"I believe that a scientist looking at nonscientific problems is just as dumb as the next guy".

Richard Feynman

US educator & physicist (1918 - 1988)

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My teaching philosophy draws inspiration different areas namely Computer Science, Mathematics, Music, Snooker, Research and Cognitive Psychology. Before I delve deeper into how these areas shape my teaching philosophy, let me first briefly explain what I have learned from these areas.

Each of these areas has made me aware of different mental faculties which we possess which we can utilize to learn effectively. For example, programming (or more generally Computer Science) teaches me how to break a problem into smaller sub problems and break the sub-problems into even smaller problems. It also challenges me to think in terms of designing systems taking into consideration the myriad of possibilities and complexities involved. On the other hand, mathematics and music has taught me to approach the same idea in different ways. For example, playing the same melody with subtle variations slightly deviating from the original yet retaining the essence. Similarly for mathematics solving the same problem in different ways. Snooker (or any cue sport) teaches me two main things. Thinking ahead in terms of how I would go about clearing the table yet not losing focus of the current ball I am aiming at. Research has helped me to look at things more objectively and understand that there is no "one solution for all". Rather it is important to narrow down the scope and context within which a given approach would work. Finally, Cognitive Psychology helps me to reflect back on what I have learned and how I have learned. What models do I internally construct to grasp concepts? How do I deconstruct complex concepts and reconstruct them? How do I connect 2 concepts which look radically different yet share a lot in common? For example, while learning to swim I noticed that I had to keep my legs moving in order to float and this movement had to be so deeply ingrained as if it was second nature. Now this is very similar to how the right hand has to keep moving while strumming a guitar while the left hand is actually the focal point of attention.

Let me try to explain how I can use these skills to help people learn effectively. There are three main aspects to learning: understanding a concept, learning a skill based on a concept and applying a concept. Before we discuss the strategies I employ to teach these skills, let me briefly explain how I start off the interaction. I find it extremely effective to present a scenario in front of the class with open questions. For example, if you wanted to write a space-ship game how would you start out?

- **Understanding a concept**

Once the motivation has been established through a scenario, the next step is to identify points from which we can start and carve out a small area of focus. Along the way the students realize that they face a deficit of knowledge to meet the requirements for the small area of focus. This is the time to introduce a new concept.

Alternatively there are also times when some concepts need to be introduced as standalone concepts. I try to engage students into a discussion about how the world would be in the absence of the concept. Usually I would do this by presenting them with another scenario. For example, imagine you are the chief investigator of a plane crash. You have the black box which has all the data about the speed of the plane at different points of time and you are interested in knowing how much distance the plane had covered 15 minutes before crashing from a graph. How would you do this? Now this scenario is pointing towards a need without giving the solution (integral calculus). I call this technique a combination of scenario based learning and question based learning (more on this later).

After sufficient motivation it is time to introduce a concept. There are two ways to expose students to a new concept viz. bottom up approach and top down approach. The bottom up approach looks at the concept in isolation without presenting information on how that concept relates to other concept. For example, let us look at the concept of a "constructor" in object oriented programming. When looked at from a bottom up view it explains what a constructor is, how to write one with all the low level details. However, I feel just this approach is not enough to grasp the concept. This is where you use the top down approach. In this approach you look at the concept as if it is a part of a big system of interrelated concepts. So in this approach, you imagine that you are developing a game and you have to create a space ship in the game. How should your space ship look when the game starts? How many weapons would you have?

What would be the initial flying speed and the initial health of your player? This is where you understand what a “constructor” really is. Simply put it presents the big picture.

- **Learning a skill based on a concept**

This is the part where you try to master a skill. It is very important to try and make this development progressive and in small increments. I draw inspiration from music and learning to play an instrument in order to master any new skill. Basically you start off with a very rough implementation of the skill and measure your own progress. Whenever you feel that a sufficient level of proficiency is reached, you move one level up which is slightly more difficult but within reach form the previous level. The key here is to resist the temptation to take big jumps (even if you can).

- **Applying the concept**

This is the tricky part and again I draw inspiration from music and research to teach this skill. If we look at music, take for example blues there are short phrases which can be combined to form a solo or a composition. The individual components or phrases are really too small but when they fit together there is a solo. In the previous step we learned how to master those small phrases. This technique is transferable to skills such as writing or even design of applications. The next step is to look at how the small phrase is used in some examples. For example, how a lick is used in a solo or how a set of words while writing a research paper or how a design pattern is used to build a system. Once you have seen sufficient examples, the next step is to present problems that can be solved with these techniques. After solving a sufficient number of examples (this number may vary from person to person), the brain becomes adept at identifying scenarios where the same pattern which we have mastered can be applied.

While trying to build skills with students I also resort to the following techniques.

Question based / Problem formulation based learning

A student asks me “What is a linked-list in a data structures computer science. I ask you a question on a concept you are familiar with. Answer to that question helps in getting closer to the concept of a linked-list but in turn raises more questions. This iterative process goes on and on until the understanding is sufficiently refined and at a level where the ideas can be introduced now. So it is basically learning through problem formulation. The whole idea is to challenge the students thinking capabilities progressively in order to induce students to think and come up with their own understanding of concepts through internalization.

Scenario based learning and Motivation oriented learning

A lot of concepts originated because there were specific scenarios which required innovation. Identifying these starting points and a little delving into history may prove as a vital tool to gain a deeper understanding. For example, I get a frequent question from students which is CS related about the use of stacks or queues. Another example which we can probably all relate to is trigonometry. Why trigonometry? What were the limitations of existing frameworks? What problems were those people interested in solving. Can a methodology be developed around this? So this is more of a top down approach to learning.

Learning as an experience

The whole idea is to make the concept of learning enjoyable. Gamification is definitely one way. Another methodology is to ask all the students at the beginning of class to identify any thing that they want to learn. Create a list of all the things that they would like to know more about. For example, someone might be interested in photography or someone in learning an instrument. Now once this data has been gathered, the next step is to find students in the class who can meet those needs. At the end of the semester, all students would trade their skills with each other and this would be given points. The whole idea is to make the class more relevant to the student’s needs. More research is required in order to find how this can be connected to the subject being taught.

Using alternate modalities/channels or presenting the ideas in different ways

One example that I can think of is the use of rhythms for teaching fractions to school kids. Read below. Can this be used to explain different concepts? When you take students who have failed or have been failing repeatedly what would be the outcome when they are taught the same concept but through a different channel. How can technology fit in? The whole idea is to present the same information in different ways which can consumed by students in different ways.