



## Teaching Resources: Learning the Hard Way

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### Abstract

As per the saying, a system has two or more than two elements that operate in cohesion to achieve a goal. Similarly, students, teachers, and institutions are the components of education systems that operate through subjects, subject matter, questions, answers, comments, research, extension, and so on. They should work in cohesion to achieve the goal, which is knowledge that brings not only confidence but also a better life; society, nation, medicine, devices, equipment, crops, and so on. Here a way out has been proposed for studying, teaching, researching, and managing an educational institution to contribute to its best performance.

### I. Introduction

It is a general observation that a large number of our students passing out with higher degrees are far behind the mark as far as their counterparts in developed countries are concerned. They are not comfortable in conversations on any topic, unable to write even a letter or application, don't have the courage to face the audience, cannot plan for their future, and sometimes they do not even have any goal in life. Similar is the situation with teachers who, basically our old scholars, having taught for decades, haven't enhanced their confidence and hold on the subject, becoming rather more disqualified year after year; the linguistic part also does not show any sign of improvement, evident from their communication, having lots of demerits such as pitiable grammar, improper pronunciation, inappropriate selection of words, lack of cohesion, and so on; they break down in between frequently, and there is no steadiness in their speech. In the case of institutions, the conditions of blackboards, laboratories, lecture theaters, galleries, windows, doors, toilets, landscapes, and so on have been noticed to deteriorate with the passage of time; teaching staff as well as lab attendants, sweepers, gardeners, and guards also stop taking interest in their jobs. What are the reasons for such worsening in the education system, especially in higher education? Who should be blamed for the status of our students? Whether teachers are responsible or

are the institutions? Students cannot be blamed either, because they are unaware of the proper way of learning coupled with no inclination for hard work. Unless 'the proper way' is followed with honesty, sincerity, and concrete effort by the students themselves, even the best teachers cannot be successful in their endeavor.

### The Proper Way for Students

The education up to 12th grade is satisfactory because it is based on the prescribed syllabus and prescribed books by establishments such as the Central Board of Secondary Education, the National Council of Educational Research and Training, and the state's education board in the country. At this juncture, the students are well aware of what they are supposed to study, and they also have to cover the whole syllabus in each subject thoroughly too. This is because the question papers that they have to face do not take care of how and what they have been taught in the class; it is supposed that the whole syllabus must have been covered, and they have performed the entire practical if it is a part of the subject, as they have to also go through an examination for practical in the subject having oral viva; these students are also supposed to practice lots of numerical problems based on all the topics in science, mathematics, statistics, commerce, economics, etc. disciplines. The overall performance in these examinations will fix his fate for higher studies and, subsequently, his career as well as his quality of life to some extent. This pressure, along with the force from parents and society, keeps them busy throughout, attending coaching classes, participating in group discussions, solving old question papers from various institutes, and prestigious competitive examinations. They keep themselves confined to this material throughout the assigned period.

But, once the student enters for a bachelor's degree and thereafter, either in a university or a postgraduate college, only the syllabus is prescribed, and the teacher is free to prepare his talk from various teaching resources available on the market, such as textbooks, lecture notes, research papers,



articles, Wikipedia, YouTube, PowerPoint presentations, and so on. After having attended a lecture, most of the students start looking for the source from which the teacher has borrowed his speech. As soon as the student has located the source and acquired the same, this makes the student comfortable connecting each point of the lecture taught; this source material gets circulated within the classmates digitally. This is not bad practice for those students who are satisfied with this limited, compact knowledge, but we should strive to learn a lot from each lecture communicated, irrespective of the subject and teaching quality, which may be either good, poor, or bad; the poor and bad coaching can also be utilized for learning; this is just like the surface of a table can be cleaned by any old piece of cloth too; not necessarily one has to borrow a new one from a fresh bale. These students will be our teachers in the upcoming days, and they should adopt the following 'proper way' for an unbelievable improvement in their scholarship, of course, through hard work. The word improvement in the previous sentence signifies knowledge with added confidence, according to the saying, knowledge brings confidence. One can learn a lot during the age when one is still a student, the most appropriate phase for learning. But this can be achieved through hard work only; there are no shortcuts prescribed. Of course, geniuses are born by the grace of the gods, having exceptional talents, but the path 'the proper way' described here will lead to an average student very close to that of a genius as well; that is, a talented one. To quote some of the examples who, in view of the author, achieved higher heights in their fields through hard work: Abraham Lincoln, Goswami Tulasidas, Madam Curie, Mahatma Gandhi, Michael Faraday, cricketer Imran Khan, etc. Geniuses are available in all walks of life; a couple of them are Newton, Einstein, Ramanujam, Lata Mangeshkar, Tesla, Shakespeare, and so on; it is quite difficult to separate out geniuses from talented ones.

When a student comes out of the class, his memory remembers more or less the whole lecture taught; it is said that it is there for at least 72 hours. The student should try to put on record the whole lecture, either in his own language or as per the lecture pronounced by the teacher. He should take note of all the points and phrases as well as anecdotes mentioned by the teacher, beginning while the teacher enters the class and finally, while going out of the class. If the teacher had any conversations with any student or showed any reaction in the class, this should also be recorded as verbatim. The student should also put on record his

own reactions, observations, and comments. Thereafter, he should read the whole lecture reproduced by himself a couple of times so that he is sure about the completeness of the transcripts provided by the teacher. Once he is satisfied by the fact that he has successfully reproduced the lecture given by the teacher, he should now start looking for the points he is unable to understand, or he finds unjustified in his view. He can underline all those sentences with red ink if pen and paper have been used in reproducing the lecture. In case the lecture has been typed on a desktop or laptop, those sentences may be converted by the red fonts to remind him later that they are not understood; it may be added that putting lecture notes on the desktop is desirable as typing speed synchronizes very well with the identical thinking speed, whereas writing with a pen on the paper is somewhat faster and does not match with that of thinking; novelists are accustomed to writing a novel on a typewriter for the same reason.

This procedure of recording and reproducing the lecture taught in the class will have a paramount impact on the systematic mastery of the subject taught and thereby the enhancement of the confidence of the learner as follows: Firstly, the student at this instant becomes aware of what he does not know in the subject, and he can put these unknown points quite precisely before anyone, rather than the observed usual saying, 'I could not follow the lecture'. Secondly, at the same time, his writing capability will also boost, along with how to express them in short, the most desirable quality; this is because no one is interested in listening to too long sentences, and they do not have time either. Thirdly, this will also enrich his vocabulary, as all kinds of words are spoken in the class, borrowed from many teaching resources and disciplines. At this stage, it becomes quite easy for this fellow to inquire about all those unclear points through individuals whom he thinks will have the answer; folks having the answer will not hesitate to reply, as they can be convinced quickly by the question asked. He can keep discussing these questions with experts from various disciplines as well as all walks of life. Consequently, it will have a positive impact on the personality of the student as it develops his confidence not only in the subject but also with the dialects of experts he learns side by side, a bonus one. It may be added here that his pronunciation also progresses through this phenomenon, as he is getting the chance to interact with experts of various disciplines having different vocabulary and accent. This is just like a non-Bengali who happens to be



associated with the Bengali community starting to speak as well as understand this language.

The practice prescribed above is independent of the quality of teaching, except with the minor difference that a poor teacher will lead to more red underlines in the reproduced class notes by the student in comparison to those having good teaching qualities; thus, the student will have rather more blurred points, and he will need to look for many more experts to clear all these doubts, providing the student more chances to interact with the experts in the case of poor-quality teachers. It goes without saying that, however skilled a teacher may be at communication and may have a love for learning, it so happens that a majority of students are not able to grasp the subject discussed in the class to a large extent. And therefore, they have to adopt the above-described procedure so that it hits their minds finally.

It may be added that it is not always easy and simple to locate an expert around you for clarifying the questions having been written in red font about the points that you could not understand while attending a lecture. There are many reasons, such as he may not have the answer; he does not want to interact with you; he may be quite busy, and so on. Then, one has to locate and contact persons belonging to the concerned disciplines spread over universities around the globe through email; for god's sake, the email facility is free of charge. If one is lucky enough, he may get back at least one reply. I would like to share a couple of incidents from my own experience. The first incident happened while I was in the first year of my Bachelor of Science degree course, and I had developed a device called 'hydrobalance' for finding densities of materials and craved its publication in the 12th-grade physics books. I contacted Mr. Banarasi Lal Kulshrestha, the author of the book 'Madhyamik Bhoutiki' in my native language, Hindi and requested he include the said device in the next edition. After a year or two, I received the reply in the affirmative, and thus, the device got published [1] in 1968 while I was still a student; later on, it also appeared in the American Journal of Physics [2]. The second incident happened in 1974 while I was registered for the degree of Doctor of Philosophy in Physics, working on the topic 'Some characteristics of the real part of the nucleon nucleus potential [3,4].' I wrote a letter to Professor Hans A. Bethe, Nobel Prize in Physics 1967, for an answer to the question, 'How is the radius of absorptive proton optical potential larger than its real part? It means inelastic scattering begins before actual interaction starts.' I still remember that the answer was not reasonable. Even

today, this question, having been raised on the ResearchGate platform by the author, has not received a to-the-point reply. These questions, along with those others that remain unanswered, are worth research topics for further investigations. But, as soon as the answer has been achieved and understood, the student can convert those red fonts' unclear points with blue ones, which reminds him that formerly this was not clear to him.

The proper way discussed above with reference to teaching class will bring all-round improvement, such as knowledge, confidence, vocabulary, pronunciation, and so on. Since a student has to go through several subjects in a semester and many more over a couple of semesters, the resulting cumulative impact will make him master of all the subjects taught. Furthermore, likewise, every subject has its own vocabulary, and therefore, this is an additional contribution to his language part, independent of every subject he learns. Also, as he encounters so many teachers in a semester, the vocabulary of each of them also becomes part of his tongue to some extent, making it rich in many aspects, such as being clear, concise, and consistent. At this juncture, he can interact, discuss, and impress an expert on every possible topic in an interview, presentation, or examination, theory or practical, as well as while communicating through email; a supplementary benefit associated with this would be the addition of admirers and friends. He can prove the worthiness of the final degree bestowed on him.

### The Proper way for Teachers

Now let us examine the case of teachers who, having taught for many years, have lost their confidence. This is just because their knowledge has not grown to the degree that it should have been. Again, for the same reason, he has not done his obligations seriously and in the proper way. The teacher has to take up teaching and research, both as a challenge. Also, he should be attentive from day one to the qualities when he speaks to someone or in the class; he should adhere to the following characteristics:

- Speak at a modest speed; a speaking rate of around 150–160 words per minute.
- Try to be concise and organized so that you get more attention.
- Ensure clarity in your speech.
- Engaging the audience
- Repeat it for more clarity.



The teacher has to be always inclined towards the improvement over the above points with the passage of time, and he gets sufficient occasions to achieve it. These qualities are a must for a teacher to be successful and thereby popular in the class and around; anybody having these qualities will be welcome, but teachers, advocates, leaders, group leaders, and so on should inculcate the same. Apart from these, the subject matter that is spoken is also very essential. As far as the subject matter is concerned, he should prepare class notes that discuss every point in detail with examples, questions, and possible answers; confusing points; the application part; and so on, so that every minute of the period is properly utilized. He should encourage pupils to stand up with questions, comments, and observations in the class. He should have a friendly demeanor so that they are comfortable discussing it even outside the class. A teacher finds a lot of time in the practical periods for interaction with the students. A brief summary of every practical and its components presented by the teacher himself will encourage the students to take an interest not only in the assigned practical but also in how to improve the same. Students should also be given a chance to summarize whatever they have been doing; such activities will boost the confidence of the concerned teacher too.

A teacher can keep himself updated with due inclination towards research. The research problems are available everywhere, such as the subject matter being taught, topics being read, experiments being performed, questions raised in the class, and so on; even the presentation of known facts in a better way is also desirable. You have to be alert to locate them, work it out, be ready with the write-up, and submit it to a proper journal and explore its possible inclusion in a book. The author has been successful in this endeavor and published around 80 papers [5-90] while teaching undergraduates. In this process, one should also look for collaboration within the country [91, 92] and outside [93]; this can be achieved through emails. The author could publish a couple of papers and could also visit a few countries where he presented his published work.

The extension work is another important job that should be carried out by all those teachers involved in teaching and research. This can be achieved through correspondence via emails all over the globe that he considers are involved with overlapping research problems. A very useful link, [www.researchgate.net](http://www.researchgate.net), is available, which gives an

opportunity to all such persons to post their published and unpublished notes, PowerPoint presentations, questions, answers, etc.; this website makes them available to everyone throughout the globe, and if one posts his photograph as well, he is also being recognized in the community. You can also know the titles of all those who are copying your work, recommending it, writing comments, suggesting citations, citing publications, and so on. While writing an article with the title "Logbook to login," the author posted a question: "Is the verb part of the noun login that is log derived from the word logbook or the tool log-chip used while measuring ship speed in the past?" on [www.researchgate.net](http://www.researchgate.net). The following answer was displayed by Albert Manfredi (Boeing Defense Systems, Chicago) the very next day:

"I'd say for sure the former. A ship's log is a record, kept by the duty watch officer, of everything that occurred during his watch. A ship's speed log is something different. It was originally a piece of wood, with rope tied to it, knots tied in the rope at regular intervals, thrown over the side to measure the speed of the ship through water. Let the rope out as the ship moves through the water. Count the knots pulled through in a given time interval." It may be added that a paper titled "Logbook to login" was later published [94] jointly with him.

In 2008, while I was teaching a course titled 'Introduction to Computers' to agricultural undergraduates, I came across an article entitled 'The Glass Computer' published in *The Physics Teacher* [95]. I thought it would be worth discussing the salient points of the paper in the class. So I wrote to the author asking for an example of a hybrid computer and was obliged by the most perfect narration just suitable for class teaching. You can see his reply as follows:

"You asked for an example of a hybrid computer, and I must say that the nervous system in animals is a hybrid. Note that in my article I point out that the human is an analog "creature" in that human processes analog information received from the senses and then output analog signals. For example, we hear a loud or a soft noise and respond with a whisper or a shout. This is input and output, not CPU. The actual processing in the brain takes place through a process that is decidedly hybrid. Allow me to explain.

A signal processed in an animal's brain travels across synapses from one nerve cell to the



next as digital information. These signals are packets of chemicals passed from cell to cell. The chemicals alter the electrochemical potential of the cell, and when a threshold reaches a certain value, the cell discharges and sends out a series of digital signals in the form of packets of chemicals to the next nerve cell. One may view each nerve cell as an analog device while the synapses are digital. Thus, the brain is a huge array of tiny analog computers (nerve cells) connected by similarly small digital computers (synapses). It is a hybrid computer”.

There were occasions when not even a single answer was received, even on ResearchGate; it will be worth mentioning here a couple of them posted by the author himself, such as, “Whether beautiful (handsome) humans are less prone to diseases as their body happens to be perfectly built and hence functioning rather flawlessly?”; “Sound wave moves in the air through rarefaction followed by compression; whether both processes consume equal times?”; “Currently the average annual rainfall over the globe is around one meter. How will it get changed if all existing water over it is replaced by ice?”; “Will a hypothetical sphere of water generating  $g = 9.8 \text{ meters per second squared}$  be a stable structure if it replaces the Earth? How will it differ from Earth?”; “There are all sorts of peculiar signatures. Can a person named ‘Mohan Singh’ put his signature as ‘Raj Chopra’? Kindly clarify its legality & validity?”; “Earth’s interior heat is liable for the presence of water on its surface as oceans hanging on their own vapor; a quantitative discussion will be appreciated?”; “How long can a person survive if he stops food intake and just consumes water and the requisite blood injected regularly? What are medical benefits, if any?”

Visiting institutions is quite rewarding to boost the confidence level of a teacher. One has to look for such occasions to attend and participate in them, such as conferences, seminars, short courses, group discussions, PhD thesis evaluation, practical examinations, as an expert member of a selection committee, in the capacity of a member or chair of an academy committee, public service examinations, and so on. A visit can also be arranged by sending requests to reputed institutions with an attached program for guest lectures, research to be carried out, proposed experiments, etc.; if there is a need for financial assistance, this should also be declared. The author visited the International Center for Theoretical Physics (Italy), University of Bonn (Germany), the Institute for Desert Research (Israel), and Hebrew University (Israel) through

such correspondence and presented his work and published a paper jointly [96]. One should also explore the possibility of working in other disciplines as well [97,98].

### The Proper Way for Institutions

The main cause of deterioration of an establishment results from the lack of the random and regular checking of the work of the employees by the authorities from time to time. This makes them reluctant towards their assigned jobs. They stop coming on time, stop doing their duties sincerely, attend half-heartedly to the assigned job, and prefer to assemble for gossip in groups. Thus, resources remain underutilized; wastage and damage to property, theft of stationery and electronic items, etc., occurrences begin. In the case under consideration of teaching institutions, where the main job is concerned with teaching, research, and extension work, the classes do not begin on time and are not engaged for the full period; the full syllabus is not covered in the semester either; teachers are not serious about practical classes and just talking among themselves; the same scene is visible in the examination hall as well; attendance in conferences, seminars, sports, get-togethers and extracurricular activities happens to be poor. The laboratory assistants stop taking interest in laboratories where equipment is left unattended, a lot of dust gathers over them, electronic items are nonfunctional, switches and electric wiring are in a rotten state, and chemical items are wasted, and so on. Cleaning of lecture theaters, floors, and stairs is not up to the mark; the observations particular to the case of stairs are worth mentioning here—the stairs connecting two floors remain mostly unattended on the pretext that this is not allotted to either sweeper attending the linking floors. Water connections for bathroom sinks and toilets are not attended regularly to conserve water. Landscapes, fields, gardens, and flowerpots are left at the mercy of God. All sorts of drawbacks prop up due to poor management.

The above indolent observations can be minimized through regular visits by senior faculty members, heads of the departments, the registrar and controller of examinations, the rector, and the vice chancellor too. They are supposed to visit ongoing classes and take a seat along with all the students and listen calmly and quietly to the lecture; examination is quite an important part of the system, and they also need such visits for fairness. Visiting institutes, departments, libraries, laboratories, toilets, and cycle stands and interacting with



associated people will infuse a new life in their work and also bring joy and satisfaction to their faces; everyone wants to present his best, but in the absence of monitoring, one loses interest. Thus, the frequent visits coupled with interaction among students and responsible ones will keep any teaching institution alive, just like flowing water is livelier in comparison to a standing still one.

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