to eight years and girls above ten to twelve years of age usually do not go to school. It is not uncommon here, even today, to find twelve and thirteen-year-olds who have never been to a school!

These children seemed special. Having grown up in the forests, close to nature one can recognize in them and their parents a deep sense of dignity, strength of mind and calm; a quality of acceptance and innocence. They seem to be in touch with the earth and have an intuitive understanding of the beauty and complexity of the forests in which they live and on which they depend. Will a school education take away these qualities from the children? Will it change their perception of the forests and the natural world? Are we capable of creating the right kind of curriculum for them? How can the learning be made relevant and meaningful to their everyday life?

The schools

With innumerable questions and very few answers, it became important to first define some features for the Sanctuary Schools. To begin with, the school would need to nurture and build on the unique qualities and strengths in the children and help to build young individuals who are healthy, happy and responsible. It must take care not to alienate them from their homes

and the forests, but instead help them recognize the value of their culture, traditional knowledge and local ecology. The programme would need to be contextual, appropriate and provide them excellent literacy along with the capacity to earn a livelihood. It would have to help them grow into willing learners who can watch and question themselves. Would it be possible that this school environment could provide them the strength to face the rapidly changing industrial world from which they are alienated?

Is it possible to have such schools and create such programmes? Where would we get the teachers from? How would the schools be sustained? It was fairly clear at this point that the long-term sustenance of these schools would depend mainly on finding the right kind of adults and the willing participation of the community in sharing some of the responsibilities.

The teachers

The task was getting harder. But we had already plunged into action. The Sanctuary Schools needed teachers who would be accepted by the communities. Such teachers needed to be comfortable working in remote places where the schools would be located. The teachers needed to be familiar with the communities and their ways, willing to accept the children without attaching any social stigma. They needed the strength to relate to the children with a sense of care and affection. As responsible adults, they would have to be open to questioning their own ways of thinking and working. They must be ready to learn and experiment with different approaches to teaching, be prepared to sustain the programme, and maybe even interested in pursuing their own higher education.

The challenge in working with teachers has been to understand their strengths and limitations, and provide them with opportunities to develop their skills and knowledge in different areas. It has also been an interesting challenge to provide them an arena that would open up new avenues to think, question and ponder.

Today

What started as just a good idea on a rainy morning in a remote tribal settlement when a group of us were sitting in a crowded cow shed, has now taken the shape of five small schools. Although the initiative is still in its infancy, it has moved a long way, in spite of many difficulties and obstacles.

In three and a half years the schools have evolved to where they are today. The livelihood programme with the adults in the tribal hamlets is now linked to the schools and the profit made from the sale of products is shared with the schools. The community thus indirectly supports, to some extent, the running of the schools. The children learn a variety of craft work as a part of the school curriculum. Many of the things that they make are of marketable quality and this also contributes in a small way. Children with their teachers have initiated seed saving and forest nurseries in their schools and are actively involved in studying the forest. Every school has a committee with representatives from the community who take important responsibilities in the everyday functioning of the schools. All the teachers are pursuing their higher studies and two of them have completed their graduation this year.

The energy and momentum that the programme needs has been constantly sustained by the spontaneous and willing support of many people. Today we are what we are not just because of ourselves but also because of what the forest, the people and our friends have taught us.

As I sit beside the river in the forest at Kalligutta wondering how it has all been and how it is going to be, I am reminded of what I read some time ago:

> *There is no rushing a river. When you go there, you go at the pace of the water and that pace ties you into a flow that is older than life on this planet. Acceptance of that pace, even for a day, changes us, reminds us of other rhythms beyond the sound of our own heartbeats.*
>
> Jeff Rennicke

Rules of Living

Yasmin Jayathirtha

It is almost received wisdom in alternative schools and other similar communities that rules are antigrowth; they restrict creativity and stifle the true cooperative spirit. My ideal for living has always been Tolstoyan anarchy—individuals taking responsibility for their actions and watching out for their fellow creatures. It was easy to visualize a small enough community that could function this way; the smallness precluding the need to set rules which are impersonal and unresponsive to individual needs. Obviously this is an ideal, and in the school we soon found rules were necessary for smooth functioning and one tried to make do with the minimum number. There seem to be two main fallouts to framing a few rules: first, the ambivalence with which the rules are regarded, as a *necessary evil*, causes confusion and the rules are not taken seriously; second, the tendency to bring in more and more rules becomes very strong, the first response to a lack rather than the last. To give examples, the school observes quiet time in the evenings where everybody is expected to spend half an hour alone. The library is a very popular place to spend the time, and is not very quiet! In frustration, we debated making the library out of bounds but wiser counsel prevailed and we contented ourselves with pointing out that an *adda* was occurring there. Another area is dress; one feels that a dress code is the easiest way to deal with inappropriate garb. It may be the easiest but may not be the wisest. Lately, very personally, I have been thinking about the role of rules in living.

The message I would like to give my students is 'we don't need to be told what to do, we are responsible enough to see what the need is'. The 'need' is, however, very easily confused with what one feels like doing, particularly in a child-centred environment, and the message received seems to be 'I should do what I want'. This confusion is not limited only to the children but also affects

the adults. We all wrestle with what can be demanded, should be demanded, and how it will affect the child. The quiet time mentioned above is a case in point. The biggest argument against it is, 'I do not feel like being quiet at that particular time, I feel like. . . ' We have also had to point out to colleagues that they too cannot engage in an activity at this time however quietly they do it. The students will be quick to pick up what they feel is hypocrisy.

Similarly, can we demand that students greet all visitors? Does it smack of 'Good morning, teacher'? If we don't, they appear cold and rude. We could demand that they all exercise and play games and do homework. Among younger children, can we demand they come in to class when called, within a fairly wide leeway that is given for a young child's distractions? These are the issues where we have been ambivalent about rules, both feeling the need for clear-cut guidelines, that is rules, and feeling that these rules will go against the grain of allowing for responsible behaviour. This ambivalence does not stop us from expecting the behaviour though, and feeling disappointed when it doesn't happen.

Society at large does not help. Particularly in India, there are very many rules framed, all high-minded and necessary; but very few are obeyed. For many it has become very hard to obey rules and see them as functional. This, of course, has its effects on the students too, and they become cynical about all rules. The most dangerous manifestation of this, to me, is the flouting of traffic rules. In the city where I live, Bangalore, there is close to anarchy on the streets, with drivers speeding, driving on the wrong side of the road and cutting traffic lights. Traffic lights were installed at a major and busy intersection recently. Within two weeks, they had to be switched off, because they made the intersection more hazardous—vehicles, including government and police vehicles, were routinely going through red lights.

Apart from the school, I have been involved in framing rules or by-laws for the small community where I live. This is a layout formed initially by people who knew each other and still comprises friends, and friends of friends. It consists of houses, empty sites, common areas and water supplies. For about two years our association functioned with no laws. But recently it was felt that putting down rules would help in keeping relationships harmonious. We considered charges for the use of common resources, the impact of our individual activities on our neighbours, ways of keeping the community

informed of our actions—and came up with a set of by-laws we felt would make it easy not to irritate our neighbours. The response of some individuals to this process was astonishing, and exemplifies our ambivalence to rules. They felt that we were making money on the resources, forgetting that the money would go to bettering the place for them. The demand that building codes be obeyed was felt to be restrictive.

We have found a similar response to the very few codes we have set for interactions with the school—such as 'please call', 'take an appointment'. Parents and former students felt that the demand that you inform before coming was too restrictive and made the school unwelcoming. Another code—that they should inform particular teachers of their visit, not just the nearest available person—is also seen by some as incipient bureaucratization. There is a feeling that spontaneity is lost and that interactions become impersonal and rigid; whereas for us it seemed to make it easier to remember and handle one's particular administrative responsibilities.

Following from this, I began to wonder whether we should change the way we view rules and the way we present them to students. Let us take traffic rules, in a way, the purest of rules. They exemplify what rules are—ways of ensuring that cooperation can occur between people who do not know each other. Stringently obeyed, they ensure that everybody is helped, though individuals are inconvenienced sometimes. There is sense in obeying traffic rules. So it is disturbing to see how often they are not obeyed, by people who don't want to be inconvenienced even for a minute and by people who have not understood the rationale behind the rules.

So what should the message be? Obey the rules and don't make individual judgment on situations when the rules can be disobeyed? This seems very simplistic and open to tyranny. How then do students learn responsibility and cooperation? To my mind, this learning will come in two areas: first, in the process of framing the rules itself and second, in the process of amending the rules.

Take the first—the community sets the rules and has to take all the needs into consideration. This means that people will have to speak up about their needs and put them up for scrutiny. They will have to listen to others and accommodate their needs too. The framing of the rules will also be educational: is the rule clear, that is, unambiguous? Can it be obeyed by well-meaning

people, that is, it does not go very much against human nature? An analogy from traffic rules would be: the lights being switched off at night so that drivers need not wait at a red light on an empty road. But most important of all: are we making rules only to avoid any inconvenience i.e. are there too many rules? Are the rules codifying what one would do naturally out of consideration and courtesy?

The second comes in when somebody finds the rule hard to obey, because his or her needs violate the rule. If it is accepted that rules cannot be disobeyed, then there should be a mechanism for amending the rules. This will mean that a person who wants a change in the rules has to scrutinize her needs in the light of the rationale behind the rules. She has to take the trouble to present her case, work for the change. This will ensure that there are non-trivial reasons for change. At school there is a rule that music can be played only in the common rooms at particular times and students cannot bring personal players to school. This is to ensure that we do not fill our lives with 'noise' and activity and to leave spaces and time for being quiet. A student, who recently started learning music, found himself wanting to listen to a lot of music. His dilemma: classical music is not popular and so he could not monopolise the player at common times. Breaking the rules left him uncomfortable and he found that younger students were also encouraged to break the rule. So it was raised in the community and accepted that serious students of music should be allowed to listen at other times. We are in the process of working out the details of how it can be implemented.

During the process of framing the by-laws, and the school rules, I realized that some people found the process disturbing and the rules irksome and difficult to follow. The operational word in the above is **some**. I realized that rules do not bother people who consider others. They are the ones who call for appointments, asking when it will be convenient to visit; they are the ones who ask, 'Whom should I talk to about this?' They are the ones who ensure that their party will not disturb their neighbours. It is what they would do anyway. Rules will, however, help most of us realize that something, which may not have occurred to us, needs to be considered. But what about the few who feel that rules are a drag on their individuality? Society at large uses policing, reward and punishment, to keep them in line. In a small community there need to be other ways of dealing with them and that can be an education in itself.

Applying rules in a small community is fraught with danger. On the one hand, it is easy to detect rule breakers, but on the other, there are hurt feelings when rules are applied strictly. Long ago, in another school where I worked, students were coming late to lunch, delaying the cleaning up of the dining area and lunch time for the staff. A rule was made that the dining room doors would be closed fifteen minutes after the start of lunch time. This set off a furore and it was in vain that the author of the rule argued that missing lunch was a consequence and not a punishment. How do you teach students that there are consequences for their actions? If you do not do your homework, it not only impacts your learning but also that of your classmates, since you will delay their learning too if the teacher has to keep you abreast of the class. If your classmates are irritated with you, that too is a consequence. I feel that learning the difference between consequence and punishment will be helpful. It is important to become aware that one's actions have consequences. As a colleague of mine once said, the school environment is not the same for all children—each child creates his own environment because of the nature of his interactions. If you break rules that define the community you will change it; it is not immune to your actions. My hope is that this understanding would be carried into society at large, where the consequences of our actions are harder to see, so that there can be a change in our response there too.

In framing rules for both communities, I realized that both adults and children react identically to rules; recognizing their usefulness, but regretting the perceived loss of freedom. So, I feel, the process of exploring rules, the need, the framing, amendment and implementation will help create good citizens in the truest sense. They may well be the ones to demand carbon taxes, be willing to pay for alternative sources of energy and pollution control—recognizing that any elected government will only give what the electorate wants.

Preparing Students for Examinations
And Teaching a Subject Well

A Kumarasamy

There is an implicit assumption widely shared by teachers in the Krishnamurti schools that preparing students to face examinations shifts focus away from learning a subject. However, before we identify exam preparation as the main cause for learning deficits, we need to carefully examine some other causative factors. To take an example from science and mathematics, student abilities vary significantly even at the level of classes eleven and twelve. This is because most students opt for sciences for reasons other than aptitude. Our teaching-learning process needs to take this into account and perhaps we need to lower our expectations in the case of students with less aptitude, without neglecting the needs of students who are enthused by the subject. This situation is even more acutely felt at the class nine and ten level, where students have little choice in the subjects they are expected to study.

Attending to the needs of different kinds of students in our classrooms is a somewhat challenging task requiring skill and careful thought. We must keep in mind that, however interesting and deep some of the ideas in the subject are, since the students are being exposed to them for the first time, they will not be able to understand them fully. Such fundamental ideas as Newton's laws in physics (or Calculus in mathematics) cannot be grasped by students fully in the first instance. We need not get anxious about it, as they will be encountering the same ideas repeatedly at increasingly more fundamental levels over the ensuing years. Therefore, clarity in the area of expectations and goals is very essential before we begin teaching a subject. Quite often in subjects like physics, apart from helping the student acquire certain basic skills, the aim should be to provide a rich flavour of the subject and make it exciting and worth pursuing further.

In my opinion teachers sometimes confuse a poorly designed syllabus with exam requirements. Whereas exam requirements pose problems that are much easier to deal with, a poorly designed syllabus poses a different set of problems. In science subjects at the senior level, there has been a tendency to pack in a large number of topics, with a lot of detail that is unnecessary for a sound appreciation of basic concepts in the subject. And yet the topics themselves are fairly standard and correspond to science curricula meant for preparing students for a higher-level study of the subjects anywhere. The issues may be more vexed when it comes to syllabi for subjects like history and economics—due to the contested nature of the choices made and the perspectives presented—but this is beyond the scope of this article.

This article proposes a set of guidelines for preparing students of mixed ability for taking examinations, without compromising on the quality of teaching. In fact, exam preparation ought not to come in the way of learning the subject effectively, and if appropriately guided, may actually enhance the overall learning of different kinds of students. Though I shall take all my examples from the subject of physics, some of these observations and suggestions are naturally more general in nature, and hence are applicable to other subjects as well. Most of the suggestions are not specifically tied to exams; they are the generally desirable intellectual or academic skills that we ought to cultivate anyhow.

Addressing diverse academic needs

For convenience we shall divide students into two groups: those who are capable of grasping the subject fairly quickly and becoming conversant with the subject content, and those who have problems in comprehending the subject. Obviously the division is not a hard and fast one; nonetheless it is helpful from the point of view of a teacher planning an approach to teaching a mixed-ability class, and especially if aiding exam preparation is also one of his explicit goals.

I will not dwell here on the manner of teaching in the classroom, for this may take several forms depending on the experience and predilection of the teacher. For instance, at class eleven and twelve levels this might involve asking students to independently read the text first and then discussing the topic in detail, or else developing an overview of the topic and then asking students to make sense of the text through a guided study. Wherever possible, practical work, with systematic recording of experimental observations and step-by-step working, should be stressed. What I will focus on is the manner

in which the teacher may diagnose typical weaknesses, give appropriate feedback, set tasks for students and get them to work on their shortcomings. As we shall see, proper assessment is crucial to this process.

First, we shall address the reasons why the first group of students often fails to perform adequately in tests and exams. It is common among these students to develop a feeling of having generally understood the subject when they are able to link together the main ideas, as well as recognize and attempt different kinds of problems in the textbook. When it comes to writing tests, however, what tends to afflict them is a lack of attention to detail; this is what teachers often term carelessness. It is reflected in several areas, some of which are listed below.

1. Various points in a given answer are carelessly arranged without due regard to logical flow.
2. Some points are elaborated too much (perhaps because the student is better informed on them) and the remaining points are given short shrift.
3. Questions that carry very few marks are answered elaborately (quite often much of it irrelevant) and those that require more elaborate answers are dealt with cursorily.
4. Numerical answers don't carry units.
5. Graphs are drawn without appropriate labels for the axes or the shapes drawn are grossly inaccurate and don't correspond to experimental observations.
6. There are always students who don't read questions properly and, in practical exams, don't read instructions carefully.
7. Solutions to problems (both numerical and non-numerical) are provided without appropriate steps. For example, in physics, students quite often do not write the formula that they have applied to compute a value—only the numbers are shown or, worse, only the final figure is shown.

Once the teacher is aware of these tendencies among even the better-equipped students, he can consciously build into his approach various ways to remedy these problems. Some of these are listed below.

1. The teacher should conduct frequent (short duration) tests or set

aside classroom time to make such students write answers under test conditions. Typically, homework doesn't seem to enable students to acquire the requisite skills.

2. While going over the answer scripts the teacher should keep in mind all the above shortcomings and make appropriate comments on the margins. Also, if marks are being given, it is necessary to consistently deduct an appropriate number of marks for each mistake. It is important that there be a high level of accuracy and consistency in assessment. Impressionistic assessment should be avoided.

3. Immediate feedback to students is very important; returning assessed papers after more than a week reduces the effectiveness of feedback, for the students would have by then forgotten the test as well as the topics covered in it.

4. It should be impressed upon students that testing is meant to provide feedback both to the teacher and the student on each individual student's strengths and weaknesses; tests are not an exercise in comparing students and identifying the best. Therefore, comparison among students should be firmly discouraged.

The second set of students (those who have difficulties in comprehending the subject) exhibit, in addition to the above-mentioned weaknesses, symptoms that reveal additional difficulties. Some of these are mentioned below.

1. The most common refrain from them after a test is: I thought I knew everything but couldn't answer the questions.

2. They apply wrong formulas to solving problems. (A formula applicable to photons, for example, is applied to electrons.)

3. They confuse similar looking symbols with one another. (For example, v, velocity with V, voltage in Modern Physics.)

4. They confuse one graph with another. (For example, charge versus time and current versus time graphs of charge/discharge process of a capacitor.) There are several such difficulties experienced by this set of students.

It is important for the teacher to diagnose the nature of difficulties shown by these students and their possible causes. Individual cases may vary, but there are some general causative factors that can be mentioned.

1. Most of these problems and confusions arise due to wrong study habits. The 'common refrain' mentioned above is due to the fact that most students tend to read rather than study the content. Rather than carefully examining each step in the deductive process that subjects like physics demand while going over the subject matter, these students merely try to memorize various steps through some mnemonic devices.

2. While solving problems given as homework they hunt for the relevant formula in the textbook. Since solving most of these problems is straightforward, it is easy to find the right formula for solving the given problem. Though the student obtains solutions, there is no real learning that takes place in this approach.

3. While solving more difficult problems they usually take the help of a more competent student to obtain the key step. Here again the student hasn't grasped methods of solving these problems by himself.

It is possible to address most of these problems by consciously encouraging them to develop a range of study skills (many of these would benefit all students).

1. One key study skill is that of making short notes while studying. Students should take time to read the text thoroughly, making notes all the while. One suggested method is simply to highlight important areas. Or else they could note down key terms, definitions and formulae. This process makes their reading more active and facilitates quicker revisions during subsequent attempts.

2. Once they have read through the chapter, they should also practise drawing graphs and diagrams without the aid of the textbook. The likelihood of their making sense of the relationships and configurations, and of retaining these, is thereby increased.

3. During the preparatory period for the Board Exams they should note down, in a separate notebook, all the important formulas to which a short note on each one's application is attached. A similar approach may be used for graphs, units of quantities and definitions as well.

4. Students should not attempt answering questions related to a chapter immediately after going over it. There must be a sufficient time gap between the study and answering questions. This time lag is intended to test the students' retention ability.

5. While preparing for the Board Exams they should study an entire section (consisting of several chapters) over a period of, say, a week before attempting questions related to that section. This tests whether the student confuses one topic with another. It is obvious that textbooks should not be consulted while attempting questions. This facilitates students' understanding and identification of their specific weak areas.

6. Mathematical derivations should be attempted first before reading from the textbook. These derivations would have already been gone over by the teacher in the class. This approach tests how much of the classwork the students have retained.

7. Prior preparation for questions that require elaborate answers (essays) should include noting down all the relevant points in logical order. Apart from making the answers more precise and logical, this facilitates quick revisions before the exams.

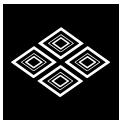
For implementing the above suggestions, it is important that teachers have an accurate picture of each student's academic profile—his weak areas, strengths and limitations in grasping concepts. This information, however, cannot easily be gathered merely through classroom interactions and assignments. There is a need for assessing a student's grasp of the topics taught through carefully designed tests or equivalent mechanisms. If the test papers are poorly designed, the feedback both to the teacher and student will be limited. For example, if the test paper is too difficult, most students are bound to perform poorly, whereas if the test is too simple, everyone will perform fairly well, and individual student's weaknesses get masked. Therefore, a test paper should contain a mix of questions of varying complexity so that the less competent student is able to answer at least some questions, and the more competent student is challenged. Questions should also test a variety of skills—memory recall (through definitions, for example), logical thinking (through short-answer logical questions), essay writing and drawing and related skills. Teachers should provide adequate time for tests so that students don't come under time pressure. In this way their abilities or lack of them are accurately revealed.

In conclusion, one can say that when the teacher makes provision in his classroom teaching, as well as assessment and feedback process, for different kinds of students in his class, the overall learning of the subject may be enhanced for all, notwithstanding the fact of having to take an examination.

Fading Boundaries

Death of the School, the Teacher and the Taught

Krishna H



'May we please go outside?' a student pleads, batting eyelids as I walk into a noisy room of fifteen-year-olds. 'You are letting us free??' another mischievous voice found its way to my ears. I can't help but smile, feeling tired after innumerable attempts at clever retorts to such questions. Now, I have to quickly think of a new one. 'You are born free!' I say, feeling impressed with my presence of mind. I could not come up with something for the first question.

The students peer into their books of short stories in English and yawn occasionally. I have to engage them differently now. Quickly managing to initiate a discussion, I declare, 'Hope is a delusion.' Responses erupt from all over the place. 'Ah! fruitful interaction!' I say to myself. Class over. I leave the room. They run out seeming pleased. Phew! 25 kids, 25,000 things they have got to say.

I am five minutes late to my next class of psychology. 'You are late!' a chorus of sixteen-year-old voices. 'Apologies. I got waylaid,' I reply picking out one of the most used answers from my head. I catch myself feeling proud and happy walking into their class. 'The older bunch seem so open to my class,' I think. 'May we please not write anything today?' My ego deflates sooner than it got inflated.

In the class we talk about feelings, sensation, perception, neurotransmitters and the human brain. 'So what is the role of attention in sensation and perception then?' I ask. It seemed inevitable to me to ask it. It seemed absurd to the children. We revisit the question slowly, trying to make sense of it all. 'The state of the brain is attention,' I blurt out in conversation, '. . . and we seem to learn to estrange ourselves from this.' Question marks spring out on their faces. We interact with caution and confusion. 'The popular content of inattention seems to be thought, mostly thoughts pertaining to the "self".' 'Blah!'— I clearly see this written all over their faces. "But then . . ." More questions. Very few answers. Class over. We leave together talking about structural details of the brain.

As the voices of children have wafted away out of school and the evening invites itself into my mind, I take a clear look at what is remaining of me. Only questions linger on in my brain. 'What is happening in a classroom when children and I come together?', 'What is learning?', 'Who is a teacher?', 'What am I trying to do?', 'What makes for good schools?' . . .These obvious questions that are real for anyone working in the field of education remain prominent amongst an array of innumerable and intertwined questions. I shake loose all the knots off my brain and try to reorder the strands in a systematic manner.

Are schools really for learning?

As I peruse the pages of history in my mind, I see that different learning atmospheres for students, young and old, have been necessary. They have helped people fit in and find a place in the social order of things in an ever-growing modernity, becoming skilled enough to be employed. But just this has not been enough. Learning about oneself, one's psychological life and sometimes the purpose of living itself, has also been of vital importance. The school has been a forum, in almost every society, for creating opportunities for both kinds of learning to happen. But looking at what we have made of the world and ourselves today, much of learning—of both inner and outer worlds—seems yet to happen. It is clear that we continue to live greatly self-engrossed, confused lives, unclear about how exactly to make any good change in the world possible. Schools have not shut down because of this failure. Instead, they have continued to grow in numbers across the globe, giving us the feeling that 'education' is growing as well.

What is 'right learning'? Can it happen in places like schools? By themselves, schools don't seem to be the most appropriate places for learning! This may probably be because they have structures and mechanisms which by their very nature oppose the natural movement of learning in a growing individual. Though some structure and scheduling is necessary, at least to the extent that some activities have a place, a beginning and an end, is it possible not to have too many oppressive structures; and yet allow for working and learning? Would it be possible to create a school where the space and learning opportunity a child receives is not confined to learning skills for examinations? A school where learning is not confined by imaginary society-expected time boundaries such as 'must finish high school education in twelve years'? Of course, there may be some value in getting things done within work-related time boundaries, such as, 'Write an assignment on global warming in one week.'

The ability to learn characterises life. Humans are capable of learning language. They are capable of sophisticated insight. We have survived for thousands of years, evolving into complex societies and cultures across the globe. We are evolving into a

life of great technological sophistication and have plunged into modernity and its challenges. Both biological and technological evolutions have taken us to a level that was unforeseen even a few centuries ago. We continue to train ourselves with skills that accelerate further technological development, to the extent that now a great deal of irreparable destruction is happening. However, psychologically, we seem to be still struggling to evolve. Anger, sorrow, fear, envy, joy and other human emotions are almost at the same place in their structure and function from wherever they have begun in us. Have we tried enough to learn about our psychological lives to enable us to simply live together in harmony with ourselves and other lives? I wonder. Most of what we have learnt has helped us rationalise the great danger in which we have put ourselves and other lives today. What is worrying is that the problem does not even seem pressing or urgent enough for school curricula to change. Marginal modification seems to be our only answer.

Does it matter whether children learn about the psychological life now, or later, or not at all? It is important that we let attention and awareness happen in all of us, including children. In this way, children may pick up employment and management skills from us and let them operate in attention and awareness. It seems important to be with children in their learning of language, thinking and finding out with them what it might mean to use these tools rightly in play, in life. It is interesting to watch how this ability to speak also gives us the ability to discriminate and crystallize our sense of ourselves. Is it possible for a child to draw home learning of oneself, of others, of adults, their vulnerabilities, limitations and through all this honesty and clarity in a group of adults, see occasionally some wisdom in them and give some wisdom to them? Without all this, destruction and violence seem inevitable. This would make us all students and teachers, learning and teaching actively at all times. Boundaries will fade.

Relationship is not manipulation

The babble grows further in my mind. I let it happen. One thing that affects our everyday working with the children in a school is the syllabus. There is very little space in school syllabi that allows us to talk about feelings, conflicts in the child's life, manipulation in adult life and the like. Though the role of relationship is primary in education, a lot of it is about having a 'good relationship' with the children, so that they may feel close to us, confide in us and learn well all that we teach them. But education is about children and adults having sufficient relationship to work and learn together about themselves, about the inner world. How does one really understand oneself in relationship? What about understanding a statement such as, 'It is not necessary to manipulate anybody to get what I want'? Is this something we

have to learn after innumerable years of exploiting and manipulating people and relationships? Or is it possible to see the futility of it right now?

It is difficult, in the structure of the school, for a child to ask to rest the brain in the middle of an organic chemistry class or a poetry class, or ask to do the lesson differently or later or even maybe not at all. For the teacher, it is difficult to keep children from misunderstanding freedom of choice and becoming indulgent consumers. Maybe the problem lies in 'us' and 'them' existing as two identities, trying to manipulate the environment and people so that learning may happen. However, learning to manipulate better is the only 'learning' possible in such a situation.

It seems difficult to create a good atmosphere where education can happen. A school seems to operate on people, working as an organism with its own existence. It seems to have the need to sustain itself, become larger, define its boundaries and grow into a sentiment. This ensures efficient working and makes sure it will survive. It somehow becomes like an individual's sense of 'self'. The individual's self, which is another powerful sentiment, identifies with an organization, feels attached to it and hence holds on to it dearly. The 'smaller individual self' and the 'big collective self' help each other survive. In the midst of all this preoccupation, is education happening because of schools and teachers or despite them? I wonder.

I am beginning to grow tired with the ramblings of my brain. With all the skills and strength of the intellect I have developed through education, it is almost impossible for me to suspend my sense of myself as the learner or the teacher. It seems difficult to suspend the need to belong and identify myself with the organization I work in. My need to look at my work as having a greater purpose than many others also seems 'natural'. My intellect remains dishonest as it thinks it will solve all this easily. If the intellect is honest with itself, it has to accept the futility of its own working in solving problems created by it.

For some strange reason I miss my six-year-old nephew. As I think of him, I recall how attentive he was while playing as an infant. Young children are very attentive. In moments of play in early childhood, children don't need to 'pay attention'. Not attentive to play, but just attentive and play happens—pure and motiveless. Like a bird flying or fish swimming. This moment of learning seems to be very interesting even to watch. What is striking is that there seems to be no player, just playing. I wonder if it is possible to create a learning atmosphere where nothing comes in the way of learning. Not even the identities of the teacher, the learner and the school. Maybe then the result of learning won't matter. Even measurement or evaluation of learning would become far less important than it is today.

All this has to end. It is time the right

thing happened, I tell myself. The old habits and the wrong approaches must die for right learning to take place. In a certain sense of the word, is it possible to 'die' so that learning takes place? Is it possible for all of us as a 'school', 'teacher' and 'learner' to die so that learning and education may happen?

As night breaks on my thoughts, the moon vaguely smiles at the futility of my introspective gymnastics. 'Am I willing to die to myself to let learning happen?' The night hums in my brain. The moon, the crickets, the darkness, the fading energy, the ever-spiralling questions—this is my night, tonight.

A Structural Answer to a Cultural Question: Mixed Age Group in the Middle School

Akhila Seshadri and S Padmavathy

This article is an account of a pilot project on learning in a mixed age group environment in the middle school classes 5, 6 and 7, initiated at The School, KFI, in Chennai in the year 2006-2007. The authors coordinated the programme, and were, in turn, mentored by G. Gautama, the Principal. - Editors

When one comes across a work of intricate art, like a beautifully carved wooden table, one is just taken aback at the depth, vision, aesthetics and design. How did the artist conceive of the design and actually translate vision into a solid piece of art? Like the Taj Mahal, it is not replicable, one feels. But sometimes a table that is plain, simple and well constructed creates the same feeling of awe. The simplicity is its beauty and that takes one's breath away just the same. And when one finds that the simple design can be learnt, shared, worked on and replicated, that adds value. Such is the programme called Middle School Mixed Age Group or MS-MAG, for short. The name alone does not, however, convey the full nature of this learning programme.

The genesis

In the beginning there were, as always, some questions. Is the same age classroom a given structure? What are the problems with it? Does the student learn what the teacher teaches? Do all students learn what the teacher teaches at the same time? What is the role of the teacher in an age where information is so easily, and sometimes freely, available? Is the word 'teacher' also a misnomer? Does the teacher really 'teach'? Is it possible for a student to be a self-directed learner? For over five years we had been looking at various structures, processes and approaches that might address these questions. In staff meetings and, in some measure in discussions among students and staff, we initiated various elements of self-study, which is at the core of a mixed-age learning environment.

The thinking

Given below are the key elements of a document entitled *Transitions in School Education*—towards fostering individual autonomy and intelligent coexistence, written in the year 2000, by G. Gautama. This document explores whether school education can happen around a new curriculum, not of reality divided into specialized subjects, but around differently organized learning, learning around eternal issues, which contain the subjects. The main aims of such a learning programme are:

To help students learn to live healthy and safe lives

Some of the ideas connected to this are: daily routine; anatomy and body posture—sitting, reading, writing without getting tired; learning to eat and live healthily; non-oppressive peer relationships, rules of safe and unsafe 'touch', learning to be safe and creating safety for others around oneself; in short, healthy living in different paradigms.

To create opportunities for and emphasising resourcefulness

Some of the ideas connected to this are: helping students see that there are always many solutions to a situation, that one can generate alternatives, listen to another opinion, learn to speak one's mind (without worrying about being complete), teaching decision making skills, and other thinking skills through processes such as the 'thinking hats' as described by Edward de Bono.

To focus on learning skills for information access and action

This involves learning how to look for information and knowing what to do with information when faced with alternative viewpoints; being open to different sources of information; practising listening, reading, expressing, and sharing insights; learning to listen to alternative perspectives; finding ways to learn with understanding and comprehension; learning from different disciplines—the sciences, arts and social sciences.

To work together

This involves expressing thoughts and feelings, asking questions for clarification, and learning about collaboration and mutual respect.

Finally, to be with others constructively

This demands that one is not invalidated by peer culture, and one learns that respect for the other is not a conditional matter. It also means finding ways of knowing how to intervene in an ongoing process effectively.

Why have a mixed age group?

A question frequently raised over the last year with reference to the mixed age group in the middle school has been: Is it not possible to replicate all the aims and processes of the MAG in a same age context? What is the significance, then, of the mixed age group? The mixed age format is a structure, and structures are statements of intention. The intention in this format is to move away from comparison and standardization and towards individuation and space to work and move at one's pace. The structure of mixed age groups legitimizes differences. It accepts different paces and styles of learning. So, since the mixed age class accepts students learning from 'where they are' and at a pace decided by them, there is room for slowing down, and for exploration, as also for rapid movement. In the same age group, there is an implicit assumption that everybody needs to learn the same thing in the same way at the same time. It does not recognize, by and large, differences in abilities in the transactions. As one child observed in a parent-student orientation meeting, even in the same age classroom, people are not of the same age. But the structure of the same age classroom disregards this fact, and sensitive teachers and friendlier programmes have struggled hard to dignify differences. This structure has thus proved to be self-limiting. The mixed age environment also creates a sense of emotional

well-being, since there is an absence of peer pressure. Hence, it is possible to free the mind and actually learn and work happily. The student's questions are legitimate, the slow pace is accepted, the struggle is a given reality and all students go through that in one way or the other. One can see the possibility of different people becoming masters in different areas, and learning from others where they see need for guidance. Finally, from the point of view of assessing and evaluating learning, it is possible to make realistic appraisals, to look at a child's work and effort for what it is rather than against the yardstick of a mythical mean. The structure has clarity of intention, and hence it works.

Out of this thinking emerged the MS-MAG programme. We conceived of the programme, discussed it in the staff body and the committees of the school, and decided on a one year pilot programme. The idea was presented to the parents and students. Twenty-nine students, with the concurrence of their parents, volunteered. The textbooks used and syllabus were to be the same as in the parallel same age classes. At the end of the year a review would decide whether to extend the programme to the entire middle school or not.

We now share the salient aspects of the pilot programme.

The heart of the programme

We have termed the key processes at the heart of the MS-MAG as the following.

- randomization
- circle time
- self study
- physical breaks
- diary entries
- behaviour norms and work culture
- invitation for initiatives
- classroom space

Randomisation

The basic arrangement of the class is a circle. The teacher is not the focus of the arrangement. The day in MS-MAG begins with 'randomizing',

a verb coined by the MAG from the adjective, to describe a process by which a student is assigned a place next to any other student at random. (A mathematical exercise undertaken by the students one day revealed that it would be years before the same combination of neighbours occurred in the permutation.) This simple structure sets the tone for preparedness on a student's part to work beside anybody. ('Randomizing' has been a practice we have been following in senior school trips to break fixed combinations and allow for greater interaction.)

Circle time

A brief circle time of ten to fifteen minutes provides a conversation space that sets the tone, psychologically, for the day. It might involve taking stock of what needs to be done for the day, planning for the day, acknowledging the inner noises that students come to school with, and proactive conversations initiated by students over issues that have interested them. There are also times when we share stories, read news articles, chant in a special way—one person leading, breaking off at different points, while others repeat twice. An important aspect of circle time is that it does not deal with problems; it is not a faultfinding space. It is a space held together by the adults and the students. Circle Time has proved to be a rich space for thinking and sharing together. For instance, we have discussed whether working under challenging circumstances is something that can actually be the making of a person. What is one's learning style? What are one's strengths and what comes in the way of learning? What would one do now if one had all the leisure one wanted?

Self study

The core of the academic learning is through a process of self study. In one format that is used, it involves the following three steps. A carefully chosen passage is given to the students to be read, for not more than 20 minutes at a stretch. A set of clear instructions is given along with the passage. The student works individually at first. Students then discuss their responses in small groups of three or four. Finally, the whole class gets together for discussion with the teacher.

On the following page is an example of one possible learning session.

Preliminary remarks: You will now read the sheet given to you and follow the instructions. After reading the instruction sheet you may ask any questions you have.

Instructions:

1. Take 20 minutes over the following exercise.
2. Please read the passage, 'Why is the Sky Blue?'
3. As you read underline the words you find difficult to understand.
4. Check the meaning of the words you underlined in the dictionary.
5. Would you like to read the passage again?

   At the end of the first reading please say if you: are satisfied/ would like to read again/ have understood fully/ are unsure.
6. Answer the following questions:

   a. What are some important ideas in this passage?

   b. Put them on a paper as a mind map.

   c. What is the most important idea here?

   d. Why do you think so?
7. What is your feeling about this piece of writing?

   a. Does it connect to your life in any way?

   b. Would you like to change the beginning/ending?
8. What do you feel like doing now?

   (This question is to help you understand yourself. You may or not be able to do what you feel like.)
9. End when the bell rings.
10. Now sit in small groups, age-wise, no more than five to a group. Take fifteen minutes for this part of the exercise.

    a. Share answers to the question 6c and 6d.
11. Discuss what the author is trying to say.
12. Is there any question you wish to share with the whole class?

13. Say one sentence about the manner in which your small group discussion went

14. End when the bell rings.

    Gather together as an MAG class and discuss your questions with the teacher and also listen to her views.

WHY IS THE SKY BLUE?

I only have to look up and see that the sky is blue. But why is it blue? The interesting point is that it is easy to answer that question in a casual way. You ask a botanist, why are leaves green? He murmurs, 'chlorophyll'. Finished. You see, all questions can be disposed of in that summary fashion, in one or two words. You can surely pass your examinations with that kind of answer, but that is not the real answer. The scientific challenge of nature is to think, not only to discover but to think, to think continually and to try to understand this mystery. Why is it blue?' That is a very interesting problem, because two things are there. The sky is there and I am here. I see it is blue. It is the human brain and the human mind as well that are involved in this problem. Now suppose I say, "Don't read any book about it, don't ask your teacher. Let us sit down and try to think out this problem: why is the sky blue? Look at it as if it is a completely new scientific problem about which nobody has troubled himself before."You sit down and think it out and you will find it a most exciting thing to ask yourself that question and see if you can discover the answer for yourself. Now I will put it to you in this way. The best way to answer a question is to ask another. At night, we all see the stars. On a fairly clear night you see the stars twinkling in the sky. Why are the stars not visible in day time? Please ask yourself this question. Well, the reason obviously is that the earth, as a modest lady, has hidden herself under a veil. The sky is a veil which she has thrown around us. We cannot see the stars during the day, because the veil hides the stars. And what is this veil? The veil obviously is the atmosphere of the earth. The same veil which at night is so transparent that we can see the faintest star and the Milky Way is covered up in day time. Obviously, it is the atmosphere which is the veil. And we see the sky as blue only because we have not got other thicker veils like these clouds. You see, for example, those clouds high in the blue sky. Obviously, therefore, for the sky to be really blue there must be nothing else, no clouds and perhaps no dust. The clearer the sky is, the bluer it is. So the sky is not always blue; it is

sometimes blue and sometimes not blue at all. So that the mere looking at the sky enables us to understand the condition of the atmosphere…

Sir C.V.Raman, Nobel Laureate in Physics

The programme has allowed for flexibility and a sense of leisure for a student to learn at her/his pace within broad frameworks. In the words of one of the students: 'In the same age class, we moved from period to period, here we seem to move from activity to activity.' Learning has been enriched by a number of activities to allow for the different learning styles. Students worked in groups on five major projects: Wheels, Civilization, Herbs, Language and Geographical Phenomena.

The self-study process per se has, as an outcome, generated substantial written work, which has necessitated effective strategies for correction. This has meant creating thorough student records and teacher records to meticulously follow up with correction and feedback. Evaluation has involved some tests that are common to the entire group and some that are level specific.

Behaviour norms and work culture

When the students meet in the large group to report on their small group proceedings, the unambiguous brief, reiterated periodically till it has been internalized, is that 'every response is equally valid, there are none to be put down.' Student reporting has to necessarily include the process of the discussions as well as their content. The teacher concludes the discussion by clarifying concepts, offering perspectives, building connections and pointing to extensions. This procedure, worked at with consistency, has now established itself as a work culture in class. The students have learnt to see themselves and their peers as resources to learn from, in addition to their teachers. Dictionaries and other reference tools are provided as further resources. One of the most gratifying experiences for the teachers has been the frequency with which the dictionaries were used. Students quickly internalized that the only sensible thing to do when one did not know a word, was to get up and head for the dictionary. And soon there were many conversations around root meanings and origins of words.

Physical breaks

There is a break for three to four minutes every hour to stretch the

muscles and provide for better blood circulation. This is diligently adhered to by both teachers and students. Different students lead this routine on different days.

Diary entries

There are daily questions for diary entries. For example: Did I learn something useful? Did I learn something new? What do I look forward to in the next session? The students share their responses with each other and with the teacher.

Invitation for initiatives

An MAG learning environment requires initial effort by the teachers to establish the work ethic. This involves adults and students listening to each other, sharing their thoughts, feelings and suggestions, and taking the communication seriously. Together with the students a review of each term is done and together we decide on how to take the programme forward, what elements to retain, and what to add. Some ideas and suggestions implemented have been:

- Creating a resource centre of games and activities, which involves learning and fun
- Creating a class library
- Creation of individual time: students plan their individual time and decide to pursue subjects and work of their choice. The coordinators make sure that there is adequate attention given to all subjects.
- Students organizing and teaching classes.
- A three-minute speech and feedback session: each child prepares a topic, speaks on it for three minutes, while the others listen and give feedback on the presentation.

When students and teachers collaborate, the learning has meaning for students, and they believe in what they are doing. Evaluation too, can happen together. No question need be taboo or irrelevant or irreverent.

Classroom space

The classroom is maintained by the teachers and students together: the chowkies neatly arranged; shoes in order; water bottles and bags in their places;

dictionaries and atlases in racks; soft boards updated regularly. All students have classroom duties and some responsibilities, which they undertake on a fortnightly rotational basis.

Reviewing the MAG

The MAG coordinators regularly review the programme, keeping in mind the following two questions:

How would a teacher know that justice was done to every student?

How would a teacher know that the day was effective for the student?

The coordinators maintain a regular log of proceedings. An excerpt from a teacher's log is given below:

MAG thoughts, reflections for the period June 26th to July 5th 2006:

I feel that the following things are going well.

There is good work, no resistance; the self-study process seems to be valued by students People are able to take breaks quietly; physical breaks are happening regularly. There is no flagging of enthusiasm. Overall, they have respect for each other. Mingling across classes is happening; in some cases, groups have broken up. It is possible to work on one subject at length; at times for four or five periods Students take responsibility for the class on their own; straightening things, putting things right on the soft board Space for initiative is slowly being recognized. Y's initiative led to some good processes; students listened respectfully to her; asked her good questions; she too learnt to communicate better. This has led to other students asking if they could make presentations too. I have seen students who finished some work, pick up some books My corrections are on time and almost immediate feedback is available to students. The students seem to enjoy and appreciate the looseness of their day as well as the structured academic work.

However, I am experiencing some discomfort with the following: Sometimes, the level of noise and chaos is uncomfortable. As yet, I have been trying to keep my voice quiet, express my feelings without disapproval; asking students to take responsibility for something to begin. While looking through the books, I was dismayed to find that some students had actually not completed their work when they said they had. Some of the discussions in small groups have actually not worked at all. I found some interfaces with

the same-age groups in school not so healthy; are there mixed messages coming to them?

What is to be done with someone who is habitually irregular with books and work?

The teacher logs were shared on googledocs and the mentor for the teachers (G. Gautama) had access to the log entries. This allowed comments and suggestions to be exchanged. While the entries were not made daily and there were some misses, the number of entries was large enough to make for a meaningful exchange. Towards the end the log entries were put into a spreadsheet structure allowed by googledocs. The entries were under the headings: Happenings, Celebrations, Problems, and Questions. This makes a rich record of the year available in a form that can be easily shared.

Parent meetings

There were fortnightly meetings with the parents in the first two terms and monthly in the third term to share experiences. The first meetings were to communicate the intentions of the programme in concrete terms. Later meetings were around themes such as communication with students, the process of self-study and what makes for understanding. The participation of parents in the meetings was wonderful as also that of students in a few meetings.

Conclusion

If we were to count the gains, there were many to celebrate throughout the programme. There were few, if any, behavioural problems. Every child made progress, and many progressed far more than anyone could have anticipated. There was also collaboration. Students did good academic work; many of them found their strengths and did not feel devalued. This, we feel, was mainly on account of the process and the structure.

What has been the learning, the value of a pilot venture such as this? The programme has demonstrated a way to 'unleash the learner'. The MS MAG is a way of 'removing the lid', so students do not feel stopped by their 'level' or their 'class'. It is replicable, it has been shown that it is the process that matters; the content is secondary. It is now the way of the school. The Rubicon has been crossed.

And now, it is time to give the programme an apt name: Individual and collaborative study in MAG - a process within a structure, both coexisting mutually.

Postscript

The School, KFI subsequently introduced MAG in the whole of the middle school. Mahanadi, Amravati and Godavari are the new rivers that have started flowing since June 2007.

The elements of this exploration were the core principles used in the ACTIVE LEARNING METHODOLOGIES (MS ALM) programmes conducted for Sarva Shiksha Abhiyan trainers by our teachers under the Outreach work of the school. Based on the inputs offered, the SSA tried out the ideas in 120 schools in Tamil Nadu in June and July 2007. Given the enthusiastic response of students and teachers, it has now been decided to implement MS ALM in all Upper Primary schools in the state for science and social studies.

Action Research
The Power of Action through Inquiry

Raji Swaminathan

Teachers often see research as involving distance and separation from their work. According to most teachers, researchers walk into the classroom, distribute surveys, gather data, scribble notes and depart to a distant ivory tower where they analyze and write up their findings. When results are shared with the teacher or the school, they are, as one teacher expressed, 'pages filled with jargon and "researchese"—best fit for wedging under tilting tables to help them stand upright.' Teachers and students are rarely consulted for their feedback during the process of analysis. Such distance within research traditions is seen as promoting objectivity, credibility and plausibility and is used to test or prove hypotheses.

When research is viewed as separate from teaching, teachers do not conceive of themselves as researchers. However, when teachers are invited to discuss their work in supportive settings, they identify a rich variety of concerns and questions that they wish to explore further. Increasingly, a different type of research is gathering momentum in educational circles that promises to galvanize change in classrooms and schools and stand the test of practicality and relevance. Educators everywhere have a new buzzword—action research. In this essay, I draw on examples from a course that I have been teaching for the last four years on action research to an audience comprising, in large part, teachers and administrators. Since my own work is inspired by holistic educators and in particular by the teachings of J. Krishnamurti, I present examples from the course projects that are particularly relevant to holistic educators.

What is action research?

Action research is a form of systematic inquiry made public. It is not

a process of proving something but a process of discovery and learning that aims at a systematic development of knowledge in a self-critical community of practitioners. Action research gives meaning to the constant learning referred to by J. Krishnamurti that involves 'listening to everything that's happening both outside and inside…' Action research assumes that research is a natural part of teaching and builds on the understanding that teaching is informed by personal knowledge, trial and error, reflection on practice and conversations or dialogues with colleagues and students. The aim of action research can range from a desire to improve the learning environment for all, to address the essential educational questions, advocate for all learners, work for social justice and human rights, educate for insight and for a peaceful and liveable society.

Teachers taking a course on action research begin by exploring the different strands of action research. They follow this up with questions that they are interested in investigating and finally, choose the procedures for gathering data. While there are different types of action research, the action research process itself is operationalized in five phases: (1) frame critical questions, (2) collect relevant data, (3) take well-researched action, (4) reflect on the impact of the action, and (5) share results. It is represented in a diagram as a cycle or a spiral of activity involving planning, acting, observing and reflecting. Some scholars simplify the process to 'look, think and then act'. The important feature of action research is that it not only recommends action but also further research, thereby generating a continuous process of learning and reflection. While the differences among types of action research are not necessarily rigid, they do have different emphases. In one, a problem solving approach is key, and in another, reflection is central. Action research operates within a paradigm of praxis, a term used by Aristotle to mean the art of acting upon the conditions one faces in order to change them.

Types of action research

The problem solving model: This model begins with a teacher identifying a problem who then tries to solve it through some data gathering in the classroom. Once the problem is solved, she evaluates the effectiveness of the intervention. Action research, in this case, involves less collaboration and is usually undertaken by a single teacher in a single classroom. For example, one of the teachers in my action research class decided to implement a new

method of reading through writing in her classroom. She was dissatisfied with the existing classroom texts and hemmed in by regulations that insisted that she use them. She began to document how students responded to the texts and experimented with using writing to teach reading. She invited other teachers to sit in on her classes for feedback and documented student progress in reading skills. Her peers gave her feedback that she incorporated into her teaching. Feeling affirmed in this way, she introduced journal writing in her classroom as a regular part of the day, and found that even those who struggled to read could always read their own writing.

The reflection model: Action research that involves teacher reflection often stems from a desire to change one's teaching practice. The goal is to understand practice and solve immediate problems. The changes that result in such projects tend to be associated with the individual teacher, and consequently the interventions may cease to be used once these individuals leave the system. For example, one teacher wanted to reflect on his practice in terms of paying particular attention to gender equity in his classroom. He videotaped his classroom and analyzed the number of times and the ways in which he interacted differently with boys and girls in his classroom. While watching the videotapes, he asked questions that would prompt reflection. For example, what kinds of decisions did I make during the lesson? What was I thinking about and feeling during the lesson? What responses and reactions of students prompted or influenced my decisions? He used the data he gathered to prompt changes in the way he taught.

Emancipatory model: Emancipatory action research works for social change. The first aim of this model is to decrease the gap between the day-to-day problems encountered by practitioners and the theories used to explain them. The second is to raise the collective consciousness through a three part social critique of theory, enlightenment and action. One example of an emancipatory model is a social action project that two teachers decided to introduce to their high school students. Students identified one problem in the community, reflected on what caused that problem, learned to negotiate and understand power structures and finally came up with a plan to resolve the problem. This project involved not only the teachers and the students, but also the community and the local political authorities. Its impact was felt beyond the walls of the classroom in the community. In this case, students chose to promote environmental awareness by identifying the problem of a

lack of recycling in their communities. With the help of a local community-based organization, they succeeded in getting recycling bins to every home in their neighbourhood.

Towards a holistic action research model

After examining these models, I emphasize that the boundaries between different types of action research models are not set in stone. The more complex or comprehensive a project, the more likely it would be to encompass critical thinking, reflection and problem solving within it. Having looked at these models, we challenged ourselves to think about what action research would look like in a holistic school. Thus far, in keeping with the different models, we had read scholars who emphasized each of these areas. Since my own teaching is inspired by holistic education, I introduced the writings of holistic educators—J. Krishnamurti, Rudolf Steiner and Maria Montessori. The teachers in the class, some of whom were at alternative schools, were excited by the readings and wanted to design holistic action research projects. I now describe the process of one action research project that was designed and implemented in a holistic school. My role in the project was to serve as the listening post and a reflective guide. Once the project expanded beyond the class to the school site and involved collaborations and permissions, I was invited in as a trusted 'friend' and consultant to help analyze the data.

Case study of action research at a holistic school

At Maple Leaf School, the focus was on creative arts. A small school of 120 children, it was a successful school in the area. Two of the teachers from the school were in the class on action research. Inspired by their readings on holistic education, they reflected on alternative strategies to nurture the inner lives of children. In action research, this process is called awareness planning, requiring one to expand ways of thinking and form new mental connections. The teachers decided to abandon their customary mode of thinking only about their own classroom, and chose instead to act and think about the whole school.

They used a five-step outline comprising the following questions:

1) What do I want to know and why is it worth knowing?

2) Procedures—what will I do in order to find out?

After carrying out the procedures:

3) What did I find out and what did I observe?

4) What do I think this information means?

5) What would I recommend as a result of this information?

The answer to the first question would create educational change. Learning in holistic education is seen as a journey in consciousness, a passage of self-unfolding. Although the school they were working in was holistic, it had embraced the creative arts as a way of being. The question that the teachers had was whether other dimensions were being ignored and what needed to be included.

The second question was answered by their decision to involve everyone at the school, including students and parents, as co-participants in the research. They decided to hold a series of focus group discussions on how different groups viewed holistic education—what was considered central and necessary to holistic education. By doing this, they hoped to build up a set of criteria to establish what holistic education might include, and to propose changes to the curriculum of the school.

During the focus group discussions, the facilitators explained that this was a discussion focused on what makes a holistic school, and as such, while parents were definitely interested in their children's job prospects and academic skills, the purpose of the discussion was to find out what else they might like to see happen at the school. What kind of adult did they want their child to grow up to be?

The focus group discussions produced lively debate and generated numerous ideas and suggestions.

Findings from the focus group discussions

The teachers found to their surprise that there was much more consensus around what parents wanted for their children at a holistic school than they had expected. Parents wanted the school to be committed to the cultivation of spiritual intelligence. Overall, parents stressed that they wanted to see the following qualities nurtured in their children: self-awareness, a capacity to be inspired by truth, the ability to face and transcend pain and suffering, the ability to face truth and 'what is', the sensitivity to see connections between diverse things, and the ability to be field-independent, by which they meant the capacity

to stand against what a crowd believed or stand up against convention.

Students wanted the capacity to be spontaneous, flexible and adaptive, all of which they deemed as vital for them as they grew into adulthood. They saw their teenage years as becoming increasingly constrained with pressures to be popular, famous and to make it big. They were convinced that they would have to learn to adapt to failure and quickly changing circumstances. They wanted to learn to develop the capacity to 'slow down' enough to experience a quality of life, and learn to be strong in the face of failure. They also wanted to learn how to find meaning and satisfaction in what they did.

Teachers added that they wanted students to feel compassion. They wanted students to become aware of the aspects of human life that have some mystery about them and that cannot be explained away easily. Finally, they wanted students to feel empowered and become aware of the power of their own ideas.

The teachers took all the information and analyzed it thematically. I was called in as a consultant during this period and I helped in the analysis and grouping of data and information. They categorized the qualities and skills that parents and youth were looking for in school. At the end of this, they had a series of discussions about what was found in the data. They first discussed it among themselves, and then opened up the discussions to all participants and presented to them what they had found in the data.

From all that they had learned, they made a series of recommendations that included changing the curricula of the school to incorporate specific times where teachers and students would pay attention to nurturing their inner lives. One small example of this was a project for the eighth grade called Thin Places.

Thin Places

In J. Krishnamurti's teachings, both aesthetic beauty as well as a natural environment are referred to as important for educating for intelligence. Krishnamurti often pointed out the importance of relating with one's natural surroundings. In his words:

. . . healing [of the mind] gradually takes place if you are with nature, with that orange on the tree, and the blade of grass that pushes through the cement, and the hills covered, hidden, by the clouds. This is not sentiment or romantic imagination but

a reality of a relationship with everything that lives and moves on the earth.

The teachers at Maple Leaf School decided to take seriously the idea that connecting with nature in meditative ways is important for the growth of students. They decided to experiment with the idea that there are 'thin places' in the world where it is possible to connect with nature at a more fundamental level, where the layer between direct experience or perception and the weight of conditioning is thin.

Students were first asked to think about times when they had been overcome with the beauty or magnificence of nature. The teachers then explained that such places were referred to as 'thin places' where the veil between the physical and the spiritual was thin. Students were intrigued by this idea and were open to the question of whether they could find such places on the school grounds. Taking the idea of thin places seriously, every student in the class was asked, either with another student or preferably in solitude, to take walks on the school grounds in silence. They were asked to sit down wherever they felt they connected with nature in some deep way. After a few days of walking and sitting for half-hour periods, they were to identify places that they had an affinity to or felt especially quiet in, and take photographs of these places. Students kept an ongoing record of their observations and thoughts in a journal, and eventually shared some of them with the rest of the class.

Conclusion

Action research is a holistic method to problem solving rather than a single method for collecting and analyzing data. It points a way to answering questions such as— how can teachers learn from their own work of teaching? How can they encourage critical inquiry among students? How can teachers or administrators be participants in generating change? Through action research, teachers become aware of themselves as both the products and producers of history. In this sense, action research gives concrete meaning to the statement by Krishnamurti:

> *So the real function of education is not only to help you uncondition yourself, but also to understand this whole process of living from day to day so that you can grow in freedom and create a new world—a world that must be totally different from the present one. . . That is why education must be a process of educating the educator as well as the student.*

Book Reviews

A Flame of Learning
by J. Krishnamurti
published by
Krishnamurti Foundation
India
reviewed by Gurveen Kaur

'*A Flame of Learning*' is not an easy book to read—but then few worthwhile things are easy. It is not a difficult book if one wants to merely understand it verbally or intellectually, but if one wants to really, truly understand what it is about, one needs to read it with great attentiveness.

One can learn much about teacher-training from this book. It is a record of some of J.Krishnamurti's conversations with teachers. It gives a glimpse of an out-of-the-ordinary (to say the least) educator and philosopher training his teachers. Krishnamurti asks in the beginning of the book, 'If we all think these teachings are important, how shall we transmit them to the student so that we have a different kind of human being leaving these schools who is not just like everybody else? … Now, how shall we do it?' One can relate to this immediately for it is the question that we are all seeking an answer to as teacher educators and as teachers.

As one reads further, one realizes that this training is very different from most of the teacher training sessions conducted today. Most training today focusses on the means while remaining silent about the aims of education. Krishnamurti gets to the heart of what, at the end of the day, makes education an intrinsically worthwhile activity. Throughout the book, he pursues this question: how are we to light the flame of learning that will result in the transformation of the student? *A Flame of Learning* is not merely about how we should teach History, Math or Science, but about how to transform the student while also teaching these subjects.

In sharp contrast to the trend in modern training sessions that attempt to upgrade quality by focussing almost exclusively upon technique and technological factors, Krishnamurti focusses on the human and the psychological aspects of the transaction.

This serves to draw teacher-educators' attention back to the centrality of the human interaction that lies at the heart of education, and makes us recognize that even the most sophisticated methodological considerations can assist in the teaching-learning process only up to a point.

One of the first few things that strike the reader is the way in which Krishnamurti relates to teachers. He does not talk to them but with them. Unfortunately, at most teacher-training programmes these days, the trainer talks down to teachers, but not with them, and the teachers in turn do the same with their students. Krishnamurti rightly points out that it is essential for the teacher to get off his pedestal of authority; for, it is only possible to light a flame of learning if the teachers and students explore issues together. One of the highlights of this book is to learn how this can be done without abdicating the responsibility that lies with the teacher.

It is interesting to note here that while Krishnamurti asks the question, 'How shall we do it?' he is not looking for a method. He is interested in laying bare the general form or structure of teaching that would serve as a guide, but cannot be mechanically followed. Too often in teacher-training sessions, a precise lesson-plan with the method is detailed and teachers are expected to follow. Such a detailed outline calls for nothing from the teacher. It is not internalized and not meaningful to the teacher. Therefore it is mechanically taught and, in turn, leads to indifferent, superficial, and mechanical memorising. Krishnamurti walks his teachers through the teaching, thus giving importance to process, which is essential not just for the teachers to internalize the lesson, but also to understand the importance of process in any learning.

There is another (unintended) lesson for us in this book. One realizes that at times even Krishnamurti is a bit impatient with some answers and the very genuine doubts that teachers express in the course of the conversation. As a result, at times one finds that some teachers try to give 'correct' answers rather than really say what they think. This happens whenever the teacher gives more importance to what needs to be taught and forgets that it can only be taught if one travels at the pace of the student. This should alert us even more to that ever-present danger in teaching and make us careful and determined to avoid the same pitfall.

Finally, the book has great relevance to teachers even outside the Krishnamurti schools. Building attention and intelligence, self-awareness, order, freedom, discipline and uncovering the sources of our conditioning, prejudices, fears and jealousy must be the concerns of all teachers. Whether one is interested in simply improving the ability to learn through sharpening attentiveness or with the more

challenging task of bringing about a deep, radical change within a person, this book should be of interest to teacher educators, teachers and parents alike.

BIRDS AND PLANT REGENERATION
BY TARA GANDHI
PUBLISHER: RAVI DAYAL, DELHI.
REVIEWED BY K. RAMESH

I remember a conversation I had with a young bird watcher in Sahayadri School. It was at dinnertime, and I was telling him about my trip to the peacock hill, not far from the campus. I had been there to look for peacocks. There was not a single bird around, but I came upon a feather. It was long and beautiful. I couldn't identify the bird from whose wings the feather would have drifted down. I showed what I found to the bird watcher. It was a treat to see the sense of wonder spread on his face.

Children love birds. For a boy or a girl, there is nothing quite like climbing a tree and peeping into a nest full of spotted eggs, on a fine summer morning. It is not uncommon these days for students to do projects on trees or birds. Unfortunately they tend to look for all the information they need from the websites. The irony is the trees and birds about which they have to study may be found just outside the classroom. Watching a banyan tree and the birds that nest in the branches, one can learn so much about the inter-relationship that exists between flora and fauna. If students are asked to read a book on birds, however good it is, not many will relate to the content with interest. At most, they will look at the colourful pictures. But if a teacher asks the students to observe the birds on the campus, and share what they have seen, they will find the activity interesting. An outdoor activity of this kind will probably make them visit the school library to look for details in books or journals.

Inter-relationship between plants and birds

Birds and Plant Regeneration by Tara Gandhi, has an abundance of facts relating to birds, their habitats, and mainly their role in regeneration. The book is an outcome of an assignment to document different aspects of natural regeneration, in which birds have a vital role. The author has included tables of data and drawings related to the topic. The information is a good resource for anyone who is involved in the study of the inter-relationship between plants and birds. There are also colourful photographs of forests, islands, wetlands and birds such as the spot-billed duck, jungle mynah, and the koel, to name a few.

In the introduction the author refers to Dr Salim Ali's concern over the loss of flora and fauna, and she says that the book 'attempts to draw attention to the role that birds play in this process of natural

regeneration'. She speaks of the inter-relationship between plants and birds by citing the example of the Calvaria Major, in other words, the dodo tree. We learn how the tree could reproduce only when the dodo ate the fruit and excreted the seed. The tree and the bird were found in Mauritius 300 years ago when the Portuguese invaded the island. The dodo became extinct a short while after. As a result the trees couldn't reproduce, and now there are only thirteen of them in the island. This information gives us an idea of the significance of the symbiotic relationship between birds and plants in general.

Classification of birds

Reading the first chapter of the book, we get an idea of how birds are classified. There are frugivores, omnivores, grainivores, insectivores and nectarinivores, based on the food they eat. If we have ever wondered what babblers or mynahs that are so common, eat, then this classification provides us with the details. The author points out how birds of each category help in germination and enrichment of soil nutrients, the role they play in reproduction and distribution, and in protection from insects and pests. After defining what an ecosystem is, she goes on to write about seed dispersal and regeneration caused by birds in different ecosystems such as forest, wetlands and islands. She vividly describes the process of fertilization of water by water fowls. Her reference to painted storks, open billed storks, spoon bills, herons, pelicans, ibis, cormorants and various types of egrets building their nests on bushes in and around water bodies, and her mention of all other activities associated with rearing of nestlings, bring to our mind a picture of a bird sanctuary like Vedanthangal near Chennai.

The roles the birds play in regeneration

We often see an egret or a heron standing very close to cattle in the fields. In the book, there is an account of how people in the village Kokhaarbelur in Karnataka, protect the water fowls like painted storks and spotted pelicans. This reveals the fact that birds and animals can relate to us without fear; but this mutual understanding depends a lot on our interest in taking care of them. In dealing with island ecosystems the author cites a number of examples to explain soil fertilization for which the birds are the cause. As we read the book, our knowledge on ecology gets broadened; the author refers to many environmental truths. In the chapter assigned to mechanisms for natural regeneration by birds, Tara Gandhi with suitable examples writes about the role of different kinds of birds in promoting the regeneration process.

In the final chapter the author describes birds that belong to different categories, giving useful information about the nests they build, the food they eat and also their zoological names. Conservationists as well

as bird watchers will benefit from reading this chapter.

Care for nature

Except man, all other life forms seem to be conscious of the significance of inter-dependence. Tara Gandhi's book is mainly about this inter-relationship. It brings to our mind an excerpt from the book, *All The Marvellous Earth* by J. Krishnamurti. 'If we could, and we must, establish a deep, long abiding relationship with nature—with the actual trees, the bushes, the flowers, the grass and the fast moving clouds—then we would never slaughter another human being for any reason whatsoever.'

Tara Gandhi shows us how birds contribute to the well being of Mother Earth. Although the book is full of facts, the author has used simple language to present them, and also to explain concepts related to ecology in a lucid style, which a lay person can easily understand. Since we have not been giving importance to the ecological truth that for sustenance inter-relationship is important, we have become solely responsible for the degradation of the planet. Our so-called development will no longer be meaningful, if the concern for nature is not in our agenda. In the introduction the author begins with Salim Ali's lines: 'But for the trees, the insects would perish; but for the birds, the trees would perish, and following this inexorable law of nature to its conclusion…but for the trees, the world would perish'. This concern is the essence of the book.

Dr Gurveen Kaur is Principal and Secretary, Centre for Learning, Secunderabad.

K. Ramesh teaches Physics and English at The School, KFI Chennai.

Contributors

P Krishna

Shailesh A Shirali

N J Krishnan

T M Krishna

Patrick Foster

Radhika Neelakantan

G Gautama

Anya Van Zijll Langhout

V Arun

V Santaram

Sudha Premnath

Yasmin Jayathirtha

A Kumarasamy

Krishna H

Akhila Seshadri and S Padmavathy

Raji Swaminathan

Addresses of Schools

Rishi Valley School
Rishi Valley Post
Chittoor District 517 352
Andhra Pradesh
E-mail: office@rishivalley.org

Rajghat Besant School
Rajghat Fort, Varanasi 221 001
Uttar Pradesh
E-mail: kfivns@satyam.net.in

Sahyadri School
PO Tiwai Hill
Taluka Rajgurunagar District
Pune 410 513, Maharashtra
E-mail: sahyadrischool@vsnl.net

The School – KFI
Damodar Gardens, Beasant Avenue
Adyar, Chennai 600 020
E-mail:alcyone@satyam.net.in

The Valley School
'Haridvanam'
17th K.M. Kanakapura Road
Thatguni Post, Bangalore 560 062
E-mail: thevalleyschool@sify.com

Brockwood Park School
Bramdean, Hampshire
SO 24 OLQ, UK
E-mail: admin@brockwood.org.uk

The Oak Grove School
P.O.Box 1560, Ojai
California 93023, USA
E-mail: office@oakgroveschool.com

Centre for Learning
Village Varadenahalli
Magadi Taluk
Bangalore Rural District 562 120
E-mail: cfl@vsnl.com

Nachiket
c/o Rajghat Education Centre
Rajghat Fort
Varanasi 221 001
Uttar Pradesh

Bal Anand
Akash Deep
28 Dongersey Road
Malabar Hill
Mumbai 400 006, Maharashtra

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