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Editorial

Strategy and Approach for Learning through a System of Self-study and Self-motivation

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1. THE SELF FOR MODERN EDUCATION

Education is more a process of learning than teaching. Vedic concept of 'learning without understanding is cramming and is more like dry wood on ashes that can never blaze forth' (*Nirukta 1.18*). Current practices in education lecture-based imparting of knowledge, use of textbooks to back up the lectures, coaxing student to work with home assignments, and employing examinations to evaluate the student learning – were established quite a while ago and do not reflect the modern times. With the increasing availability of knowledge freely accessible from electronic sources, many of them with critical analysis, the lectures are becoming less attractive for students to acquire knowledge. Furthermore, textbook-based lectures become fixed in time and context, which make them less engaging for modern students. This is particularly true for higher education but holds true even at the level of high school.

The time has come to emphasise learning, which can be mainly accomplished by self-motivation. In the past decade, the advancement in information technology, ease of availability of information from electronic sources, including e-books, e-journals, etc., dramatic use of computers in classrooms (at least in colleges and universities; and outside the classroom through smart phones), and development of many encyclopedic websites have facilitated access to information on fingertips of students of all ages simultaneously. The systematic and hierarchical flow of information to students (teaching) from teachers and textbooks is increasingly becoming obsolete. The world has moved from prescription to subscription. Education needs to move into the arena of informed subscribers, who need skills to package information into knowledge, and wisdom to utilise the knowledge for appropriate purposes. Education itself is becoming a science, not just for imparting knowledge, but for making the knowledge practical by education, for education, and of education. The knowledge of science is attractive primarily because it is practical.

The fundamental purpose of science is to pursue the truth by systematic examination of a subject matter to obtain consistent results so that scientific principles and laws can be derived or verified. To obtain true knowledge, strategies include the collection of objective data to derive a non-falsifiable truth. In the modern scientific approach, these two strategies are fulfilled by obtaining data using randomisation of the samples and by running control experiments, respectively. Both these aspects of the modern approach are carried out to avoid subjective bias on the part of the observer. However, the two-pronged approach is generally untenable under ideal conditions, as there is nothing fundamentally random, and it is not practical to run all possible control experiments to meet the criteria of non-falsifiable

scientific truth. This line of reasoning is to establish more a scientific temperament than to understand the nitty gritty of science for developing technology.

The motivation to learn and motivation for education need to be addressed. A more extensive educational framework needs to be developed for a modern globalised world to acquire a rational (scientific) attitude. Under this framework, standards need to be set up that can equip students with philosophical concepts, social communication skills, technical skills, and meaningful work for a sustainable and purposeful life. It may be worthwhile to mention here a series of Vedic concepts of self-empowerment such as *Aham Bramhasmi* (I am the supreme, *Shukla Yajurved* 1.4.1), *Vasudhaiva Kutumbakam* (the entire planet is a family*, Maha Upanishad, VI.72*;), *Swadhyay* (self-study, *Yogah Karmashu Kaushalam* (learning and realising through work (*Bhagvad Gita 2.50*), *Eko Aham Bahusyam* (diversity is the true reflection of the infinite (*Chhandyogya Upanishad 6.2.3*) that may be included in the framework for modern education.

Rabindranath Tagore once said, "The highest education is that which does not merely give us information but makes our life in harmony with all existence." In other words, one needs to unite oneself with the existence around us. This concept is usually practiced with the Patanjali yoga concept of *Yogah Chittavritti Nirodhah (Patanjali Yogsutram 1.2)*, i.e., by controlling the *chittavritti* (mind) one practices Yoga. Yoga practice leads to the state of detached observation of the events, making one objective which is a prerequisite for the practice of science.

The ultimate goal of yoga is to unite everything to everything, providing an integrated approach to developing universal understanding and principles. Yoga, however, is practiced at an individual level with the goal of detaching oneself from all the objects perceived via the five senses thus creating an unbiased state of mind for examining an object. This system is practiced first on self, through body-mind examination, most aptly described for *Ashtang* Yoga. Self-examination is considered as the highest form of learning according to *Bhagvad Gita* (15.1) – *Oordhamulaadhamashakham Ashswatthamprahurvyayam, Chhandasi Tasya Parnani Yastam Ved sa Vedvid (Bhagvad Gita 15.1)*, meaning, the nervous system of the human body (self) is the most important object for study, and those who can understand this system are the knowers of the Vedas.

In an article entitled "Cultivating the Habits of Self-Knowledge and Reflection," Terry Heick poses four Questions for Self-Knowledge and Reflection (Heick, 2014) as to what do students "retreat to" in the face of a challenge. He suggests four questions that students can ask for their self-awareness and to reflect on their thoughts and actions:

- How do I respond when I'm challenged, both inwardly and outwardly?
- Which resources and strategies do I tend to favor, and which do I tend to ignore?
- What can I do to make myself more aware of my own thinking and emotions?
- What happens if I don't change anything at all?

These questions can be used to promote self-awareness and metacognition in the classroom. How can we establish these actions as habits – reflexive actions that students initiate on their own with little to no prompting?

Self-awareness is a trending concept for education and learning. Kamath (2019) in a recent article posited that "self-awareness is arguably the most crucial academic skill and a building block of self-regulation, which according to Eisenberg et al. (2010), is the balancing and management of one's emotions in everyday life. Effective learners successfully guide

attention and intention towards the self as a doer, thinker, and evaluator and help yield academic and social goals set by self for self." Thus, self-awareness and self -knowledge appear to play a substantial role in learning by students and may become a more relevant post-Corona experience of social distancing and online learning. In addition to Yoga and Kriyayoga which help in self-realisation (Hall et al., 2014), Ayurveda provides lifestyle and pedagogical resources (Kochanek & Singh, 2020).

One of the Ayurvedic concepts involves identifying one's dosha *prakriti* (or nature) broadly as *vata* (movement), *pitta* (transformation), and *kapha* (storage). An individual with one of these *prakritis* dominating has a natural inclination towards certain types of lifestyle practices related to food, sleep cycle, body weight, approaching learning, etc. "We introduced a practical exercise of quilt making for students to address their Ayurvedic prakriti, which was very helpful to students in becoming aware of their own nature, verified by self-observation of their habits and lifestyle" (Kochanek & Singh, 2020). Self-awareness and Self-realisation through self-study is the trinity of education in the modern virtual world.

2. EDUCATION IN THE VIRTUAL WORLD

We are already in the virtual world. This has placed many people, at least those in higher education, in an intellectually churning mode. The study reports in the United States are also expressing concern as to what will happen to the American education system. Of course, most of my experiences is in the USA as a teacher, although I do get involved in K-12 of school in my village as well as some of the Indian Universities including Jawaharlal Nehru University where I am currently an adjunct faculty . It is important to think more philosophically about what we think about the pedagogy of education than to how can we impart what we want, and then address the question of what exactly the contemporary education's goal is. If you consider the two countries, where I'm settled and where I was born, these goals may in fact be affected by time and space.

- The American founding father, Thomas Jefferson was a very thoughtful man, and he says an educated citizenry is a vital requisite for our survival as free people. However, one might wonder about the definition as well as importance of education.
- "..that any person born after that day should ever acquire the rights of citizenship until he could read and write. ....Of all those which have been thought of for securing fidelity in the administration of the government, ..., it is the most effectual."
- So, Jefferson was really more interested in how the government or administration can manage people, to achieve the overall goal of the so-called "free people". In contrast Mahatma Gandhi, the father of the India said, quoting Adolf Huxley
- "That man I think has had a liberal education who has been so trained in youth that his body is the ready servant of his will and does with ease and pleasure all the work that as a mechanism it is capable of..."

This is a very important contrast and one needs to focus on this especially in today's world where transition is happening, whether it's because of the COVID crisis or otherwise. The challenges are not whether we get the Internet or good broadband, as every village and every household can access it. The real challenge is how to use this transition to enforce, or at least make an effort, to bring out what might be the actual goal of education. The challenge lies in preparing a generation of youth capable of tackling many pertinent issues faced by the society worldwide. We have a lot of environmental problems, medical problems, health issues, and disparities in society. Moreover, there are fundamental differences in the Eastern world's approach to environment, in contrast to that of the Western world. Major innovative

interventions are needed to address political, economic, and social issues. Education itself, whether we like it or not, has become a business that is considered worth over 10 trillion dollars in the next decade. And, when one thinks of India and India's youth and India's total population, and their level of education, and their potential for contributing to the world education, its business prospects should be taken into consideration as well. This is a humongous opportunity for the Indian people.

Education is the key factor for the welfare and progress of any society. Since 1950, India's population grew roughly four- fold from 359 million to 1.43 billion. At the same time, the number of universities has increased 56 times from 20 in 1950 to 1,113 in 2021. US has over 4,000 universities for a population of 332 million, an average of one university per 83,000 people, whereas India has one university per 1.3 million people, showing a nearly sixteen-fold gap in educational opportunities between the two largest democracies. The number of colleges has also registered a manifold increase of 88 times with just 500 in 1950 growing to 43,796, as of 2021 in India. Unfortunately, the government of India spends 2.9% of GDP on education (probably less than 1% on higher education), whereas the United States spends 6% of its GDP on education. Norway spends 7.4%, and Mozambique spends 6.8%; all numbers for 2012. Thus, the virtual platforms make it much easier for India to play a major role in the world. It may be worth to go global for India, and this may provide an entirely new dimension to the concept of वसुधैवकुटुम्बकम् (*Vasudhiava Kutumbakam*, the entire planet as a family).

3. VIRTUAL TO PRACTICAL STRATEGY

Also, the idea that India can play the role of Vishwa Guru (the world teacher) might seem contradictory to the Gurukul system of ancient Indian education. During the Vedic time, and much later as well, the students used to go to the forest to learn from the guru. What were the implications of the forest for education? It was in part important to teach the pupils all sorts of household skills as well as to integrate them into learning. The question is whether the essence of the Gurukul system is feasible in the current system of education. The ancient Gurukul system had Gurus and Acharyas sharing their knowledge with pupils in the natural environments for practical use. Some of these practices changed once the book revolution happened in 1440 with the discovery of the printing press, as suddenly the knowledge became available to all without any monopoly.

With the advent of online material, could the book revolution be repeated with the internet revolution, whereby knowledge is available everywhere, and thus a village system of living and practical learning may be possible for all, irrespective of their geographical location. While the earlier transition from Guru and Acharya-based learning to book-based learning can teach much for the current transition underway, it may be important for one to think not only of quantitative changes but also the qualitative ones, especially as it relates to the bookish/internet vs. practical knowledge and skills. The acharya to book transition led to bookish/memorisation facts to be the knowledge, taking away the practical experience-based knowledge, but the efforts to memorise and remember to use various book sources to verify lent credibility to the knowledge that was synthesised. This framework of reading and writing-based knowledge eventually led to rules and laws being written to control people.

In the current transition of books to digital sources of information, one does not need even memorisation, feel of the surrounding, or facing the facts physically. It is a virtual world, seen with a click of button, without the burden of any weight. Human perception the gravity of the situation if we continue the tradition of memorized knowledge. However, when viewed from the earliest quest and the need of knowledge that was meant for self-realisation with personal

practice, it opens a huge door of learning virtually to realise practically by practicing the lessons in the most appropriate context of home and community.

No need to travel,
No need to stay,
Taking own trouble,
Realizing in one's way!

In other words, one can practice the knowledge virtually in the most creative and effective way, yet practice it in the most contextual way of one/e real life with family and community at home. These are the most appropriate ways to develop a society with self-reliance ,skills and practice.

In an era of information highways, global integration, and changing standards of teaching and learning, higher education is coming under pressure to outline essential goals for knowledge impartation and student development. In the past decade, the advancement in information technology, availability of information from electronic sources, including e-books, e-journals, etc., dramatic use of computers in classrooms (most US universities and colleges require possession of laptops for undergraduate students), and development of many encyclopedic websites have facilitated access to information on fingertips of students of all ages simultaneously. Thus, the systematic and hierarchical flow of information to students from teachers and textbooks is increasingly becoming obsolete.

4. LECTURE TO PRACTICE PEDAGOGY

Current practices in higher education – lecture-based imparting of knowledge, use of textbooks to reinforce lectures, coaxing student to work with home assignments, and employing examinations to evaluate the student learning – were established quite a while ago and may not reflect the time. Students generally comply with the system to earn the knowledge and their degree certificate. With increasing availability of knowledge freely accessible from electronic sources, many of them with critical analysis, the lectures are becoming less attractive for students to acquire knowledge. Furthermore, textbook-based lectures become fixed in time and context, which make them less engaging for modern students. This is particularly true for higher education.

The use of textbooks only, or predominantly textbooks, for teaching students in higher education is problematic for a variety of reasons. (a) The textbooks written by authors are limited in general to their experience with students at their colleges and universities. (b) The teaching styles of instructors are different, and use of a textbook generally restricts the innovativeness in them for inspiring students. (c) Following textbooks limits use of context in describing topics to students, making lectures merely mechanical exercises. (d) Textbooks being very expensive at least in the United States, discourage students from buying latest editions, if they buy the textbooks at all.

The degree of problems in issues raised above may vary with area of study (e.g., sciences vs. humanities) but there is a major shift in classroom experiences in all the fields in over past 10 years or so, even though the issue of learning and teaching has been debated for several decades (Beard, 1968). Although some of the outcomes differ with disciplines, but generally it has been observed that active learning through projects and tutorials meet the objectives better than traditional lecture methods (Liow et al., 1991).

In addition to including project-based learning, which I have included in all my classes of chemistry for science majors (Singh, 1999; Blanchette & Singh, 2000), I have also found that

making students not only learning partners but also teaching partners (through presentations and research) in chemistry courses is equally effective. This is particularly critical for students who otherwise find subjects like chemistry difficult and less attractive. As an introduction to the American system of higher education, it is important to mention that undergraduate students generally choose a major area of study, such as chemistry, psychology, music, philosophy, economics, etc. and take over half of their courses in four years related to that field. Students are also required to take courses in general areas, which include science, arts, ethics, humanities, etc. Allied sciences such as nursing, engineering, textiles, etc. need to take chemistry courses so that they can learn their own subjects more comprehensively.

5. THE BIOCHEMISTRY LABORATORY

I would like to describe my experience with an innovative approach I had employed to teach practical biochemistry course at the University of Massachusetts Dartmouth (Singh, 1999). Using chemistry to introduce learning allows new avenues to pedagogy, as one can grasp from the following paragraphs reproduced from my earlier publication (Singh, 1999).

Biochemistry encompasses a vast number of chemical processes to yield the basis of a biological phenomenon. Students generally need a high level of concentration and critical thinking to relate to several interconnected topics. While biological processes easily attract students' attention and enthusiasm for the sake of both curiosity to learn about ourselves (living beings) and a likely opportunity to improve the quality of life, the delicate nature of biological samples generally requires a greater hands-on experience for students to learn and perform chemical analysis of such samples. Generally, all chemical techniques are applicable to biological samples, but they usually require substantial modifications and adaptations to be applied to understand significant biological processes. Therefore, an advanced biochemistry laboratory course is necessary to introduce chemical techniques that are commonly used to analyse biological samples.

Biochemistry laboratory courses tend to be limited in their depth and are scattered in terms of their content, primarily because of the vast number of biochemical processes involving a wide range of substances (e.g. lipids, nucleic acids, carbohydrates and proteins) which are further complicated due to variations in organisms (e.g. bacteria, plants, and animals). Biochemistry laboratory textbooks currently available describe experiments using 'cookbook' experiment method. For example, in a standard Experimental Biochemistry textbook, an enzyme kinetics experiment may involve egg lysozyme, but for enzyme inhibition analysis it may be lactate dehydrogenase. In the same book, the gel filtration technique may be described using immunoglobulin G as a biological sample. In such cases, while students may succeed in the 'cookbook' exercise because a given biological system is the most suitable sample to demonstrate a technique, they lose the connection between different experimental exercises. Their ability to understand the design and execution of experiments remains limited, and their potential to utilise these techniques to solve any real-world problem remains minimal. An additional problem with biochemistry laboratory courses is that the lecture class material is not always easy to directly practice in the laboratory because of the sophisticated instruments required and the substantial amount of time needed to complete experiments. One way to alleviate this is to teach a biochemistry laboratory course that is on a research topic-based system and could involve several commonly used biochemical techniques. Currently, there is no textbook available to carry out such an exercise. Therefore, the approach must be tested on an experimental basis, and if successful, it must be propagated through literature dissemination.

6. A MODEL AND INITIATIVE

We have developed a research-based Biochemistry Laboratory course that engages students in the learning of laboratory skills focused on the solution of a real science problem. A research problem is generally chosen that is related to a significant biological question that can easily be understood by students with one semester of biochemistry knowledge. The project that we have tried relates to the analysis of glutathione-S-transferase (GST) of marine organisms from a local harbor that has been contaminated with polychlorinated biphenyls (PCBs). New Bedford harbor (6 miles from the UMass Dartmouth campus) is a super-fund site for PCB pollution.

The enzyme (GST) has several desirable features to be used for an undergraduate project in a biochemical laboratory set-up. It is a relatively small protein (25 kDa) that exists as a dimer in solution. It is an enzyme whose genetic expression is induced by organic pollutants, including PCBs. It specifically binds to glutathione so that affinity chromatography may be used for its purification. The enzyme exists in several isomeric forms which differ in isoelectric points that can be exploited for ion-exchange chromatography. Finally, it is inhibited by several polyaromatic hydrocarbons (PAR), thus allowing varying kinetic analysis. We exploit biochemically relevant features of this enzyme to teach several biochemical techniques and to provide students with independent research projects for evaluating glutathione-S-transferases from different marine animals such as clams, oysters, quahogs, scallops, and other organisms. The availability of different organisms makes new projects available every year. Our long-term goal was to collaborate with the biology faculty to coordinate one of their laboratories with a Biochemistry Laboratory course so that we could include nucleic acid chemistry experiments on glutathione-S-transferases from local marine animals to understand the role of marine pollution in the genetic expression of this enzyme as well. This approach seems to have created enthusiasm in most of the students taking this course. The approach can be applied in any part of the world because GST is ubiquitous in all organisms ranging from prokaryotes to mammals, and its gene expression is responsive to environmental conditions including pollution (Blanchette et al., 2007; Mannervik & Danielson, 1993; Prestera et al., 1993; Rushmore & Pickett, 1993; Vandewaa et al., 1993). The approach has cited tremendous enthusiasm in students because not only do they learn laboratory techniques, but they also get a chance to practice them to solve a real local environmental problem.

7. LEARNING FROM FAILURES

Institutions throughout the world are adopting a grading system in place of marks or percentage of marks received to indicate the level of learning. The University system since its beginning has utilised student performance assessment through marks, divisions, and grades. Marks indicate the relative amount of learning whereas the divisions and grades indicate the status of the students. While EzraStiles of Yale University is credited with recording status of student performance as *Optimi,* Second *Optimi, Inferiores, and Pejores* in 1785, the first formal letter grading system was started by the Mount Holyoke College in 1897 (Lahey, 2014). It peculiarly uses A, B, C, D, then skips E to reach an F. The question is what the best grade for a student is, especially when the grades are awarded with a scaling process. A given grade only indicates how well a student performed relative to others, not how much a student may have learned. Given the fact that most of the teaching is done with textbooks and lectures, a student with memorising capacity may easily earn an A grade with possibly no learning lessons. A lower grade student may in fact learn more by using the lower grade to focus on improvement. Ideally every student should learn all that is to be learnt by putting in all the needed efforts and time. The grades thus become an estimate of efforts and time one is willing to learn a lesson, skill, or subject matter. My own personal experience has been that I learnt the most when getting lower grades in the exams,

and the efforts allowed me to develop a lot more confidence than the top grade would have ever done. Although I was able to score an overall A+ in my M.Sc, M.Phil, and Ph.D programs, struggles with lower grades in individual examinations made me more determined and helped me increase my efforts.

In teaching the project-based Biochemistry Laboratory course outlined above, I also experienced the value of failure for students. While the students succeeded in all the experiments that were meant to teach the techniques using cookbook recipes prepared for them, when they needed to apply those techniques for their group projects, they invariably failed the first time they tried. That was because they had to apply their training in techniques for a real research project. However, with that failure came the realisation that they needed to thoughtfully apply the techniques they had otherwise mastered for a novel problem. This made them not successful but made them excited to work on those projects beyond the completion of the course, and several of them ended up with research publications. Thus, failure is not necessarily a bad thing for learning, and a grade of even F may be more inspirational to a curious and determined student. An overconfident A-grade student may achieve lower in life than a self-aware F-grade student who overcomes the failure with added effort.

A&F
@Bal Ram Singh, September 30, 2023
Learning begins with A,
Learning ends with F
Learning is a mainstay,
When things are really tough!

A just shows what you already know,
F actually inspires to explore what one needs to know
A is the comfort of the path we know,
F is the effort for the path we seek to know.

In education, A must choose space,
F needs time to win that race
Space and time coalesce with no trace,
A maybe Ace but F is the ultimate face!

A brings attitude but no grace,
F brings multitude with so much grace
Attitude hounds one with never-ending race,
Multitude to gratitude is F's headspace.

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