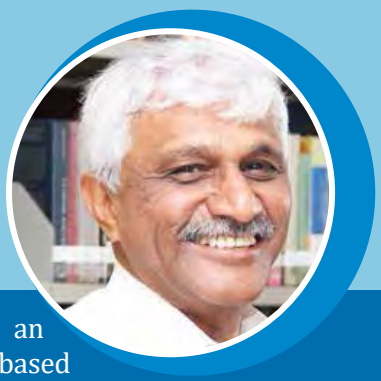
INTERVIEW WITH RICHARD FERNANDES



Richard Fernandes co-founded Centre for Learning (CFL), Bangalore - an 'alternative' school, where he developed and implemented laboratory-based curricula for learning Physics. A strong believer in the dictum that "Physics is best learnt by doing", he enjoys building experimental apparatus from material found in scrap yards or cannibalized from discarded instruments. In this interview, he shares his experiences of being a Physics teacher at the middle and high school.

Tell us something about your work as a science educator, especially at the middle-school level.

I set up a Physics teaching laboratory for students of the middle to higher secondary level, in a small, 'alternate' school that was started by a group of educators, including myself. The unique thing about the programme I set up was that experiment and theory were not two separate aspects of the subject. Classes were held in the laboratory and students hardly ever sat down to be 'taught'. They were on their feet doing things most of the time.

It did not take much money to set up this laboratory; most of the equipment was built by me using very rudimentary woodworking and machining skills and equipment. The main sources of material were the scrap shops and 'chor bazaars' around Bangalore. But that did not mean that the experiments were crude and unsophisticated. Using such simple equipment brought a sense of connection with the data collected or phenomenon studied. This is in contrast to the black box approach that is followed even in engineering education today where experiments are set up and sealed in a polished box by some manufacturer of scientific equipment and a prescription then given to get the experimental results.

What made you want to become a science teacher?

The joy of sharing what I enjoy is probably the foremost. Other reasons include a missionary zeal to do my bit to get rid of superstition and obscurantism in society. I was strongly inspired by the work of the Nuffield Foundation, who developed one of the most comprehensive science and student friendly education programmes ever, and drew heavily on the material developed by them. However, I cannot see myself being a science teacher in the mainstream school system with its emphasis on content and the pressure to deliver it in a specified time.

On a daily basis, how do you prepare for class?

I do not teach school-level science any more. When I did, preparing for a class meant getting apparatus out of cupboards and making sure that things were in working order. I generally had a lesson plan that I threw out of the window if the class took an interesting turn. This is a big advantage of not being weighed down by a syllabus.

If one walked into your classroom on a typical day, what would they observe?

Students going through a set of instructions, written or verbal, setting up and doing a set of experiments, discussing the results of these experiments, drawing logical and not necessarily correct conclusions, and being guided by me to the desired conclusion if that was important. These activities are often boisterous and noisy, and much of my effort goes into preventing accidents.

Do you have any advice for science teachers who might have big ideas for ways to get their students interested, but might not be sure how to implement them?

Early interest in Science is in wanting to know the how and why of the workings of things, both natural and human-made. Address those things that are accessible, be honest and logical, and do not give hand-waving reasons. I believe that remarks like "scientists have

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found" discourages students and puts them in awe of these 'scientists' and at best makes them want to be one of those scientists. On the other hand, tell them, "you are the scientist, make your discovery". The first approach makes them ambitious; the latter gives them the confidence that comes with achievement.

Do not make nationalism an agenda in science education. The Raman Effect is very hard for the average high school student to understand. Leave it alone.

Is there something as a 'natural aptitude' for science? What is the role of a science educator in identifying and nurturing it?

This is dangerous territory for a teacher. I like to believe that all students are equally capable and I pay equal attention to all of them. Students get fired up by different things at different times. It would be wrong to judge students too early. Very often the more articulate and precocious students are identified as having a natural gift.

I have seen some students take to science more easily than others. A little detective work then leads to the fact that the reasons are more social than anything else; students are picking up stuff from their environment – a parent, older relative or friend.

The genius and the prodigy will always find a way to emerge. It is the average student that needs to be nurtured.

What if your students don't 'get it'? In other words, if a lesson is not working for all your students, do you have a plan for remediation?

If students don't get it, try another approach. There are many ways to look at any problem.

How important are specialist subject qualifications for effective science teachers?

In a perfect world, school science teachers would have research degrees in their respective disciplines. Not because researchers know more but because they develop the skill to tease out information out of what they study. This would enhance their ability to attempt many different approaches to help a student understand something. This is your answer to the ksjdgprevious question.

How can a teacher motivate a student to read science articles outside school textbooks?

Informative posters, such as those brought out by National Geographic magazine, liberally distributed in the laboratory, encourage students to explore reading material in those topics. Have articles lying around. Do not be too concerned about these being ruined by handling. Do not force anything; just an occasional suggestion is adequate. An open library with every spare bit of money being spent on popular science magazines is a big help. Let them see you reading; that inspires them to do the same.

How important is it for middle school teachers to look at science without fragmentation into disciplines (physics, chemistry, biology)?

We learn various disciplines in a fragmented manner. This is out of convenience rather than the nature of the disciplines. Nature does not behave in this fashion. It is therefore necessary that teachers be aware of this; and not place excessive emphasis on this fragmentation in their classes.

Describe a teaching method or strategy that is successful in helping students learn a concept in biology, chemistry, or physics?

Follow the scientific method: experiment, abstract, predict and test.

Have you ever used differentiated instruction?

In the classroom situation, I have not provided any kind of differentiated instruction. Instead, I prefer to use more individualised assessments.

What is the role of: a) experiments, b) computers, c) place-based experiences and d) story-telling in middle-school science teaching? What are you your experiences of these? How should a teacher introduce them in classrooms?

Without a doubt, experiments and place-based experiences are central to science teaching. We

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should not teach science as a bunch of facts or a series of explanations of phenomena that are not seen easily by the student. We should encourage students to make observations about things around them, distil these observations, teach them to ask critical questions, and then do controlled experiments. I cannot imagine myself teaching science without getting students to do experiments. When you teach about density, measure the mass and volume of a brick, calculate its density and then use it to estimate the weight of the walls of the classroom or a truck load of mud. The immediacy that it brings is far more valuable than a dozen problems involving the application of density.

Computers are way over-rated and should not enter the science classroom unless a student actually wants to use it to control an experiment.

Anecdotes about discoveries and their discoverers are very valuable; the one about James Joule going on his honeymoon with a sensitive thermometer and measuring the temperature difference of water at the top of the waterfall and that at the bottom evokes giggles in a bunch of teenagers, but drives home an otherwise abstruse idea.

How can teachers encourage greater participation by women in science and technology?

I would think that a teacher has to work on his/her prejudices, if any, on the ability of women to participate in the scientific workspace. If no prejudice exists, teachers will not discriminate between boys and girls in the classroom or laboratory. If there is prejudice, no amount of regulation will prevent it from being conveyed to the girls that they are not capable of being just as good as the boys.

What would a science assessment in middle school look like if you designed it with learning as the goal?

When a young student learns science, the information s/he absorbs is fairly rudimentary and will undergo many refinements as s/he progresses through the educational system. On the other hand, the methods of observation have the same innate character and I would give far more importance to them. For these reasons, I place emphasis on formative assessments, and generally ignore any kind of summative assessment at the middle school level.

Can competition be re-defined to function as a positive, non-stressful process?

I do not believe that competition can be a non-stressful process.

What is the weirdest thing that you have ever done in the name of science?

I once sang loudly and in high falsetto into a microphone connected to an oscilloscope to demonstrate the frequency range of the voice. It led to considerable mirth (and annoyance) all around.

What do you love most about being in the classroom and teaching middle school science?

I was schooled in the conventional way: stock questions with stock answers, concepts to be learned and problems to be solved; with no emphasis on observation and deduction.

Teaching middle school science brought me startling, yet natural, answers from students to common questions. This showed me that Physics was often counter-intuitive, and quite frequently changed my perspective on what I thought I knew well.

What have been some of the moments/events/memories of teaching that you cherish the most?

I once set a lab mock exam for students appearing for their higher secondary examination. It had to do with observing and listing the standing waves in a hack-saw blade excited with a variable-speed eccentrically loaded motor. The students were doing this experiment for the first time. The "Wow!" one of them excitedly yelled out when he saw the first stationary wave and the many such "Wows" from students when they see something that is 'mind blowing and awesome' is what makes up my most memorable moments in teaching science.

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Do you have any advice for, say, students who realize they like science, or want to be a science teacher?

It can take a long time, and there is a lot to learn before you may get creative; just hang in there!